RELATIONSHIPS AMONG STRESS, COPING, AND BLOOD PRESSURE IN YOUNG, LOW-INCOME ADULTS

By

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ABSTRACT

Chronic stress is increasingly recognized as a potential contributor to cardiovascular health problems. Young, low-income adults typically experience more stressors with greater severity and chronicity and are at an increased risk for developing early-onset cardiovascular disease (CVD). However, the mechanisms linking chronic stress to CVD have yet to be fully understood. Guided by an adapted version of McEwen's (1998) Allostatic Load Model, this three-manuscript dissertation had three aims: (1) Comprehensively examine and quantitatively synthesize evidence on the relationships between hair cortisol concentration (HCC) and blood pressure, (2) Examine the associations among perceived stress, HCC, coping strategies, and blood pressure in a sample of young, low-income individuals, and (3) Describe and compare stress conceptualizations of young, low-income adults with low- versus high-stress levels, how they cope with stress, and how they perceive stress as impacting their health.

Manuscript 1 is a systematic review and meta-analysis assessing the relationships of HCC with systolic blood pressure (SBP), diastolic blood pressure (DBP), and hypertension status. Five databases were searched, yielding 34,014 records. Sixteen articles met eligibility criteria and were included in the systematic review, while 14 were included in the meta-analysis. Findings showed small, positive associations between HCC and SBP and DBP. In addition, higher HCC was associated with higher odds of being hypertensive.

In Manuscript 2, path analysis modeling was used to assess the associations among perceived stress [measured by the 10-item Perceived Stress Scale (PSS-10)]; emotion-focused, problem-focused, and avoidant coping strategies (measured by the Brief COPE); HCC; SBP; and DBP among 63 young, low-income adults with young children. Results showed that perceived stress was negatively related to HCC, and HCC was positively associated with both SBP and

DBP. Emotion-focused coping was significantly and negatively related to HCC, while problem-focused and avoidant coping were positively related to HCC. Additionally, avoidant coping and HCC partially and significantly mediated the relationship between perceived stress and SBP and DBP. The path model explained about 14.4% and 12.7% of the variances in SBP and DBP, respectively.

Manuscript 3 reports results from a qualitatively driven explanatory mixed methods study comparing the stress and coping experiences of a group of young, low-income adults with low stress levels (n = 8; measured by the PSS-10) to a group with high stress levels (n = 9). Interpretive phenomenological analysis was performed. Results demonstrated important differences between groups in their experiences of stress as a mental strain, negative emotions, coping strategies utilized, physical manifestations of stress, and perceived experiences of declining health.

Findings from this dissertation contribute to science by improving our understanding of the associations among stress, coping, and blood pressure among young adults living in poverty. This dissertation also sheds light on the experiences of stress within this population and their ways of coping. Results generally support the adapted version of McEwen's (1998) Allostatic Load Model and provide a foundation for future research addressing chronic stress and CVD prevention among young, low-income populations, as well as implications for policy and nursing practice.

This dissertation is dedicated to those whom this research serves.
And to my family, for the love and joy you bring to my life.

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CHAPTER 1: INTRODUCTION

Introduction

Despite advances in science and healthcare and an overall reduction in morbidity and mortality rates over the past several decades, cardiovascular disease (CVD) remains the leading cause of death in the United States (U. S.), claiming about one out of every three lives (Angell et al., 2020). Of further concern, despite improvements in nationwide progress, the decline in CVD incidence and mortality has stagnated or even reversed among young and low-income populations, creating significant health disparities (Allen & Wilkins, 2023; Arora et al., 2019; Odutayo et al., 2017; Wilmot et al., 2015). According to the Atherosclerosis Risk in Communities (ARIC) surveillance study, the proportion of acute myocardial infarction (AMI) admissions attributable to adults $\leq$ 54 years old have increased from 27% in 1995 to 32% in 2014 (Arora et al., 2019). Additionally, National Health and Nutrition Examination Survey (NHANES) data reported that from 2011 to 2014, 16.5% of low-income adults had a $\geq$ 20% risk for developing CVD compared to only 9.5% of higher-income adults (mean age = 54.4 years; Odutayo et al., 2017). Given these trends, it is critical to explore potential causes of these disparities among young, low-income adults.

In the U.S., the federal poverty guideline is the minimum annual household income deemed adequate based on the number of people living in a household (*Poverty Guidelines*, 2023). This guideline is updated yearly and used to determine financial eligibility for certain federal assistance programs. Those living below this federal poverty guideline often struggle with economic stability, safe housing, transportation, education and job opportunities, food insecurity, and several other social determinants of health (U.S Department of Health and Human Services, 2023). These determinants contribute to health inequities between those living

above and below the federal poverty guideline, including disproportionate prevalence of CVD (Powell-Wiley et al., 2022).

High blood pressure is the most important modifiable risk factor for CVD, accounting for about 55% of ischemic events globally (Forouzanfar et al., 2017; Fuchs & Whelton, 2020; GBD 2016 Risk Factor Collaborators, 2017). However, early-onset hypertension (< 55 years old) is under-recognized and understudied (Niiranen et al., 2020). Data from the Framingham Heart Study and Coronary Artery Risk Development in Young Adults (CARDIA) study has shown that early-onset hypertension is associated with a higher risk for hypertension-mediated organ damage and cardiovascular death compared to hypertension onset in later years (Niiranen et al., 2017; Suvila et al., 2019, 2020). Furthermore, among participants in the CARDIA cohort, an increased odds of developing hypertension was observed in those who experienced difficulty paying for basic needs at baseline (OR = 1.45, 95% CI = 1.05-2.02) and ten years later (OR = 1.62, 95% CI = 1.04-2.53) and those whose income declined over ten years (OR = 1.50; 95% CI = 0.96-2.33; Matthews et al., 2002).

The health of low-income populations is of critical concern to public health as these individuals have higher odds of developing hypertension (OR = 1.45, 95% CI = 1.25-1.69) and experience more poorly controlled blood pressure than their higher-income counterparts (Beckman et al., 2017; Leng et al., 2015). Low-income groups are more likely to engage in unhealthy lifestyle behaviors that increase one's risk for hypertension, including smoking, and poor adherence to antihypertensive medications when they are prescribed (Centers for Disease Control and Prevention, 2019; Shahu et al., 2019; van der Laan et al., 2017). Additionally, due to structural barriers, low-income individuals also have less access to healthy diet choices and fewer opportunities to be physically active (Shahu et al., 2019; Vilar-Compte et al., 2021).

However, previous lifestyle interventions focused on diet, physical activity, and smoking cessation behaviors to address traditional risk factors for hypertension (e.g., smoking, obesity, and high dietary salt intake) have resulted in limited effects in young, low-income adults (Bull et al., 2014, 2018; Craike et al., 2018). This may be because stress, especially persistent or chronic stress, has not been targeted as an underlying contributing factor. Stress can have strong negative influences on lifestyle behaviors, including smoking, alcohol and substance use, sedentary behavior, disturbed sleep, and poor dietary habits (Suvarna et al., 2020). Therefore, it is critical to investigate how stress may contribute to early-onset hypertension in young, low-income adults.

Stress, either acute or chronic, is a complex phenomenon defined in various ways by a wide range of disciplines and can broadly be defined as a threat to homeostasis through internal or external challenges (McEwen & Stellar, 1993; O'Connor et al., 2021). *Acute stress*, or a short-term threat to homeostasis, occurs in response to temporary challenges (Roos et al., 2021). It can be beneficial in emergencies or situations requiring enhanced performance and result in short-term physiological changes through the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic-adrenal-medullary (SAM) system (Dhabhar, 2018). The stress response becomes maladaptive when it persists over time and has pathophysiologic consequences, such as sustained elevated blood pressure (McEwen, 2016, 2017). *Chronic stress* is defined as the cumulative load of ongoing demands or day-to-day stressors that threaten homeostasis for a prolonged period of time, usually a minimum of one month (Crosswell & Lockwood, 2020; McEwen & Stellar, 1993). Exposure to chronic stress is not beneficial or adaptive. Persistent activation of stress responses systems can pose a significant risk to health, including elevated blood pressure (Godoy et al., 2018).

The various mechanisms linking stress to elevated blood pressure are complex. Upon stress perception, corticotropin-releasing hormone (CRH) is released from the paraventricular nucleus of the hypothalamus (M.-Y. Liu et al., 2017). CRH binds to receptors in the pituitary and subsequently triggers release of adrenocorticotropic hormone (ACTH) into the bloodstream (M.-Y. Liu et al., 2017). The adrenal cortex is the primary target for circulating ACTH, where it stimulates the synthesis and release of glucocorticoids, such as cortisol (M.-Y. Liu et al., 2017). Over time, glucocorticoids may result in elevated blood pressure through their influence on vascular reactivity (Ayada et al., 2015; Chu et al., 2020; Yang & Zhang, 2004). Salivary, urinary, and blood (serum and plasma) cortisol levels are biomarkers often used to capture exposure to acute stress, while hair and fingernail cortisol levels have been used as an indicator of exposure to chronic stress (Greff et al., 2018; C. H. Liu & Doan, 2019).

Despite our understanding of these established biological mechanisms, findings on the interrelationships among perceived stress, cortisol, and blood pressure are still inconsistent. An individual's level of *perceived stress* – the thoughts and feelings an individual has about how much stress they are experiencing over a given time period (Phillips, 2013), does not necessarily result in proportionate levels of cortisol output. Some studies have found positive relationships between higher levels of perceived stress and greater salivary (Hernández et al., 2018), blood (Gürpınar et al., 2019), urinary (Gemignani et al., 2014), and hair cortisol levels (Faresjö et al., 2014), while others have found negative relationships (Buzgoova et al., 2020; Wu et al., 2021), no significant relationships (Gürpınar et al., 2019; Hollenbach et al., 2019; Lanfear et al., 2020), or curvilinear relationships (Wells et al., 2014) between perceived stress and cortisol levels. Furthermore, some studies have found positive relationships between perceived stress and blood pressure (Lu et al., 2019; Spruill et al., 2019), while others have found no significant associations

(Scott et al., 2020; Wright et al., 2018). Similarly, positive relationships between cortisol and blood pressure have been observed in some studies (Bautista et al., 2019; Haddad et al., 2021), but not others (Barksdale et al., 2013; Walvekar et al., 2015).

One possible explanation for variability in the relationships among perceived stress, cortisol levels, and blood pressure may lie in the coping strategies used in response to stress. Prior work suggests that rather than having fixed effects on physiology, stressors are subject to cognitive responses that may shape physiologic responses to stress (Lazarus & Folkman, 1984; Logan & Barksdale, 2008; McEwen, 1998). More specifically, individual characteristics, the nature of the stressors, and the cognitive and behavioral strategies used to cope with stress combinedly determine physiologic responses (including HPA axis reactivity) with potentially significant implications for health (Kemeny, 2003).

Coping can be situational (i.e., state) or dispositional (i.e., trait) in nature (Carver & Scheier, 1994). Dispositional coping strategies may be more often associated with chronic indicators of stress, such as hair cortisol (Milam et al., 2014). Situational coping strategies have been associated with acute stress biomarkers, such as salivary or serum cortisol, likely due to their temporal characteristics and susceptibility to change (Janson & Rohleder, 2017; Perez-Tejada et al., 2019). Coping strategies are often further broadly considered as *problem-focused* – "the management or alteration of the person-environment relationship that is the source of stress", *emotion-focused* – "the regulation of stressful emotions", or *avoidant* - efforts to disassociate from the stressor (Folkman & Lazarus, 1980; S. Roth & Cohen, 1986). Problem-focused strategies, such as active coping, use of instrumental support, and planning, are generally considered to be more adaptive, and studies have shown that people who use them often have

lower cortisol reactivity and better health outcomes than those who do not (Perez-Tejada et al., 2019; Siwik et al., 2020).

Understanding how young, low-income adults utilize certain coping strategies and their impact on physiologic outcomes may help us to better understand the impact of psychological well-being on physical health. However, limited research examining these constructs, especially within this population, currently exists. Therefore, the purpose of this dissertation is to elucidate the relationships among perceived stress, hair cortisol concentration (HCC), coping, and blood pressure in young, low-income adults and to understand how young, low-income adults with low- versus high-stress levels conceptualize stress, how they cope with stress, and how they perceive stress as impacting their health.

This dissertation is comprised of three manuscripts: 1) a systematic review and meta-analysis examining the relationships of HCC with systolic blood pressure (SBP), diastolic blood pressure (DBP), and hypertension status; 2) a secondary analysis using path analysis modeling to assess the associations among perceived stress; emotion-focused, problem-focused, and avoidant coping strategies; HCC; SBP; and DBP among 63 young, low-income adults with young children; and 3) a qualitatively driven explanatory mixed methods study comparing the stress and coping experiences of a group of young, low-income adults with low stress levels to a group with high stress levels. Each of these manuscripts are guided by McEwen's Allostatic Load Model (1998), which demonstrates the mechanisms linking chronic stress to disease. This model is described in more detail below.

Background & Significance

CVD Prevalence among Young, Low-Income Populations

Cardiovascular disease is a wide-ranging term used to describe a group of conditions of

the heart and blood vessels, including ischemic heart disease (IHD), coronary heart disease (CHD), cerebrovascular disease, peripheral arterial disease, rheumatic heart disease, congenital heart disease, and deep vein thrombosis (World Health Organization, 2021). In the U.S., an estimated 126.9 million adults have at least one type of CVD (Virani et al., 2021). Advances in medication and treatment strategies have caused cardiovascular events and mortality to decrease worldwide over the past 20 years (Eisen et al., 2016; G. A. Roth et al., 2017). Unfortunately, this trend has not extended to all populations, creating significant cardiovascular health disparities. Incidence and prevalence of CVD has increased among young, low-income groups. As observed in the CARDIA cohort, young adults who experienced higher income volatility and more drops in income experienced a higher risk for developing CVD from 1990 to 2015 (n = 3,937; [income volatility] HR: 2.07, 95% CI: 1.10-3.90; [income drop] HR: 2.54, 95% CI: 1.24-5.19; Elfassy et al., 2018). Additionally, in a recent computer simulation study investigating the burden of premature CHD in the U.S. using the Cardiovascular Disease Policy Model, an estimated 19% of low-income adults who were 35 years old in 2015 will develop CHD by age 65 (n = 1.3 million), with 48% of those cases occurring in excess of those expected for higher-income adults (Hamad et al., 2020). Therefore, there is a critical need to address potentially modifiable risk factors contributing to these disparities among young, low-income populations.

Hypertension as a Risk Factor for CVD

Hypertension, defined as a systolic blood pressure (SBP) of >130 mmHg and diastolic blood pressure (DBP) >80 mmHg measured at least two times on at least two separate occasions, is the most important modifiable risk factor for CVD (Carey et al., 2018; Whelton et al., 2018). Over time, mechanical stress imposed by high blood pressure on the cardiovascular system leads to increased arterial wall stiffness and compensatory left ventricular hypertrophy (Martinez-

Quinones et al., 2018; Nwabuo & Vasan, 2020). This results in cardiovascular pathologies including cardiomyocyte changes, abnormalities in contractile function, and myocardial remodeling (Martinez-Quinones et al., 2018; Nwabuo & Vasan, 2020).

An estimated 121.5 million U.S. adults (47%) have hypertension (Virani et al., 2021). Hypertension prevalence is higher among men than women (50.4% vs 43.0%) in the U.S.; however, epidemiological research has demonstrated that the rate at which women develop hypertension is much steeper than men beginning in the third decade of life (Connelly et al., 2022; Ji et al., 2020; Tsao et al., 2023). Suboptimal blood pressure control is attributable to 55% of ischemic heart disease cases, 58% of hemorrhagic strokes, 50% of ischemic strokes, and 58% of other forms of CVD, including peripheral arterial disease and heart failure (Forouzanfar et al., 2017; GBD 2016 Risk Factor Collaborators, 2017). Within young adults hospitalized for acute MIs from 1995 to 2014, rates of hypertension have increased from 59% to 73% (p for trend < 0.0001; Arora et al., 2019).

Hypertension in Young and Low-Income Populations

Recent epidemiological data also suggests that blood measure measurements formerly within the normotensive and prehypertensive ranges are now considered too high and pose an increased risk for cardiovascular mortality, indicating that more people than ever have high blood pressure (SPRINT Research Group, 2015; Whelton et al., 2018). Additionally, this shift in cutoff values now includes more young adults than before in the elevated and hypertensive ranges. The mean age of adults with hypertension is now estimated to be 56 years old (95% CI, 45-73) according to the 2017 American College of Cardiology (ACC)/American Heart Association (AHA) guidelines, compared to 60 years old (95% CI, 46-74) as previously estimated by the eighth Joint National Commission (JNC-8) guidelines (Khera et al., 2018).

Hypertension in young adults (< 45 years old) is especially problematic since it has been associated with greater risk of CVD (HR = 2.26, 95% CI = 1.19 – 4.30) and all-cause mortality (HR = 2.59, 95% CI = 1.32 – 5.07) compared to adults aged 45 years or older (HR = 1.29 - 2.12, 95% CI = 1.11 – 1.51; Wang et al., 2020). In the CARDIA study, hypertension onset in adults < 35 years old was associated with higher odds of organ damage over 26 years (left ventricular hypertrophy, OR = 2.29, 95% CI, 1.36–3.86; coronary calcification, OR = 2.94, 95% CI, 1.57–5.49; albuminuria, OR = 1.12, 95% CI, 0.55–2.29; diastolic dysfunction, OR = 2.06, 95% CI, 1.04–4.05) compared to those without hypertension. Furthermore, adults with hypertension onset at age ≥ 45 years did not experience increased odds of organ damage than those without hypertension (Suvila et al., 2019). During this time, approximately 50% of the CARDIA sample had been in poverty at least once (Elfassy et al., 2018).

One potential factor that may contribute to early-onset hypertension among young, low-income adults is chronic stress. Psychological factors, like chronic stress, can influence health outcomes both directly through physiologic mechanisms and indirectly through lifestyle behaviors (e.g., alcohol/substance use, unhealthy dietary habits, and physical inactivity; McEwen, 1998; Suvarna et al., 2020). Unfortunately, prior interventions aimed at improving lifestyle behaviors known to be traditional risk factors for hypertension have had limited success among this population. For example, in one study testing the effects of a lifestyle program consisting of diet, exercise, and behavior modification among American Indians and Alaskan Natives (58.9% ≤ 50 years old), participants with lower income lost less weight, participated in less physical activity, and consumed less healthy foods than those of higher income (Jiang et al., 2015). A systematic review on physical activity interventions found that only four out of eight studies focused on individuals with low socioeconomic status reported positive physical activity

outcomes with a low overall net percent change in physical activity (7.7% [-6.7%; 22.0%]; p = 0.248; Bock et al., 2014). Underlying factors, such as chronic stress, may have an influential role in explaining why some behavioral interventions have been ineffective (Schuman-Olivier et al., 2020). Healthy emotion regulation is vital for behavior change, and feelings of stress may impede a person's intention to adopt healthy behaviors (Louis et al., 2009; Schuman-Olivier et al., 2020).

Poverty-Related Stress and Blood Pressure

Due to their financial circumstances and reduced access to less health-promoting residential, occupational, educational, and recreational environments, young, low-income individuals chronically experience higher levels of stress (American Psychological Association, APA Working Group on Stress and Health Disparities, 2017; Baum et al., 1999; Cuevas et al., 2017). For example, in one study using three national surveys, perceived stress generally decreased as age and income increased (Cohen & Janicki-Deverts, 2012). Individuals with an annual income of < $25,000 had significantly higher levels of perceived stress than those with an income of $75,001 or greater (17.77 ± 7.60 vs. 14.74 ± 6.88, $p < 0.001$; Cohen & Janicki-Deverts, 2012). Within this same sample, adults 18 – 54 years older reported higher levels of perceived stress than individuals 55 years or older (M = 16.38 – 17.46 vs. 11.09 – 14.50; Cohen & Janicki-Deverts, 2012).

This population experiences a variety of unique stressors that contribute to poor mental and physical health. Limited income, food and job insecurity, past exposure to adverse childhood events (ACEs), supporting children with truncated resources, and living in disadvantaged neighborhoods with increased crime, pollution, and noise are all examples of stressors that may accumulate and predispose them to illness (American Psychological Association, APA Working

Group on Stress and Health Disparities, 2017; Bethell et al., 2014; Cuevas et al., 2017; Liao et al., 2021; Ling et al., 2019). Living in underprivileged communities and raising young children with limited income creates chronic and overwhelming stress that contributes to poor mental health, decreased coping capacity, and diminished life expectancy (Hodgkinson et al., 2017). Generational poverty, early life adversity, and exposure to ACEs have been also associated with dysregulated stress responses and higher allostatic load (Dich et al., 2014; Lovallo, 2013; Nelson et al., 2020).

Persistent activation of stress response systems, including the HPA axis and SAM system, can have effects on the cardiovascular system and pose a significant risk to health (Godoy et al., 2018). Chronic sympathetic activation and glucocorticoid release have been linked to several CVD risk factors, including elevated blood pressure (Ayada et al., 2015). The HPA axis is responsible for the neuroendocrine pathways that result in glucocorticoid release and elevated blood pressure (Herman et al., 2016; M.-Y. Liu et al., 2017). Corticotropin-releasing hormone binds to receptors on the pituitary gland that results in ACTH release, subsequently binding to receptors on the adrenal cortex and stimulating release of cortisol (M.-Y. Liu et al., 2017). Cortisol then contributes to plasma volume expansion and inhibition of vasodilatory hormones (e.g., nitric oxide) that lead to increased cardiac output and peripheral vascular resistance, subsequently elevating blood pressure (Delong & Sharma, 2021; Whitworth et al., 2005).

Cortisol as a Biomarker for Stress

Stress can be assessed through self-report (surveys or questionnaires measuring perceived stress such as the Perceived Stress Scale) and biomarkers (e.g., cortisol concentration analyzed from saliva, blood, urine, fingernail or hair samples; Carpenter, 2016; Greff et al., 2018). Stress perception results in activation of the SAM system and HPA axis which causes glucocorticoids,

such as cortisol, to be released into the bloodstream (Godoy et al., 2018; McEwen & Stellar, 1993). Salivary, urinary, and blood cortisol concentrations are useful for measuring diurnal patterns of cortisol release and understanding changes in these patterns within the context of certain disorders (Wosu et al., 2013). However, these measures inform a short timeframe (usually hours to one day) and can be invasive (e.g. blood sample collection; Wosu et al., 2013). Hair cortisol is currently the most reliable biomarker of chronic stress as it provides quantification of cortisol secreted into hair over several weeks to months, is minimally invasive, and is not subject to acute alterations in HPA axis functioning due to diurnal variation or acute stressors, as is the case with widely used salivary, urinary, plasma, or serum cortisol. Hair cortisol concentration (HCC) tends to be about 21% higher in men compared to women and increase with age (Stalder et al., 2017).

Perceived Stress and Hair Cortisol Concentration

Although a correlation between perceived stress and HCC may seem intuitive, data on this relationship are very inconsistent. For example, in a sample of 35 low-income mothers of preschool-aged children, perceived stress and HCC were negatively correlated ($\rho = -0.49$; Ling et al., 2020). Additionally, one study found a positive relationship between perceived stress and HCC in 25 pregnant women ages 18-45 ($r_s = 0.47$; Kalra et al., 2007), while another sample of 30 pregnant women showed no significant positive relationship ($r = 0.3$, mean age = 21.6 ± 3.5) between perceived stress and HCC (Bowers et al., 2018). In a study that examined the association between perceived stress and HCC among 324 participants from a pooled sample (mean age = 41.86 ± 5.81, 44.2% with annual income < $20,000), Wells (2014) observed a curvilinear relationship (quadratic association: $\beta = -0.127$, $p = 0.022$). This mixed evidence

suggests that a gap remains in understanding how perceived stress may be related to cortisol output, especially among low-income populations where a paucity in research exists.

Perceived Stress and Blood Pressure

High levels of perceived stress may also be associated with elevated blood pressure; however, findings in published literature are also inconsistent. In one analysis of the Jackson Heart Study data, where 51.3% of participants have a household income < $35,000 per year, having higher versus lower perceived stress levels was associated with greater risk of developing hypertension in 887 African Americans (RR = 1.22, 95% CI = 1.07–1.39; mean age = 52.06 ± 11.36; Min et al., 2017; Spruill et al., 2019). Similarly, in a large adult sample, having high levels of perceived stress was associated with higher odds of having prehypertension or hypertension (n = 59,798; OR = 1.40, 95% CI = 1.28-1.53; Gawlik et al., 2019). Within this sample, adults 31-60 years old experienced higher prevalence of stress compared to those over age 60 (27.9% vs. 21.2%, $p < .001$; Gawlik et al., 2019). No significant associations ($r = -0.08$) between any level of perceived stress and blood pressure were found in 20 African American college students (Wright et al., 2018), while a meta-analysis found perceived stress to be positively associated with DBP (ES = 1.04 mmHg, 95% CI 0.18 – 1.89), but found non-significant association with SBP (Tenk et al., 2018). Based on this varied evidence, it is also unclear how stress perception may influence blood pressure.

Hair Cortisol Concentration and Blood Pressure

Elevated cortisol has been associated with various effects on the vasculature which may lead to blood pressure elevation (McEwen & Seeman, 1999; Whitworth et al., 2005). Furthermore, persistent sympathetic activation and glucocorticoid release as a result of chronic stress exposure have been associated with several risk factors for CVD, including hypertension

(Osborne et al., 2020). However, findings on the relationship between HCC, a biomarker for chronic stress, and blood pressure is inconsistent in the literature. For example, Bautista et al. (2019) reported increased odds of developing hypertension in adults with high HCC (n = 75; OR = 2.04, 95% CI = 1.43 - 2.73; mean age = 46.9 years). In a study of 64 older adults, there was no significant association between hair cortisol and hypertension; however, the investigators did observe a significant inverse relationship between hair cortisol and DBP (β = -0.09, p = 0.03; Feller et al., 2014). No studies have been identified that assess the relationship between HCC and blood pressure among individuals with low-income. This varied evidence and lack of studies among low-income populations suggest that more research needs to be conducted in this population, and other factors that may impact the stress response should be considered to help explain these disparities.

Coping in Response to Stress

Coping, defined as the ongoing cognitive and behavioral efforts to tolerate, master, or reduce stressors (Folkman & Lazarus, 1980), has been studied extensively across taxa and viewed from multiple perspectives (Carver et al., 1989; Lazarus, 1993; Lazarus & Folkman, 1984; Weiss, 1968). One of the most prominent views on coping among humans is through the lens of emotion-focused and problem-focused coping as introduced by Folkman & Lazarus (1980). They theorize that threat or challenge appraisal prompts the use of coping strategies that modify the person-environment relationship by altering the situation and addressing the source of stress itself (problem-focused coping) and/or altering interpretation of the situation to regulate emotional distress (emotion-focused coping; Folkman & Lazarus, 1980). Building upon the work established by Folkman & Lazarus, Carver (1989) studied coping strategies that provide a more detailed examination of the stress-coping relationship (Carver et al., 1989). Carver (1997)

proposed 14 coping strategies, used by people in response to stress: a) active coping; b) acceptance; c) behavioral disengagement; d) denial; e) humor; f) planning; g) positive reframing; h) religion; i) self-blame; j) self-distraction; k) substance use; l) use of emotional support; m) use of instrumental support; and n) venting (see Table 1.1). Active coping, instrumental support, and planning are considered problem-focused coping strategies, while acceptance, emotional social support, humor, positive reframing, religion, and self-blame are strategies that are considered to be emotion-focused (Carver et al., 1989; Lazarus, 1993; Solberg et al., 2021). *Avoidant coping* has been identified as a third category to include behavioral disengagement, denial, self-distraction, and substance use (Carver, 1997; Carver et al., 1989; Parker & Endler, 1992; Solberg et al., 2021).

Table 1.1

Overview of Coping Strategies

Coping Strategy	Definition	Category
Active coping	The process of taking steps to attempt to eliminate or circumvent the stressor or to improve its effects.	Problem-focused
Acceptance	Acknowledgment of the reality of the stressful situation.	Emotion-focused
Behavioral disengagement	Decreasing one's effort to deal with a stressor and giving up attempts to achieve goals with which the stressor is interfering.	Avoidant
Denial	Refusal to believe that the stressor exists or attempting to act as if the stressor is not real.	Avoidant
Humor	Tendency to use humor or jokes.	Emotion-focused
Planning	Discerning how to cope with a stressor.	Problem-focused
Positive reframing	Altering one’s way of thinking about the situation to make it seem more positive.	Emotion-focused

Table 1.1 (cont'd)

Religion	The tendency to turn toward religion or spirituality (through prayer, meditation, etc.).	Emotion-focused
Self-blame	Criticizing oneself for responsibility in the situation.	Emotion-focused
Self-distraction	Using alternative activities to mentally disengage from the situation.	Avoidant
Substance use	Using drugs, alcohol, or other substances.	Avoidant
Use of emotional support	Seeking moral support, understanding, or sympathy.	Emotion-focused
Use of instrumental support	Seeking advice, information, or assistance.	Problem-focused
Venting	The tendency to focus on one's distress and express those feelings.	Emotion-focused

Influence of Coping Strategies on Cortisol Output

Evidence suggests that the type of coping strategies used by a person in response to perceived stress may influence cortisol reactivity (Janson & Rohleder, 2017; Nicolson, 1992). In other words, some people may execute coping strategies that attenuate or buffer cortisol reactivity in response to stress perception, while others may increase it. For example, problem engagement coping (problem-focused) was inversely related with salivary cortisol output over the day in a sub-sample of the Whitehall II cohort, a sample of healthy middle-age to older adults (> 55 years) based in London (n = 542; $\beta = -0.135$, $p = 0.003$; O'Donnell et al., 2008). Contrarily, increased use of denial coping (avoidant coping) was associated with higher peak levels of salivary cortisol ($\beta = 0.0798$, SE = 0.0381, $p = 0.041$) in a sample of young adults acutely exposed to the Trier Social Stress Test (TSST; n = 59, mean age = 22.93 ± 4.31; Janson & Rohleder, 2017). As another example, higher levels of dispositional optimism (linked to positive reframing [emotion-focused]), was associated with lower hair cortisol levels in 27 adolescents (*r*

= −0.44, $p < 0.05$). Given these inconsistent relationships between coping strategies and cortisol levels, a gap remains in understanding the potential mediating effect of coping strategies on the relationship between perceived stress and cortisol reactivity. Because coping is a modifiable factor in a young, low-income individual's life that may influence the stress response, it is important to understand the impact of coping on physiologic stress outcomes. Findings may inform future work with the potential to impact stress-associated conditions, such as hypertension.

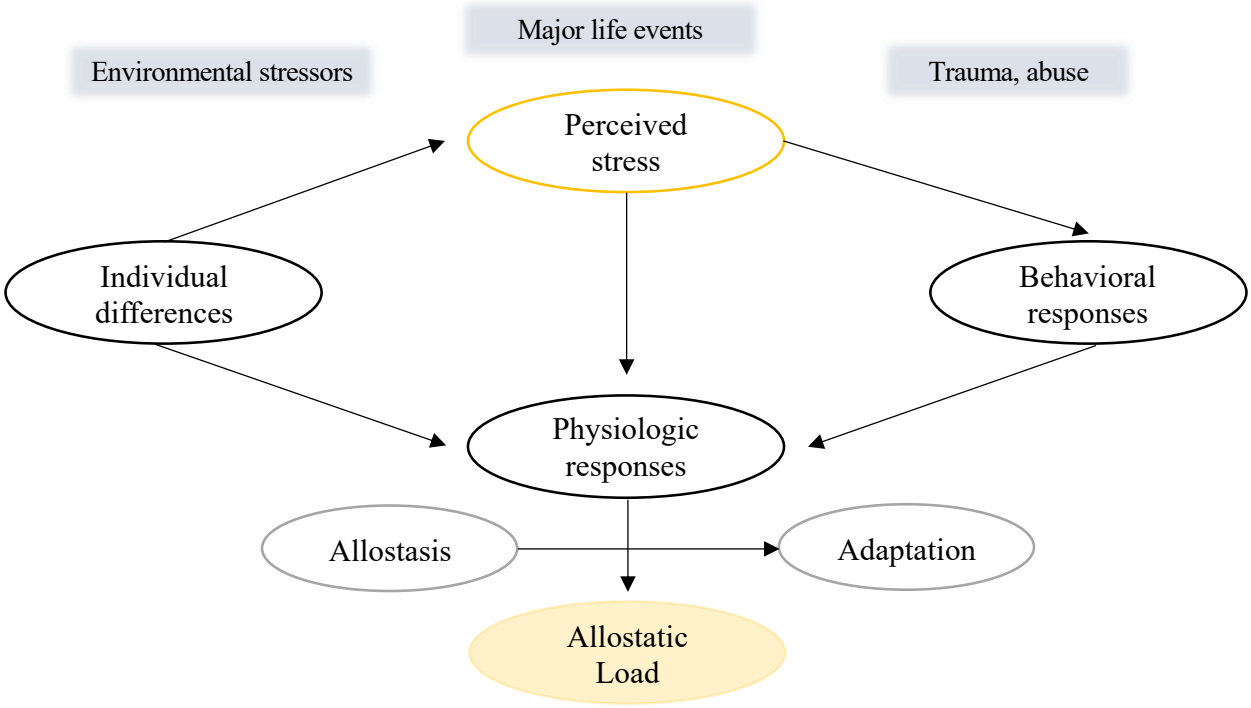
In summary, inconsistencies regarding the relationships among key components of the stress response, including perceived stress, coping strategies, and physiological changes (cortisol and blood pressure reactivity) exist in the literature. There is also a gap in research investigating these relationships among young, low-income adults, a population that experiences high levels of stress and is at risk for early-onset hypertension. This dissertation seeks to address these gaps through a systematic review and meta-analysis (Manuscript 1), a secondary analysis using path analysis modeling (Manuscript 2) and a qualitatively driven mixed-methods investigation (Manuscript 3).

Theoretical Framework

This work is guided by the Allostatic Load Model proposed by McEwen (1998). This model provides the theoretical foundation for examining the mechanisms linking chronic stress to hypertension (see Figure 1.1). In this section, the original model is presented, followed by the adapted theoretical framework, and then the operational model for this dissertation work.

Figure 1.1

Allostatic Load Model (McEwen, 1998)



At the top of the model are examples of personal and environmental experiences that may contribute to chronic stress. Stressful neighborhood, home, and work environments, as well as major life events and trauma, are examples of stressors that may influence an individual's susceptibility to stress-related diseases (McEwen, 1998; Santiago et al., 2011).

Individual differences, including genetics, life experiences, and developmental factors, influence how a person may perceive their circumstances or situations to be stressful (Agorastos & Chrousos, 2021; McEwen, 1998). Individual differences also affect the body's physiologic response to stressors (McEwen & Stellar, 1993). When the brain perceives stimuli as stressful, behavioral and physiological responses are initiated (Agorastos & Chrousos, 2021; McEwen, 1998). Behavioral responses may include actions taken by an individual to respond to stressful situations, such as engagement in risky lifestyle behaviors. McEwen (1998) proposes that

personal lifestyle behaviors exacerbate the effects of chronic stress on the body. For example, coping through tobacco and alcohol consumption, high-fat diets, and sedentary behavior contribute to physiological dysregulation (e.g., heavy alcohol consumption and cigarette smoking contribute to hypertension and dyslipidemia; high-fat diets are linked to atherosclerosis; and sedentary behavior contributes to obesity; McBride, 1992; McEwen, 1998; Mozaffarian et al., 2006; Rehm et al., 2003; Suvarna et al., 2020; Van Gaal et al., 2006).

"Allostasis" refers to "a dynamic regulatory process wherein homeostatic control is maintained by an active process of adaptation during exposure to physical and behavioral stressors" and "allostatic load" is defined as the "cost of chronic exposure to fluctuating or heightened neural or neuroendocrine responses resulting from repeated or chronic environmental challenges that an individual reacts to as being particularly stressful" (McEwen & Gianaros, 2010; McEwen & Stellar, 1993; Sterling & Eyer, 1988). When stimuli are perceived as stressful, neuroendocrine, cardiovascular, metabolic, and immune responses are initiated to physiologically adapt to stress (Doan, 2021; McEwen, 1998; McEwen & Wingfield, 2003). The framework developed by McEwen (1998) was further refined by McEwen & Seeman (1999), who suggested that primary mediators lead to primary effects, leading to secondary outcomes, which then lead to tertiary outcomes that signify disease. Primary mediators, including cortisol, dehydroepiandrosterone (DHEA), epinephrine, and norepinephrine, are products of the neuroendocrine response to stress perception (Guidi et al., 2021; McEwen & Seeman, 1999). When released under stress, these mediators trigger cellular events (primary effects) that eventually result in secondary outcomes (Guidi et al., 2021; McEwen & Seeman, 1999). These secondary outcomes include dysregulation in cardiovascular (SBP/DBP), metabolic (glucose, glycosylated hemoglobin, and high-density lipoprotein), and immune (C-reactive protein and

interleukin-6) systems (Gillespie et al., 2019; Guidi et al., 2021; McEwen & Seeman, 1999). Under chronic stress, overexposure to mediators and overactivity of allostatic systems can result in tertiary outcomes, such as hypertension (Guidi et al., 2021; McEwen, 2004).

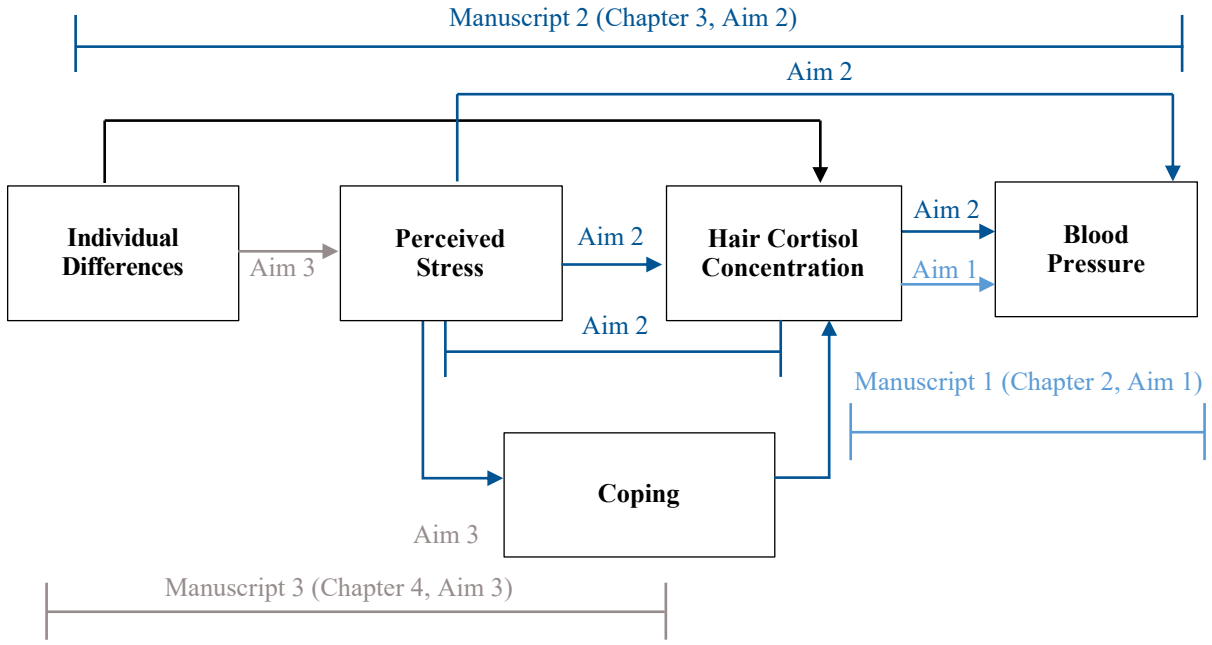
Allostatic load is sometimes operationalized through an allostatic load index to quantify multisystem physiological dysregulation. Multiple physiological indicators (primary mediators and secondary outcomes) may be included in the index and scored using various methods including count-based, *Z*-score, grade of membership, and canonical correlation (Li et al., 2019; McLoughlin et al., 2020). Many combinations of biomarkers and scoring methods have been used, but no consensus has been established regarding a standard algorithm to reliably measure or score allostatic load in this manner.

Adapted Theoretical Framework

McEwen's (1998) original Allostatic Load Model illustrates "physiological responses" as one broad concept; however, literature shows distinct and complex relationships between responses that warrant closer investigation (Iob & Steptoe, 2019; Kivimaki & Steptoe, 2018). Building upon the Allostatic Load Model, this dissertation applied the adapted theoretical framework (see Figure 1.2) to focus specifically on the relationships among individual differences, perceived stress, coping strategies, HCC, and blood pressure.

Figure 1.2

Adapted Theoretical Framework with Dissertation Aims



The adapted theoretical framework seeks to investigate allostatic load manifested as physiological dysregulation of the cardiovascular system in response to chronic stress, with a tailored focus on cortisol release due to HPA axis activation and blood pressure elevation as a result of cortisol output. McEwen's (1998) original Allostatic Load Model illustrates "physiological responses" as one broad concept; however, literature shows distinct and complex relationships between responses that warrant closer investigation (Iob & Steptoe, 2019; Kivimaki & Steptoe, 2018).

The HPA axis is an integral component of the stress response, responsible for releasing primary mediators (e.g., glucocorticoids such as cortisol) associated with allostatic load (McEwen & Stellar, 1993). Furthermore, cortisol has well-established effects on the cardiovascular system (Whitworth et al., 2005). Elevated cortisol over time has been linked to sodium retention, inhibition of vasodilator hormones, and plasma volume expansion, all of which

may lead to blood pressure elevation (secondary outcome), and eventually hypertension (tertiary outcome; McEwen & Seeman, 1999; Whitworth et al., 2005). Despite these links between increased glucocorticoid levels and cardiovascular consequences, the relationship between HCC and blood pressure is inconsistent in the literature (Bautista et al., 2019; Feller et al., 2014). For these reasons, the adapted theoretical framework seeks to investigate the gap that still exists in understanding this phenomenon by examining the physiological response described by McEwen (1998) more closely. This adapted theoretical framework examines cortisol output (HCC; primary mediator) as an influential factor on blood pressure (secondary outcome).

McEwen's original Allostatic Load Model includes "behavioral responses" as a mediating variable between perceived stress and physiological responses to explain how people "cope with challenge" (McEwen, 1998). McEwen suggests that this might include risky lifestyle behaviors such as alcohol and tobacco consumption, unhealthy dietary choices, and increased sedentary time (McEwen, 1998). The deleterious effects of these risky lifestyle behaviors on health outcomes have been well-established for decades; however, the effect of cognitive coping strategies is not as well-studied (Institute of Medicine (US) Committee on Health and Behavior, 2001). Folkman (2013) suggests that cognitive coping is key to understanding why health outcomes vary among people. Furthermore, evidence suggests that certain cognitive coping strategies may be significantly associated with cortisol, blood pressure, and cardiovascular outcomes and may also vary depending on age and income (Barksdale et al., 2013; Brantley et al., 2002; Chen et al., 2017; Martin et al., 2013; Svensson et al., 2016). However, research on the influence of coping on stress and blood pressure is lacking within the low-income, young adult population. Therefore, this model replaces "behavioral responses" with "coping strategies" to explore this gap. Finally, McEwen & Seeman (1999) define tertiary outcomes as the diseases that

result from allostatic load. In this adapted theoretical framework, the tertiary outcome is hypertension.

Contribution to Science

This exploratory research will contribute to the understanding of relationships among stress, coping, and blood pressure in a young, low-income adult sample. Because these concepts have not yet been adequately investigated within the context of this population, this work provides novel insights into the impact of chronic stress and coping on blood pressure within this population. This will contribute to science by identifying potential areas for further research.

Research comprehensively investigating stress through self-reported measures and biomarkers, coping strategies, and blood pressure among young, low-income adults is scarce. This dissertation work compares self-reported and objectively measured stress with blood pressure and examines the partial mediation effect of coping strategies on the association between perceived stress and hair cortisol levels. It will also examine the partial mediation effect of hair cortisol levels on the association between perceived stress and blood pressure. Understanding these multidimensional relationships among self-reported and objective measures of stress, coping strategies, and blood pressure is critical for understanding the influence of the stress response on cardiovascular health in young, low-income adults, and may contribute to future investigations.

This small-scale, exploratory work provides data that will inform larger and more robust prospective studies. Findings from qualitative data will also provider richer insight into how low-income groups experience chronic stress. Results from the study will provide a foundation for developing future coping-based interventions to reduce stress, as well as teach adaptive coping

strategies that may ultimately promote better cardiovascular health within this vulnerable population.

Dissertation Format

The Allostatic Load Model applied to young, low-income adults has been used to guide the aims of this dissertation. The chapters include:

Chapter 2 (Manuscript 1, Aim 1)

Chapter 2 is a systematic review and meta-analysis assessing the relationships of HCC with SBP, DBP, and hypertension status. In consultation with a masters-prepared health sciences librarian, a comprehensive search was conducted in PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science, Cochrane Library, Embase, medrxiv.org, and ClinicalTrials.gov. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram and checklist were used to enhance rigor and reporting (Page et al., 2021). Data was imported into Comprehensive Meta-Analysis software for analysis. This manuscript has been published in *Journal of Hypertension* (Pageau et al., 2023).

Chapter 3 (Manuscript 2, Aim 2)

The purpose of Chapter 3 was to assess the associations among perceived stress [measured by the 10-item Perceived Stress Scale (PSS-10)]; emotion-focused, problem-focused, and avoidant coping strategies (measured by the Brief COPE); HCC; SBP; and DBP among 63 young, low-income adults with young children. A secondary analysis of baseline data from a quasi-experimental trial and a cluster randomized controlled trial was conducted. PROCESS (version 4) for SPSS 28 was used to conduct path analysis modeling.

Chapter 4 (Manuscript 3, Aim 3)

Chapter 4 reports results from a qualitatively driven explanatory mixed methods study comparing the stress and coping experiences of a group of young, low-income adults with low stress levels (n = 8) to a group with high stress levels (n = 9) as measured by the PSS-10. Interpretive phenomenological analysis (IPA) was used to analyze qualitative data.

Chapter 5 (Conclusion)

Chapter 5 provides a synthesis, conclusion, and recommendations for future research. Contributions to science, nursing research, practice, and policy implications are discussed.

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CHAPTER 2: ASSOCIATIONS BETWEEN HAIR CORTISOL AND BLOOD PRESSURE: A SYSTEMATIC REVIEW AND META-ANALYSIS

Introduction

The adverse impacts of cardiovascular disease (CVD) worldwide are substantial, claiming almost one out of every three lives (Virani et al., 2021). Approximately 1.4 billion people worldwide have hypertension, the most significant modifiable risk factor for CVD (Virani et al., 2021; World Health Organization (WHO), 2022). Cardiovascular risk increases with increases in systolic and diastolic blood pressure (SBP, DBP; Whelton et al., 2018). Lifestyle behaviors like smoking, high dietary salt intake, and sedentary activity have well-established links with hypertension and have been primary targets of interventions aimed to improve blood pressure (BP). Despite targeted interventions, hypertension is still widely prevalent (Virani et al., 2021). Recently, there has been increased interest in the role of psychological factors such as stress in affecting blood pressure (Levine et al., 2021).

Stress may affect BP independently of traditional risk factors through a number of mechanisms, including activation of the hypothalamic-pituitary-adrenal (HPA) axis (M.-Y. Liu et al., 2017). Stress induces the release of higher levels of corticotropin-releasing hormone (CRH) from the paraventricular nucleus of the hypothalamus triggering the release of adrenocorticotropic hormone (ACTH) into the bloodstream (M.-Y. Liu et al., 2017). Circulating ACTH binds to receptors in the adrenal cortex, subsequently stimulating the production and release of glucocorticoids, such as cortisol (M.-Y. Liu et al., 2017). Over time, higher levels of cortisol can affect BP through its influence on plasma volume expansion, inhibition of vasodilatory hormones, and vascular reactivity which can cause increased cardiac output and peripheral vascular resistance (Delong & Sharma, 2021; Whitworth et al., 2005).

Cortisol, the most prominent glucocorticoid also referred to colloquially as the "stress hormone", is perhaps the most widely-used biomarker for stress (Greff et al., 2018). Cortisol can be sampled through various sources, including saliva, blood (serum and plasma), urine, hair, and fingernails (Lee et al., 2015). Samples from saliva, blood, and urine are typically used to capture short-term HPA axis activation, while hair and fingernails can be considered retrospective indicators of the response to chronic stress exposure (C. H. Liu & Doan, 2019).

When cortisol is released into the bloodstream, it is diffused into the hair matrix and remains incorporated in the hair shaft as it grows (Greff et al., 2018). Hair grows at a rate of approximately one centimeter per month; therefore, a 1-cm sample of hair collected closest to the scalp reflects average cortisol secretion over the past month (Sauvé et al., 2007). Similar to hair, cortisol is believed to be diffused from the bloodstream into the nail matrix which grows at a rate of 0.1 mm/day (De Berker et al., 2007). Thus, a 1-mm sample is hypothesized to reflect a 10-day period (Fischer et al., 2020). By the time the nail has grown approximately 5 mm and is long enough to be cut, a 1-mm sample may then reflect a 10-day period from five months prior (Fischer et al., 2020).

Because cortisol is increasingly being used as a biomarker of stress and predictor of cardiovascular risk (Iob & Steptoe, 2019), a critical need exists to systematically review the evidence on the associations between long-term measures of cortisol and BP. One systematic review and meta-analysis found no significant associations between hair cortisol concentration (HCC) and DBP, but noted a very small, positive association ($r = 0.07$) between HCC and SBP (Stalder et al., 2017). Although these findings are important, this review was limited by a single database (Web of Science) and to articles published through 2015. Further, because the primary aim of their review was not to examine the relationships between cortisol and BP, the search

strategy lacked search terms related to BP. To address these limitations and expand current literature, this study aimed to comprehensively examine and quantitatively synthesize evidence on the relationships between HCC and BP and explore the potential factors that may moderate these relationships. Additionally, this study sought to investigate any evidence on the relationship between nail cortisol concentration (NCC) and BP as an exploratory aim. Findings would help determine whether long-term exposure to stress may have an influence on BP or hypertension status, as well as clarify if hair and nail cortisol is a useful biomarker of cardiovascular risk.

Methods

This systematic review and meta-analysis was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021).

Search Strategy

In consultation with a university health science librarian, searches were conducted in July 2022 in the following databases: PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Web of Science Core Collection, Cochrane Library, and Embase. Keywords included: cortisol, salivary cortisol, urinary cortisol, serum cortisol, plasma cortisol, blood cortisol, nail cortisol, hair cortisol, blood pressure, systolic blood pressure, diastolic blood pressure, and hypertension. All search strategies are available in Table 2.1A in Appendix A. Reference lists of included articles and grey literature, including medrxiv.org, clinicaltrials.gov, and conference proceedings were also searched. No filters on date of publication were applied.

Eligibility Criteria

Studies meeting the following inclusion criteria were selected: (1) participants were 18 years or older, (2) cortisol was measured within the context of stress from endogenous sources

(including hair and nails), (3) the relationship between cortisol and BP was examined, and (4) studies were published in English. Interventional studies were included if the association between cortisol and BP was assessed at baseline prior to intervention.

Animal studies and case studies or reports were excluded. Studies that reported on adrenocortical disorders (e.g., Cushing disease, Conn syndrome, Addison's disease), hypothalamic, adrenal, or pituitary tumors (e.g., pheochromocytomas, paragangliomas), genetic disorders affecting the HPA axis, or monogenic hypertension (e.g., Liddle syndrome) were excluded as these conditions have manifestations involving abnormally high or low cortisol levels or BP unrelated to stress (Cleveland Clinic, 2021; Raina et al., 2019). Other morbidities were not excluded. Additionally, studies where participants were treated with exogenous cortisol (e.g., corticosteroid medications such as hydrocortisone and prednisone) or BP medications (e.g., ACE inhibitors, calcium channel blockers, beta blockers) were excluded. Studies focused on majority (> 50%) pregnant women or individuals who smoke were also excluded. Pregnancy results in a transient increase in cortisol production (Mastorakos & Ilias, 2003), as well as a decline in BP in the first trimester followed by a rise in BP in subsequent trimesters (Whelton et al., 2018). Cigarette smoking is known to stimulate the HPA axis (Rohleder & Kirschbaum, 2006).

Study Screening

Title and abstracts were independently screened by the first author, as well as by three secondary reviewers. Any discrepancies were discussed between reviewers until agreement was reached. Full-text articles were screened independently by the first and second authors. Any discrepancies were resolved through discussion. During the screening process, articles were classified by cortisol type. Hair and nails were classified as chronic stress biomarkers and are

discussed in this review. Saliva, urine, serum, and plasma were classified as acute measures and therefore not included in this review.

Risk of Bias and Study Quality Assessment

The Appraisal Tool for Cross-Sectional Studies (AXIS) was used to assess the quality of cross-sectional studies (Downes et al., 2016). AXIS consists of 20 components assessing the introduction, methods, results, discussion, conflicts of interest, and ethical considerations (Downes et al., 2016). The revised Cochrane Risk of Bias Tool for Cluster-Randomized Trials (RoB 2 for Cluster-Randomized Trials) was used to assess the risk of bias for studies with a cluster-randomized design (Eldridge et al., 2021). The RoB 2 for cluster-randomized trials tool assesses bias (low, some concerns, and high) arising from five domains: timing of identifying and recruiting participants, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome, and bias in selection of reported results (Eldridge et al., 2021). The CLARITY Group's Tool to Assess Risk of Bias in Case Control Studies was used to assess bias across five domains including confidence in assessment of exposure, confidence that cases developed the outcome of interest and controls did not, cases were properly selected, controls were properly selected, and cases/controls were matched accordingly (The CLARITY Group at McMaster University, n.d.). All studies were assessed independently by L. P. and T. N. and any discrepancies were resolved through discussion.

Data Analysis

Comprehensive Meta-Analysis (CMA) version 3 was used to conduct the meta-analysis. Random effects models were used to assess the pooled effect size of Fisher's *z* when evaluating the relationship between HCC and BP, and odds ratios (ORs) when evaluating the relationship between hypertension status and HCC. Correlation coefficients were transformed to Fischer's *z*

for analysis and then transformed back to *r* for interpretation. Regression coefficients were transformed into correlation coefficients using Peterson & Brown's (2005) equation $r = .98\beta + 0.05\lambda$, where λ is an indicator equaling to 1 when β is > 0 and equaling to 0 when β is < 1. For articles that did not provide the needed test statistic, corresponding authors were contacted twice (two weeks apart) in attempt to obtain this information. Forest plots were generated to display effect estimates. Statistical heterogeneity was estimated using Cochrane's *Q* and the I^2 statistic, where $I^2 \geq 50\%$ indicate substantial to considerable heterogeneity (Higgins et al., 2021). Any estimates with large standardized residuals (≥ 3) were considered influential outliers (Lin et al., 2017). Subgroup analyses were performed categorically based on cortisol analysis method (enzyme-linked immunoassay [ELISA], ultra high-performance liquid chromatography [UHLPC-MS/MS], chemiluminescent immunoassay (CLIA), and liquid chromatography-mass spectrometry [LC-MS/MS]), age (18-54 years vs. $\geq$ 55 years), and continent (North America, Europe, and Asia). Each outcome (SBP, DBP, and hypertension status) was analyzed separately. Publication bias was assessed using the Begg-Mazumdar rank and correlation test, Egger's test, and funnel plot. If the funnel plot was asymmetric and results from either the Begg-Mazumdar rank correlation test or Egger's test were significant, then publication bias was suggested. Duval & Tweedie's (2000) trim and fill method was used to adjust the effect sizes when publication bias was a concern.

Results

Search Results

Articles were uploaded into Covidence Systematic Review Software (*Covidence*, 2021). A PRISMA flow diagram detailing the number of records identified, number excluded, and reasons for exclusion can be found in Figure 2.1A in Appendix B. The initial search of all

databases and grey literature generated 34,010 records. Four studies were added from reference lists, and 14,769 duplicates were removed. A total of 18,713 irrelevant studies were excluded, leaving 532 full texts to be assessed for eligibility.

Study Characteristics

Sixteen studies met eligibility criteria for the review and are described in Supplementary Table 2.0 (Bautista et al., 2019; Chan et al., 2014; Feller et al., 2014; Kuehl et al., 2015; Langerak et al., 2015; Manenschijn et al., 2011; Mazgelytė et al., 2021, 2022; Nafisa et al., 2021; O'Brien et al., 2013; Richards et al., 2022; Stalder et al., 2013; Stomby et al., 2021; Wester et al., 2017; Younge et al., 2015; Žėkas et al., 2019). No study assessed the relationship between NCC and BP. Therefore, all studies included in the review and meta-analysis were focused on HCC. All studies were published between 2011 and 2022. Four studies were conducted in the U.S., four in the Netherlands, three in Lithuania, two in Germany, one in Canada, one in Pakistan, and one in Sweden. Fourteen studies were cross-sectional, one was a case-control, and one was a cluster-randomized trial. Nine studies focused on general, healthy populations with no specified morbidities, one focused specifically on human immunodeficiency virus (HIV) patients, and six studied both healthy- and non-healthy populations.

Ten studies analyzed the association between HCC and SBP, while 11 analyzed the association between HCC and DBP. Most studies did not provide information on how BP was measured; however, the three studies that did report this information measured BP $\geq$ 2 times using automated oscillometric devices while participants were sitting down. Three studies analyzed the association between HCC and hypertension status. In these studies, participants were considered hypertensive if SBP was $\geq$ 140 mmHg or DBP was $\geq$ 90 mmHg (Bautista et al., 2019; Nafisa et al., 2021), or if they reported a diagnosis of hypertension or reported receiving

pharmacological treatment (Stomby et al., 2021). Of 10 studies that reported mean SBP and DBP, average measurement range was 121.3 – 136.4 mmHg and 76.0 – 82.0 mmHg, respectively. Four studies reported the median SBP and DBP, and the observed median measurement range was 110.0 – 130.0 mmHg and 70.0 – 80.11 mmHg, respectively.

Five studies measured HCC using enzyme-linked immunoassay (ELISA; pg/mg), three used ultra high-performance liquid chromatography (UHLPC-MS/MS; ng/g), two used chemiluminescent immunoassay (CLIA; pg/mg), and one used liquid chromatography-mass spectrometry (LC-MS/MS; pg/mg). The conversion rate from ng/g to pg/mg is 1:1, so studies were described in pg/mg for summary purposes. Of seven studies that reported mean cortisol levels, average measurements ranged from 2.2 to 226.8 pg/mg. Eight studies reported median cortisol levels, which ranged from 3.4 to 158.9 pg/mg. Two eligible studies were not included in the meta-analysis, as one provided only data on the association between cortisol and mean arterial pressure (MAP; Stalder et al., 2013), and the other provided only the significance levels but not the test statistic on the association between cortisol and SBP/DBP (Manenschijn et al., 2011).

Risk of Bias and Quality Assessment

One cluster-randomized trial was assessed for bias using the RoB 2 for cluster-randomized trials (Table 2.2A, Appendix C). This study demonstrated some concerns for risk of bias arising from the randomization process of the original study. One study was assessed using the Tool to Assess Risk of Bias in Case Control Studies developed by the CLARITY Group at McMaster University (Table 2.3A, Appendix C). Fourteen studies were cross-sectional in design and were appraised using the AXIS (Table 2.4A, Appendix C). Of these 14 studies, one study demonstrated problematic quality on 2 out of 20 domains, one on 5 out of 20 domains, five on 6

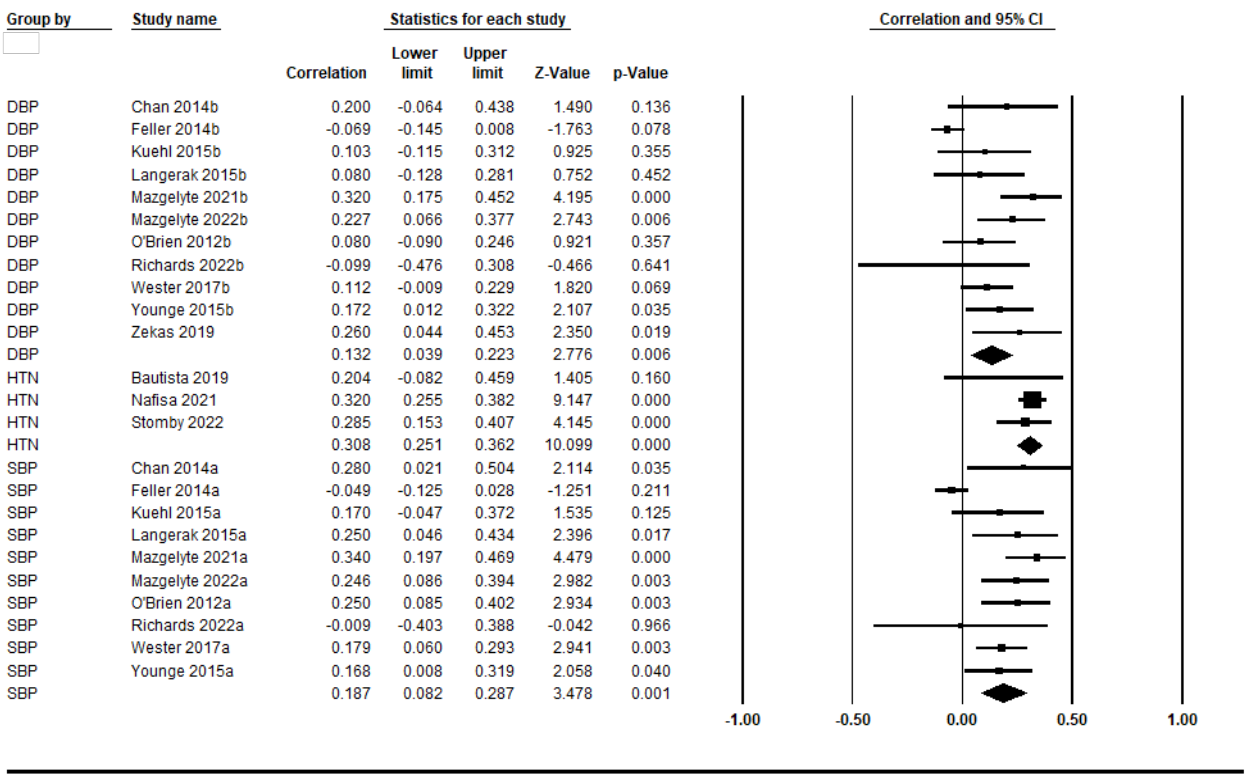
out of 20 domains, three on 7 out of 20 domains, three on 8 out of 20 domains, and one on 9 out of 20 domains. The most commonly problematic domains were: 1) no justification of sample size (12 studies), 2) inappropriate selection process (10 studies), 3) measures not taken to address and categorize non-responders (13 studies), 4) incorrect measurement of variables (11 studies), 5) inadequate description of basic data (9 studies), 6) information not provided about response rates (13 studies), and 7) information not provided about non-responders (10 studies).

HCC and SBP/DBP

Among studies reporting SBP as an outcome, no outliers were identified. Studies were highly heterogenous ($Q = 37.22$, $p < 0.001$; $I^2 = 75.82\%$). A small, positive association was observed between HCC and SBP ($r = 0.19$ [95% CI: 0.08 – 0.29], $p = 0.001$; see Figure 1). No significant moderators were identified (see Table 2.1). For studies reporting DBP as an outcome, no outliers were identified. Random effects models were used due to studies' heterogeneity ($Q = 33.629$, $p < 0.001$; $I^2 = 70.26\%$). The association between HCC and DBP was small ($r = 0.13$ [95% CI: 0.039 – 0.223], $p = 0.006$; see Figure 2.1).

Figure 2.1

Forest Plot of the Association between Hair Cortisol Concentration and Systolic Blood Pressure, Diastolic Blood Pressure, and Hypertension Status



Group by	Study name	Correlation	Lower limit	Upper limit	Z-Value	p-Value
DBP	Chan 2014b	0.200	-0.064	0.438	1.490	0.136
DBP	Feller 2014b	-0.069	-0.145	0.008	-1.763	0.078
DBP	Kuehl 2015b	0.103	-0.115	0.312	0.925	0.355
DBP	Langerak 2015b	0.080	-0.128	0.281	0.752	0.452
DBP	Mazgelyte 2021b	0.320	0.175	0.452	4.195	0.000
DBP	Mazgelyte 2022b	0.227	0.066	0.377	2.743	0.006
DBP	O'Brien 2012b	0.080	-0.090	0.246	0.921	0.357
DBP	Richards 2022b	-0.099	-0.476	0.308	-0.466	0.641
DBP	Wester 2017b	0.112	-0.009	0.229	1.820	0.069
DBP	Younge 2015b	0.172	0.012	0.322	2.107	0.035
DBP	Zekas 2019	0.260	0.044	0.453	2.350	0.019
DBP		0.132	0.039	0.223	2.776	0.006
HTN	Bautista 2019	0.204	-0.082	0.459	1.405	0.160
HTN	Nafisa 2021	0.320	0.255	0.382	9.147	0.000
HTN	Stomby 2022	0.285	0.153	0.407	4.145	0.000
HTN		0.308	0.251	0.362	10.099	0.000
SBP	Chan 2014a	0.280	0.021	0.504	2.114	0.035
SBP	Feller 2014a	-0.049	-0.125	0.028	-1.251	0.211
SBP	Kuehl 2015a	0.170	-0.047	0.372	1.535	0.125
SBP	Langerak 2015a	0.250	0.046	0.434	2.396	0.017
SBP	Mazgelyte 2021a	0.340	0.197	0.469	4.479	0.000
SBP	Mazgelyte 2022a	0.246	0.086	0.394	2.982	0.003
SBP	O'Brien 2012a	0.250	0.085	0.402	2.934	0.003
SBP	Richards 2022a	-0.009	-0.403	0.388	-0.042	0.966
SBP	Wester 2017a	0.179	0.060	0.293	2.941	0.003
SBP	Younge 2015a	0.168	0.008	0.319	2.058	0.040
SBP		0.187	0.082	0.287	3.478	0.001

As shown in Table 2.1, cortisol analysis method was identified as a significant moderator (Q = 11.548, p = 0.009). Cortisol analyzed using UHPLC-MS/MS (r = 0.27) was more strongly correlated with DBP than other methods. Although not statistically significant, the positive correlations between HCC and BP were slightly stronger in adults < 55 years old than those ≥ 55 years old (0.23 vs. 0.07 for SBP; 0.17 vs. 0.04 for DBP).

Table 2.1

Moderators of the Relationship between Hair Cortisol Concentration and Systolic and Diastolic Blood Pressure

Systolic Blood Pressure					
Categorical moderators	k	Effect size	95% CI	$Q_{between}$	*P* value
Age				1.676	0.195
≥ 55 years	3	0.071	-0.163, 0.297		
< 55 years	7	0.228	0.166, 0.288		
Cortisol Analysis Method				5.528	0.137
CLIA	2	-0.025	-0.097, 0.048		
ELISA	5	0.214	0.124, 0.301		
LC-MS/MS	1	0.179	0.060, 0.293		
UHPLC-MS/MS	2	0.191	0.191, 0.396		
Continent				0.123	0.725
Europe	6	0.183	0.042, 0.317		
North America	4	0.215	0.102, 0.322		
Diastolic Blood Pressure					
Age				1.047	0.306
≥ 55 years	3	0.038	-0.197, 0.268		
< 55 years	8	0.165	0.099, 0.229		
Cortisol Analysis Method				11.548	**0.009***
CLIA	2	-0.015	-0.170, 0.142		
ELISA	5	0.117	0.024, 0.207		
LC-MS/MS	1	0.112	-0.009, 0.229		
UHPLC-MS/MS	3	0.274	0.178, 0.364		
Continent				0.415	0.520
Europe	7	0.151	0.026, 0.272		
North America	4	0.096	-0.020, 0.208		

Note. CLIA = Chemiluminescent immunoassay; ELISA = Enzyme-linked immunosorbent assay; LC-MS/MS = Liquid chromatography-mass spectrometry; ULPC=MS/MS = Ultra high-performance liquid chromatography
*$p < 0.05$

HCC and Hypertension Status

Among the three studies that examined hypertension status as an outcome, no outliers were identified. These studies demonstrated low heterogeneity ($Q = 0.840$, $p = 0.657$; $I^2 = 0\%$).

HCC was largely, positively associated with hypertension status (OR = 3.23 [95% CI: 2.55 – 4.09], $p < 0.001$).

Publication Bias

Among the studies reporting SBP, publication bias was evident based on Egger's test (b = 3.01, p = 0.023) and asymmetrical funnel plot (Figure 2.2) but not Begg and Mazumdar's test (τ = -0.16, p = 0.266). After adjustment using Duval and Tweedie's trim and fill method, the effect size estimate decreased to 0.16 (95% CI: 0.06, 0.25). Similarly, among studies reporting DBP as an outcome, Egger's test (b = 2.37, p = 0.039) and the asymmetrical funnel plot (Figure 2.3) indicated potential bias, while Begg and Mazumdar's did not (τ = -0.06, p = 0.815). Duval and Tweedie's trim and fill did not suggest any modification of effect size. Possible bias was also detected for studies reporting hypertension status (Egger's test: b = -1.14, p = 0.004; Begg and Mazumdar's test: τ = -1.00, p = 0.059). After adjustment using Duval and Tweedie's trim and fill method, the effect size increased (OR = 3.40 [95% CI: 2.75, 4.20]; see Figure 2.4 for funnel plot).

Figure 2.2

Funnel Plot on the Association between Hair Cortisol Concentration and Systolic Blood Pressure

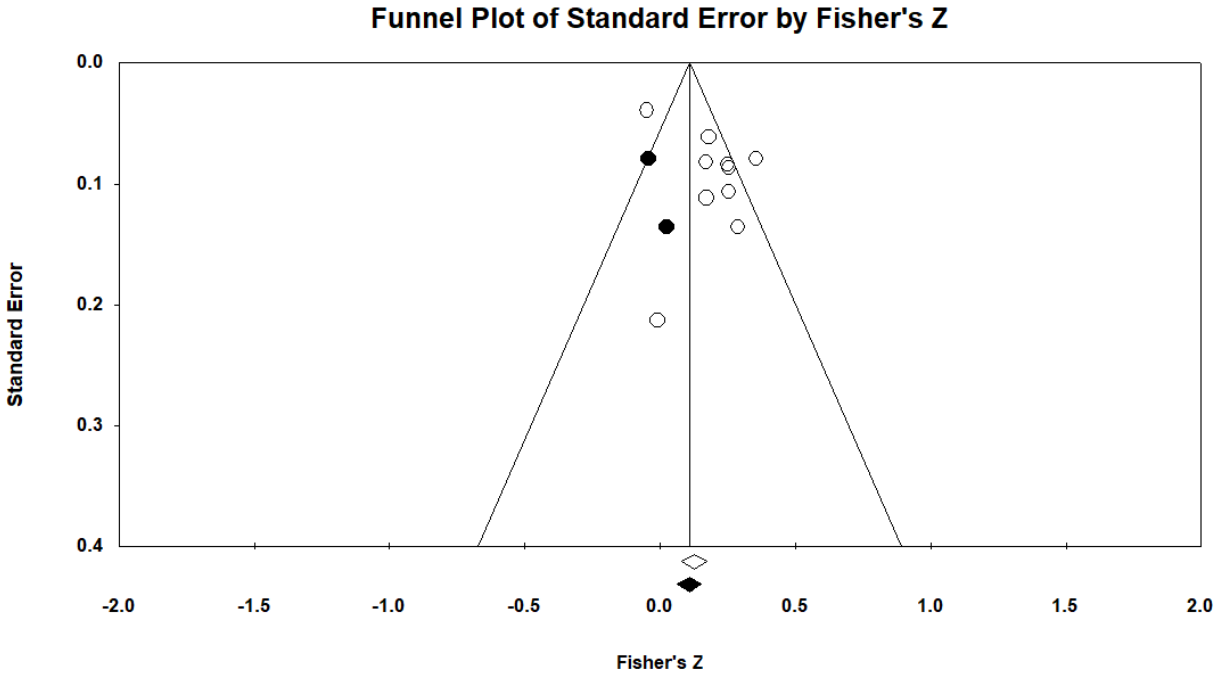


Figure 2.3

Funnel Plot on the Association between Hair Cortisol Concentration and Diastolic Blood Pressure

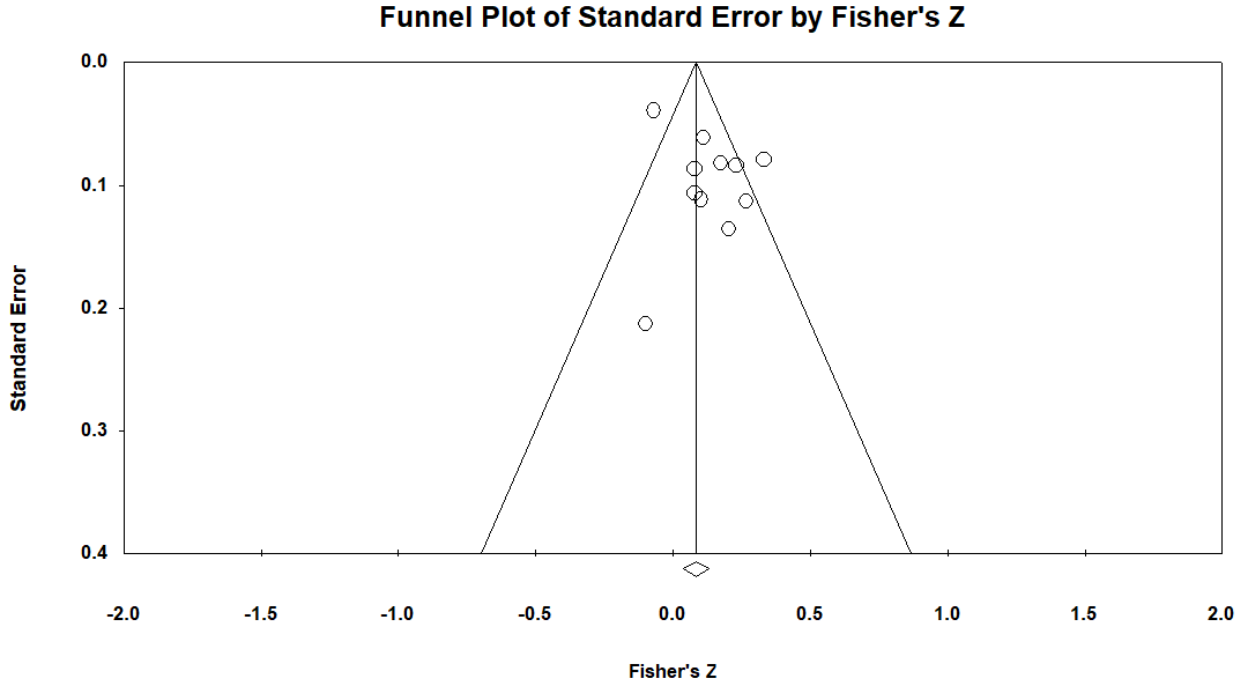
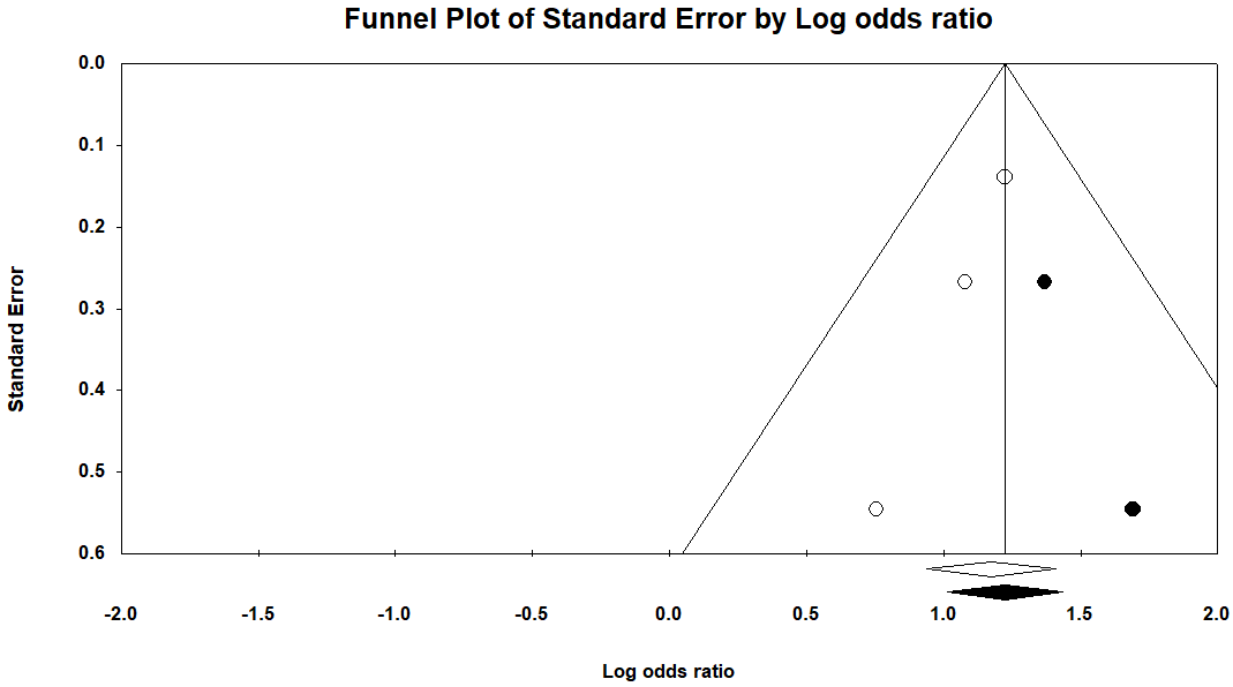


Figure 2.4

Funnel Plot on the Association between Hair Cortisol Concentration and Hypertension



Discussion

Chronic stress has been long regarded as a risk factor for high BP. Over the past two decades, cortisol has been collected from sources such as hair and nails to serve as an indicator of exposure to chronic stress (C. H. Liu & Doan, 2019). This systematic review and meta-analysis aimed to synthesize current evidence on the associations between hair and nail cortisol and BP. Overall, results indicated that HCC had a significant, small, and positive association with SBP ($r = 0.19$, $p = 0.001$); a small positive association with DBP ($r = 0.13$, $p = 0.006$); and a large positive association with hypertension status (OR = 3.23, $p < 0.001$). These effect sizes are somewhat larger than those found in another meta-analysis conducted in 2015, which found a very small positive relationship with SBP ($r = 0.07$, $p = 0.017$) and an even smaller relationship with DBP ($r = 0.04$, $p = 0.281$; Stalder et al., 2017). One possible reason for these effect size

differences is that our review excluded studies involving participants with conditions that may impact cortisol or BP (e.g., pregnancy, smoking, post-traumatic stress disorder [PTSD]), while the prior meta-analysis had no such exclusion criteria. Furthermore, due to the increasing use of HCC as a stress biomarker, nine additional studies have been published since the previous meta-analysis in 2015, thus improving the estimates.

SBP measurements across most studies in this review were slightly high according to the American Heart Association/American College of Cardiology (AHA/ACC) and the European Society of Cardiology/European Society of Hypertension ESC/ESH), which recommend an optimal SBP of < 120 mmHg (Whelton et al., 2018; Williams et al., 2018). As expected, the associations between HCC and SBP/DBP were positive, with the associations being slightly larger with SBP than with DBP, likely because SBP has a much larger range and variability than DBP. For example, in this study, the mean SBP and DBP range was 121.3 – 136.4 mmHg and 76.0 – 82.0 mmHg; while the median SBP and DBP range was 110.0 – 130.0 mmHg and 70.0 – 80.11 mmHg, respectively. When examined together, both SBP and DBP are important indicators of cardiovascular risk, but evidence shows that DBP is not associated with cardiovascular risk after adjusting for SBP (Whelton et al., 2018). For example, one study assessed cardiovascular risk in hypertensive subjects and found that subjects with DBP > 100 mmHg showed a 1.60-fold increase in CVD mortality compared with those with DBP < 90 mmHg (Benetos et al., 2002). However, there was no association between DBP and CVD mortality after adjustment for SBP (Benetos et al., 2002). Similarly, a retrospective cohort study including adults without hypertension noted that cardiovascular risk significantly increased with a 20 mmHg increase in SBP (HR 1.99; 95% CI 1.95–2.03) and a 20 mmHg increase in DBP (HR 2.08; 95% CI 2.01–2.16); but when stratified by SBP, increases in DBP were not associated with increased risk for

major cardiovascular events (Choi et al., 2019). Thus, focusing on reducing SBP may be more important for CVD prevention; however more research is warranted.

Although only three studies examined the association between HCC and hypertension status, a large positive association was observed. This large association between HCC and hypertension status emphasizes the important negative effects of chronic stress on hypertension. After adjusting for publication bias, the increased effect size further supports the risk factor of chronic stress contributing to hypertension. As hypertension is directly linked to CVD (Whelton et al., 2018), reducing chronic stress may help prevent CVD. However, due to the small number of studies examining the relationships between HCC and hypertension status, greater research effort is warranted to confirm this large association.

Interestingly, a negative correlation between HCC and BP was observed when using CLIA as an analysis method. Only two studies used this method; therefore, the results should be interpreted with caution. Studies using other cortisol analysis methods (ELISA, LC-MS/MS, UHPLC-MS/MS) noted a positive association between HCC and BP. These variations may be due to the different sensitivities and specificities of the cortisol analysis methods. Immunoassays, including ELISA and CLIA, are cost-effective, simple, and have high sensitivity; however, their specificity is usually low which may lead to potentially inaccurate results through overestimation (Gao et al., 2016). On the contrary, LC-MS/MS analysis methods have high specificity, high sensitivity, and wide dynamic range; so, findings from these methods may be more trustworthy (Gao et al., 2016). Racial distribution and factors associated with it, including hair texture, pigment, and maintenance practices are necessary to consider as they can affect HCC and how it is analyzed (Wosu et al., 2015). Importantly, reported data on racial distribution was lacking for most studies. Although some prior studies have found almost no effect of hair color on cortisol

(Raul et al., 2004; Sauvé et al., 2007), more recent research has found a positive association between darker hair and higher cortisol levels (Lanfear et al., 2020; Staufenbiel et al., 2015). Additionally, use of maintenance practices, such as hair relaxers, can impact cortisol concentration in hair. Commonly used in the African American community, relaxers are chemicals that permanently break down hydrogen sulfide bonds along the hair shaft, thus affecting the amount of cortisol collected for analysis (Roseborough & McMichael, 2009). When interpreting HCC values, researchers should be mindful of HCC differences by race and ethnicity. Reporting these demographic characteristics is also important.

Surprisingly, the positive relationships between HCC and BP tended to be stronger for young and middle-aged adults compared to older adults. Prior research has shown that cortisol levels tend to increase with age (Lanfear et al., 2020; Stalder et al., 2017; Staufenbiel et al., 2015). Additionally, it is well-established that blood pressure and risk for hypertension progressively increase as people get older (Whelton et al., 2018). Although not significant, studies with young- and middle-aged participants demonstrated a stronger association between SBP and HCC than studies with older samples. A similar trend but with a slightly smaller effect was observed between DBP and HCC. This finding could potentially indicate that stress may be a more important risk factor for increased BP among younger individuals than older adults. It also emphasizes the need for regular BP screenings among younger populations. Currently, annual BP screening is only recommended for high-risk individuals and adults 40 years of age or older (Abdalla et al., 2021). Adults 18-39 years old who experience high stress may benefit from regular screening to detect and control early-onset hypertension.

Limitations

This study has some limitations. Despite a comprehensive search of the literature, only a small number of studies that analyzed an association between HCC and BP. It is also important to note that the BP measurement method was not reported in most studies. Variation among devices or use of invalidated devices undermines the quality of research and may lead to erroneous results and conclusions. Additionally, reporting information on number of measurements, time in between measurements, positioning, and smoking/caffeine consumption status is critical to justify findings as accurate (Whelton et al., 2018). Researchers should carefully select a validated device and follow expert guidelines on measurement procedures (Whelton et al., 2018). HCC ranges varied widely; however, no established reference ranges for HCC currently exist, so unfortunately it is not possible to compare these results across samples.

Studies included in this review showed significant diversity in terms of sample characteristics, including age, race, and sex, as well as measurement methods, which underlines the need for some level of caution when interpreting findings. Of note, most studies did not report findings of any separate statistical analyses on men versus women, even though men are known to have higher BP and HCC on average (Stalder et al., 2017; Tsao et al., 2023). To be consistent across studies, only raw values were used in this meta-analysis to produce the pooled estimates, rather than values that adjusted for age, race, or other covariates. This could have potentially affected the estimates, since these variables are likely to influence on cortisol and/or BP. Lastly, no studies focused on examining the relationship between NCC and BP. This notable deficiency may be due to the very recent development of cortisol extraction from nails in 2010 (Warnock et al., 2010).

Conclusions

Despite these potential limitations, the consistent positive relationships between HCC and BP indicate the important negative effects of chronic stress on individuals' cardiovascular health, especially among young- and middle-aged adults. These findings underscore the importance of primary and secondary prevention efforts for high-stress individuals, including screening for early-onset hypertension and implementation of stress management interventions. However, due to the paucity of current research focusing on young- and middle-aged adults, more studies are needed to confirm the strength of the positive relationship between HCC and BP in this population. Future research is needed to develop stress management interventions that are effective in mitigating the impact of stress on BP. Findings also emphasize the importance of detailed reporting on sociodemographic sample characteristics when considering measurement of HCC and BP, since HCC and BP can be influenced by these factors. Additionally, research is needed to provide evidence on the relationship between other biomarkers of stress (e.g., blood, salivary, and urinary cortisol) and BP so that the effects of stress on health can be understood more comprehensively.

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APPENDIX A: Search Strategies

Table 2.1A

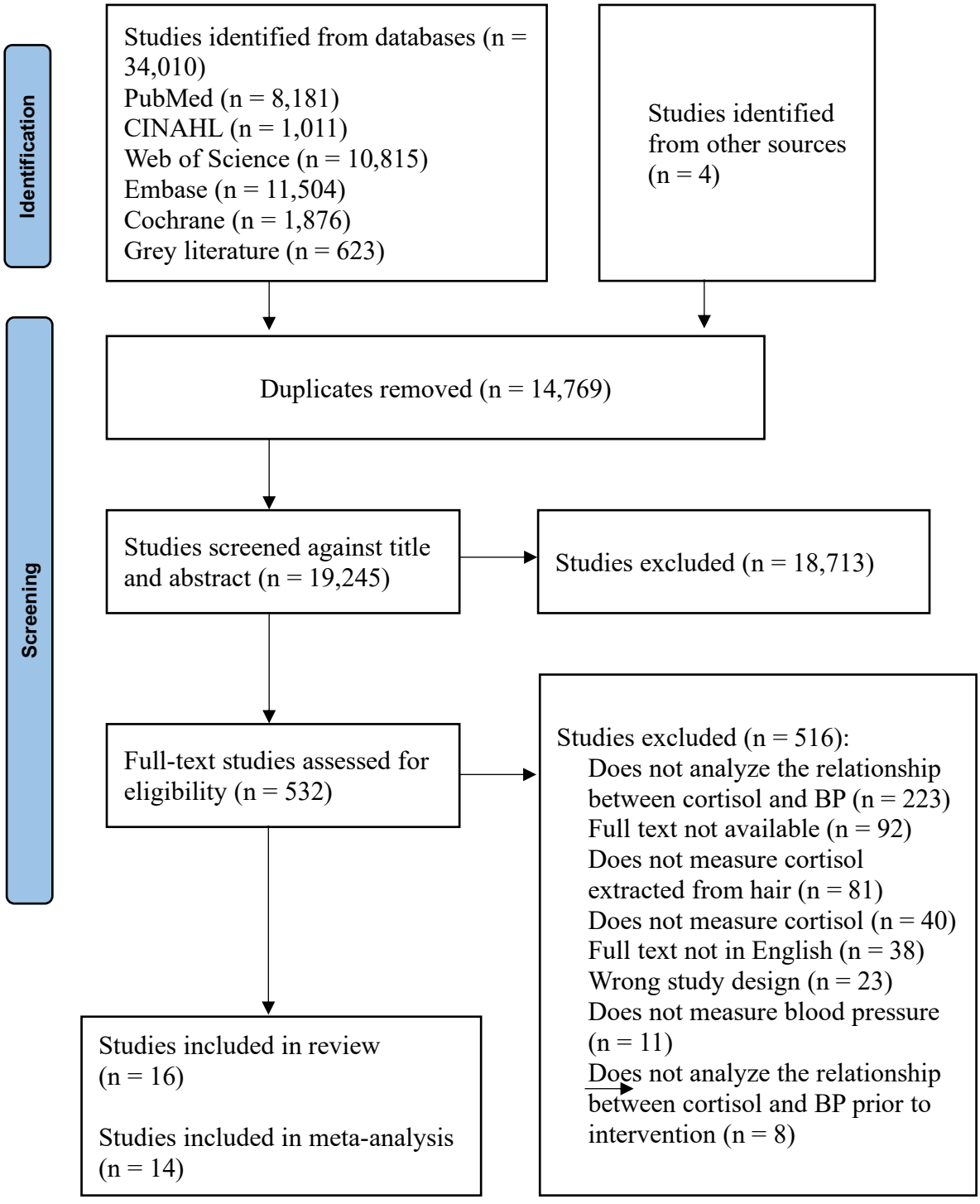
Search Strategies

Database	MeSH Headings and Key Words
PubMed	(cortisol or "salivary cortisol" or "hair cortisol" or "urinary cortisol" or "serum cortisol" or “plasma cortisol” or "blood cortisol" or "nail cortisol" OR (hair AND cortisol) OR (saliva* AND cortisol) OR (urin* AND cortisol) OR (serum AND cortisol) OR (plasma AND cortisol) OR (blood AND cortisol) OR (nail AND cortisol)) AND ("blood pressure" OR "systolic blood pressure" OR "diastolic blood pressure" OR hypertensi* OR "Hypertension"[Mesh] OR "Blood Pressure"[Mesh])
CINAHL	(cortisol or "salivary cortisol" or "hair cortisol" or "urinary cortisol" or "serum cortisol" or "blood cortisol" or "nail cortisol" OR (hair AND cortisol) OR (saliva* AND cortisol) OR (urin* AND cortisol) OR (serum AND cortisol) OR (plasma AND cortisol) OR (blood AND cortisol) OR (nail AND cortisol)) AND ("blood pressure" OR "systolic blood pressure" OR "diastolic blood pressure" OR hypertensi* OR (MH "Blood Pressure") OR (MH "Hypertension"))
Web of Science	(cortisol or "salivary cortisol" or "hair cortisol" or "urinary cortisol" or "serum cortisol" or "blood cortisol" or "nail cortisol" OR (hair AND cortisol) OR (saliva* AND cortisol) OR (urin* AND cortisol) OR (serum AND cortisol) OR (plasma AND cortisol) OR (blood AND cortisol) OR (nail AND cortisol)) AND ("blood pressure" OR "systolic blood pressure" OR "diastolic blood pressure" OR hypertensi*)
Embase	(cortisol OR 'salivary cortisol' OR 'hair cortisol' OR 'urinary cortisol' OR 'serum cortisol' OR 'blood cortisol' OR 'nail cortisol' OR (hair AND cortisol) OR (saliva* AND cortisol) OR (urin* AND cortisol) OR (serum AND cortisol) OR (plasma AND cortisol) OR (blood AND cortisol) OR (nail AND cortisol)) AND ('blood pressure' OR 'systolic blood pressure' OR 'diastolic blood pressure' OR hypertensi*)
Cochrane	cortisol OR 'salivary cortisol' OR 'hair cortisol' OR 'urinary cortisol' OR 'serum cortisol' OR 'blood cortisol' OR 'nail cortisol' OR (hair AND cortisol) OR (saliva* AND cortisol) OR (urin* AND cortisol) OR (serum AND cortisol) OR (plasma AND cortisol) OR (blood AND cortisol) OR (nail AND cortisol) in Title Abstract Keyword AND 'blood pressure' OR 'systolic blood pressure' OR 'diastolic blood pressure' OR hypertensi* in Title Abstract Keyword - (Word variations have been searched)
medrxiv.org/	cortisol AND ("blood pressure" OR hypertensi*)
Clinicaltrials.gov	cortisol AND ("blood pressure" OR hypertension)

APPENDIX B: PRISMA Flow Diagram

Figure 2.1A

PRISMA Flow Diagram



APPENDIX C: Risk of Bias and Quality Assessment Tables

Table 2.2A

Risk of Bias Assessed Using the RoB 2 for Cluster-Randomized Studies

Study	**Domain 1** Timing of identifying/ recruiting participants	**Domain 2** Deviations from intended interventions	**Domain 3** Missing outcome data	**Domain 4** Measurement of the outcome	**Domain 5** Selection of the reported result	**Overall bias**
Richards 2022; Wright 2021	Some concerns	Some concerns	Low	Low	Low	Some concerns

Table 2.3A

Risk of Bias Assessed Using the Tool to Assess Risk of Bias in Case-Control Studies

Study	**Domain 1** Confident in the assessment of exposure	**Domain 2** Confident that cases had developed the outcome of interest and controls had not	**Domain 3** Cases properly selected	**Domain 4** Controls properly selected	**Domain 5** Cases and controls matched/statistical adjustment
Nafisa 2021	Definitely yes	Definitely yes	Definitely yes	Definitely yes	Definitely yes

Table 2.4A

Cross-sectional Studies Assessed for Quality Using AXIS

Study	Clear aims/objectives	Appropriate study design	Justified sample size	Clearly defined target/reference population	Sample frame taken from appropriate population base	Appropriate selection process	Measures taken to address and categorize non-responders	Appropriate measured variables	Variables measured correctly	Statistical significance clear	Methods described	Basic data adequately described	Response rate raises concerns about response bias	Information about non-responders described (if appropriate)	Internal consistent results	Results presented for pre-specified methods	Discussions/conclusions justified by results	Limitations discussed	Problematic funding sources/conflicts of interest	Ethical approval/consent obtained
Bautista 2019	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	NI	NA	Y	Y	Y	Y	N	Y
Chan 2014	Y	Y	N	Y	Y	Y	N	Y	NI	Y	N	N	NI	NA	Y	Y	Y	Y	N	Y
Feller 2014	Y	Y	N	Y	Y	Y	N	Y	NI	Y	Y	N	NI	N	Y	Y	Y	Y	N	Y
Kuehl 2015	Y	Y	N	Y	N	NI	N	Y	NI	Y	Y	N	NI	N	Y	Y	Y	Y	N	Y

Table 2.4A (cont'd)

Langerak 2015	Y	Y	N	Y	Y	NI	N	Y	NI	Y	Y	Y	NI	N	Y	Y	Y	Y	N	Y
Manenschijn 2011	Y	Y	N	Y	NI	NI	N	Y	NI	Y	Y	Y	NI	N	Y	Y	Y	N	N	Y
Mazgelytė 2021	Y	Y	N	N	N	N	N	Y	NI	Y	Y	Y	NI	NA	Y	Y	Y	N	N	Y
Mazgelytė 2022	Y	Y	Y	Y	N	NI	N	Y	NI	Y	Y	N	NI	N	Y	Y	Y	Y	N	Y
O'Brien 2013	Y	Y	N	N	N	NI	N	Y	NI	Y	Y	Y	NI	NA	Y	Y	Y	Y	N	Y
Stalder 2013	Y	Y	N	Y	Y	NI	N	Y	Y	Y	Y	N	NI	N	Y	Y	Y	Y	N	Y
Stomby 2021	Y	Y	Y	Y	Y	Y	Y	Y	NI	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y
Wester 2017	Y	Y	N	Y	Y	NI	N	Y	Y	Y	Y	N	NI	N	Y	Y	Y	Y	NI	Y
Younge 2015	Y	Y	N	Y	Y	Y	N	Y	NI	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y
Žėkas 2019	Y	Y	N	Y	NI	NI	N	Y	NI	Y	Y	N	NI	N	Y	Y	Y	N	N	Y

Note. Y = Yes; N = No; NI = No information; NA = Not appropriate

CHAPTER 3: RELATIONSHIPS AMONG PERCEIVED STRESS, HAIR CORTISOL CONCENTRATION, COPING STRATEGIES, AND BLOOD PRESSURE IN YOUNG, LOW-INCOME ADULTS

Introduction

High blood pressure is the most important modifiable risk factor for premature development of cardiovascular disease (CVD), affecting about 1 in 5 adults and disproportionately impacting those with living in poverty (Beckman et al., 2017; Carey et al., 2018; Ostchega et al., 2020; Shahu et al., 2019). Reasons for this may be because those with low income typically have less access to healthy diet choices, less opportunities to be physically active, higher smoking rates, and poor adherence to antihypertensive medication when it is prescribed (Centers for Disease Control and Prevention, 2019; Shahu et al., 2019; van der Laan et al., 2017). Unfortunately, previous lifestyle interventions focused on diet, physical activity, and smoking cessation behaviors to address traditional risk factors for hypertension (e.g., smoking, obesity, and high dietary salt intake) have resulted in limited effects in low-income groups (Bull et al., 2014; Craike et al., 2018; Michie et al., 2009).

Although there are many possible explanations for the limited effectiveness of these interventions among low-income groups on improving behaviors associated with hypertension risk, one possible underlying factor is stress, especially prolonged or chronic exposure to stress. Chronic stress is the accumulative burden of ongoing demands or day-to-day stressors experienced by an individual that threaten homeostasis for a prolonged period (typically a minimum of one month; Crosswell & Lockwood, 2020; McEwen & Stellar, 1993). Young adults (18 – 39 years old) who are experiencing poverty are likely to experience chronic stress due to significant day-to-day stressors associated with their life circumstances, including limited income, low-wage jobs, parenting young children with reduced resources, living in unstable or

unsafe housing, and food insecurity (Hustedt et al., 2017; Ling et al., 2019). Over time, persistent exposure to these stressors may lead to poor mental health and diminished capacity to cope (Hodgkinson et al., 2017). Chronic activation of stress responses systems can also have adverse effects on health, including elevated blood pressure (Godoy et al., 2018). Therefore, there is an urgent need to focus on young adults, as there is an increasing prevalence of hypertension within this population, and early hypertension onset is associated with an increased risk of lifetime CVD and shortened life expectancy (Allen & Wilkins, 2023; Yano et al., 2018).

Chronic stress can be measured through subjective (e.g., self-report) and objective (e.g, biomarker) measures. Self-report instruments can measure perceived stress, defined as the thoughts and feelings an individual has about how much stress they are experiencing over a given time period (Phillips, 2013). Because the stress response involves multiple physiologic systems, biomarkers to reflect stress exposure in prior studies have included cortisol (hypothalamic–pituitary–adrenal [HPA] axis), alpha amylase (autonomic nervous system), and inflammatory cytokines (immune system), to name a few (Nater et al., 2013). Cortisol is perhaps the most well-studied stress biomarker, and has been reliably measured in saliva, urine, blood, and hair (Iob & Steptoe, 2019; Turpeinen & Hämäläinen, 2013). Hair is the most useful source for analyzing long-term cortisol output due to its reliable growth rate of about 1 cm per month; additionally, it does not require invasive sampling and is not subject to acute diurnal changes (Greff et al., 2018; Liu & Doan, 2019; Russell et al., 2015).

Despite existing research examining relationships among perceived stress, hair cortisol concentration (HCC), and blood pressure, findings are inconsistent. Some studies have observed negative associations between perceived stress and hair cortisol (Kalra et al., 2007), while others have observed negative or curvilinear associations (Ling et al., 2020; Wells et al., 2014). Similar

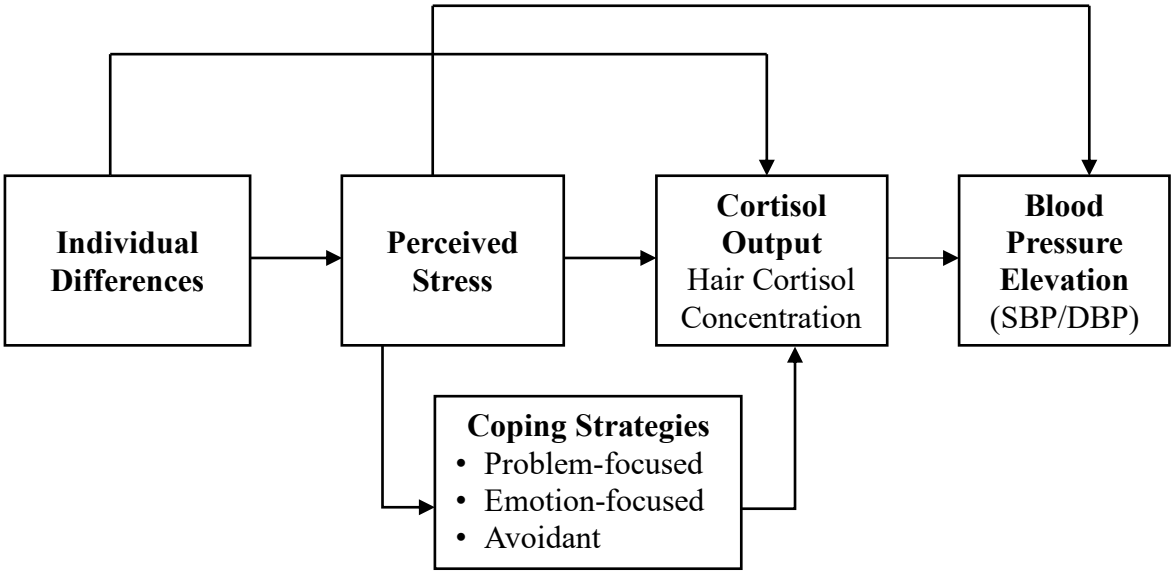
inconsistencies have been observed when comparing levels of perceived stress with blood pressure (Spruill et al., 2019; R. Wright et al., 2018), and hair cortisol with blood pressure (Bautista et al., 2019; Feller et al., 2014). These mixed findings and limited evidence within young, low-income groups highlight the need for more research within this population and investigation into other factors impacting the stress response that may help explain these discrepancies.

One potential explanation for the inconsistencies among perceived stress, cortisol levels, and blood pressure is variation among coping strategies used by different individuals. Previous research has found that stressors are subject to cognitive responses that can shape the physiologic responses to stress (Janson & Rohleder, 2017; Jentsch & Wolf, 2020; Lazarus & Folkman, 1984; Logan & Barksdale, 2008; McEwen, 1998). Individual characteristics, stressor type, and cognitive and behavioral coping strategies used to deal with stress together determine physiologic responses (including HPA axis reactivity) with possible health implications (Kemeny, 2003). Coping strategies can be further broadly divided into *problem-focused* – "the management or alteration of the person-environment relationship that is the source of stress," *emotion-focused* – "the regulation of stressful emotions," or *avoidant* - utilizing efforts to disassociate from the stressor (Folkman & Lazarus, 1980; Roth & Cohen, 1986). Strategies that are problem-focused are generally thought to be more adaptive than emotion-focused and avoidant strategies (Ben-Zur, 2009). For example, literature has shown that people who use problem-focused strategies typically have lower cortisol reactivity and more positive health outcomes than those who use other strategies (Perez-Tejada et al., 2019; Siwik et al., 2020). Understanding how young, low-income adults employ various coping strategies may contribute to a better understanding of the influence of stress on physical health. However, within this

population, little research examining these constructs exists. Therefore, guided by McEwen's (1998) Allostatic Load Model, the purpose of this study is to examine the associations among perceived stress, HCC, coping strategies, and blood pressure among young, low-income adults (see Figure 3.1).

Figure 3.1

Operational Model Guided by McEwen's Allostatic Load Model



Methods

Design

This study was a secondary analysis of baseline data from a quasi-experimental trial and a cluster randomized controlled trial. The purposes of the original trials were to examine the effectiveness of behavior change and stress management interventions on reducing stress and promoting healthy lifestyle behaviors among Head Start parent-child dyads. Head Start is a federal program for children from birth to age five from families with income below the federal poverty level (Benefits.gov, 2021).

Sample, Setting, and Recruitment of the Trials

To be included in the parent quasi-experimental and cluster randomized controlled trials, parents had to be: (a) be the primary adult caregiver [≥ 18 years old] of a Head Start child, (b) be able to read, understand, and speak English, (c) have at least weekly internet access using a smartphone, tablet, or computer, (d) be willing to use Facebook, and (e) provide written consent. A project flyer was distributed to each Head Start family who had a preschooler aged 3-5 years old in each selected classroom. Parents were instructed to review the project parental consent form via a Qualtrics survey link or a QR code in the flyer. After reviewing the online parental consent form, parents were asked to complete the project screening survey.

Based on responses to the screening survey questions, each parent was determined to be eligible or ineligible automatically via Qualtrics. Eligible and interested parents were then instructed to complete the baseline survey which included the demographic survey, PSS-10, and Brief COPE. Qualtrics was used for data collection.

Upon completion of the baseline survey, participants were contacted by the study's project manager to arrange times to collect objective data (blood pressure and hair samples). All objective data was collected at Head Start center private rooms and MSU research rooms following the project data collection protocol. Data collectors (graduate and undergraduate students) received a data collection manual and in-person training. Parents who showed up for objective data collection but had not completed the online baseline survey were asked to complete the survey prior to getting their blood pressure taken and hair samples collected. Because recruitment and data collection took place in 2021 and 2022 during the COVID-19 pandemic, data collection times and locations varied occasionally due to outbreaks within the

centers. Recruitment to data collection usually occurred from September to December in each year.

Secondary Analysis Sample

Baseline data from the parents of the trials was analyzed. For this secondary analysis, parents also had to be willing to provide hair samples and two blood pressure measurements taken five minutes apart and complete instruments measuring perceived stress and coping strategies. Pregnant women and individuals reporting taking antihypertensive medication were excluded.

Measures

Sociodemographic Characteristics

Sociodemographic data was measured through a demographic survey including age, sex, race, ethnicity, family income, education level, employment status, number of children, and marital status.

Perceived Stress

Perceived stress was measured using the 10-item Perceived Stress Scale (PSS-10) via an online Qualtrics survey. The PSS-10 is one of the most widely-used instruments to measure self-reported stress and has been used in young, low-income adults (S. Cohen & Janicki-Deverts, 2012; Lee, 2012; Ling et al., 2020; Razani et al., 2018). Participants were asked to rate items assessing how often they find their lives in general to be uncontrollable, unpredictable, and overwhelming. Items are measured on a 5-point Likert scale with responses ranging from 0 – "Never" to 4 – "Very Often." Total scores range from 0 – 40, with higher sum scores indicated higher levels of perceived stress.

In a review of the psychometric evidence of the Perceived Stress Scale, the PSS-10 has been shown to demonstrate acceptable to excellent internal consistency (Cronbach's $\alpha = 0.74$ to 0.91) and acceptable test-retest reliability (r, r_s, and ICC > 0.70; Lee, 2012). Concurrent validity has been demonstrated through relation with the negative affect subscale ($r_s = 0.46$, $p < 0.001$) and positive affect subscale ($r_s = -0.39$, $p < 0.001$) of the Positive Affect and Negative Affect Schedule (PANAS), as well as the depression ($r_s = 0.548$, $p < 0.001$) and anxiety ($r_s = 0.576$, p , 0.001) subscales of the Hospital Anxiety and Depression Scale (HADS; Ezzati et al., 2014; Maroufizadeh et al., 2018). The PSS-10 demonstrated good reliability in this study (Cronbach's $\alpha = 0.76$).

Hair Cortisol Concentration

Hair samples were analyzed by the University of Massachusetts Amherst Hormone Assay Core Laboratory and the Yale University Child Study Center Lab. Hair samples were weighed, washed with isopropanol, dried, and ground to a fine powder. They were then soaked in methanol, dried down in a Speedvac, reconstituted, and analyzed using enzyme-linked immunoassay (ELISA). The average intra- and inter-assay coefficients of variation (CVs) were 11.8% and 7.68%, respectively.

Coping Strategies

Coping strategies were assessed using the 28-item Brief COPE, a shorter version of Carver's COPE inventory (Carver, 1997; Carver et al., 1989). It addresses 14 coping strategies: a) active coping; b) acceptance; c) behavioral disengagement; d) denial; e) humor; f) planning; g) positive reframing; h) religion; i) self-blame; j) self-distraction; k) substance use; l) use of emotional support; m) use of instrumental support; and n) venting (see Table 3.1). Items are measured on a 4-point scale using a dispositional frame of reference, ranging from 1 – "I don't

usually do this at all" to 4 – "I usually do this a lot." There is no total score calculated; rather, each subscale is scored separately. A higher sum score for each subscale indicates increased use of that coping strategy (Carver, 1997). Based on prior literature, active coping, instrumental support, and planning were categorized into problem-focused coping; acceptance, emotional support, humor, positive reframing, religion, and self-blame were categorized into emotion-focused coping; and behavioral disengagement, denial, self-distraction, and substance use were categorized into avoidant coping (Carver, 1997; Carver et al., 1989; Lazarus, 1993; Parker & Endler, 1992; Solberg et al., 2021). The Brief COPE has been used in low-income populations and has shown to be reliable (Cronbach's $\alpha = 0.78 – 0.89$) and valid (Carver, 1997; Peters et al., 2020; Ruiz et al., 2015; Webb Hooper et al., 2013). In this study, the Brief COPE demonstrated good reliability in the problem-focused coping category (Cronbach's $\alpha = 0.83$), emotion-focused coping category (Cronbach's $\alpha = 0.75$), and avoidant coping category (Cronbach's $\alpha = 0.77$).

Table 3.1

Overview of Coping Strategies

Coping Strategy	Definition	Category
Active coping	The process of taking steps to attempt to eliminate or circumvent the stressor or to improve its effects.	Problem-focused
Acceptance	Acknowledgment of the reality of the stressful situation.	Emotion-focused
Behavioral disengagement	Decreasing one's effort to deal with a stressor and giving up attempts to achieve goals with which the stressor is interfering.	Avoidant
Denial	Refusal to believe that the stressor exists or attempting to act as if the stressor is not real.	Avoidant
Humor	Tendency to use humor or jokes.	Emotion-focused
Planning	Discerning how to cope with a stressor.	Problem-focused

Table 3.1 (cont'd)

Positive reframing	Altering one's way of thinking about the situation to make it seem more positive.	Emotion-focused
Religion	The tendency to turn toward religion or spirituality (through prayer, meditation, etc.).	Emotion-focused
Self-blame	Criticizing oneself for responsibility in the situation.	Emotion-focused
Self-distraction	Using alternative activities to mentally disengage from the situation.	Avoidant
Substance use	Using drugs, alcohol, or other substances.	Avoidant
Use of emotional support	Seeking moral support, understanding, or sympathy.	Emotion-focused
Use of instrumental support	Seeking advice, information, or assistance.	Problem-focused
Venting	The tendency to focus on one's distress and express those feelings.	Emotion-focused

Blood Pressure

SBP and DBP were measured using an Omron HEM-705-CP digital blood pressure monitor in private rooms by trained data collectors. This monitor has proven to be accurate and valid in measuring blood pressure (Vera-Cala et al., 2011). SBP/DBP measurements were taken twice, five minutes apart, in accordance with 2017 ACC/AHA guidelines (Whelton et al., 2018). Further instructions included 1) having participants sit quietly, without talking, in a straight-back chair with feet flat on the floor and legs uncrossed five minutes prior and during measurement; 2) ensuring participants had not smoked, had caffeinated beverages, or exercised within 30 minutes of measurement; 3) ensuring participants had emptied their bladder; 4) ensuring participants' left arms were supported on a table with upper arms at heart level; and 5) placing the bottom of the

cuff directly above the bend of the elbow, ensuring that all clothing covering this location on the arm was removed (Whelton et al., 2018). Adult-sized cuffs were used for arms with 9" – 13" circumferences, and large cuffs were used for arm circumferences measuring 13" – 17". Two readings were taken, and if there was $\geq$ 5 mmHg difference in SBP or DBP between the two readings, a third reading was taken. The average of the two closest readings was reported.

Preliminary Analysis

SPSS 28 was used for data analysis. Because hair cortisol data was skewed, log transformation was used to normalize the data. Descriptive statistics, including means, medians, standard deviations, ranges, frequencies, and percentages, were calculated to describe the participants' characteristics. Pearson's *r* was calculated to assess the bivariate relationships among model variables. Correlation coefficients of 0.10, 0.30, and 0.50 were considered small, medium, and large effect sizes, respectively (J. Cohen, 1988). To test whether variables of interest were associated with demographic characteristics, Pearson correlational analysis was conducted for continuous variables (e.g., age), independent t-tests were conducted for dichotomous variables (e.g., sex, marital status [re-coded married and not married]), and ANOVA was conducted for nominal variables (e.g., income, race, and employment status).

Path Analysis

PROCESS macro (version 4) for SPSS 28 utilizing Model 80 (serial parallel mediation) was used to conduct path analysis modeling to examine the relationships among perceived stress, coping strategies (problem-focused, emotion-focused, and avoidant), HCC, and blood pressure (SBP and DBP). SBP and DBP were analyzed in separate models as continuous variable outcomes. The bootstrap sample for this data was set to 5000, and significant mediation of a)

coping strategies on the relationship between perceived stress and hair cortisol and b) HCC on the relationship between perceived stress and blood pressure was determined by the 95% CI.

Results

Participant Characteristics

A total of 194 individuals provided baseline data for the original trials. Of these, 98 were excluded because they did not provide hair samples, 21 did not provide a blood pressure measurement, four did not provide PSS-10 or Brief COPE data, four were over the age of 39 years old, three were pregnant, and one reported being on hypertension medication. Table 3.2 shows the remaining 63 participants' characteristics on age, sex, race, ethnicity, marital status, annual family income, employment status, highest level of education, and number of children in their household. The majority of the sample fell within the same income level of $\leq$ \$19,999 per year (50.8%), while others reported higher income levels. Because poverty is not determined solely by income but also by the total number of people living in a household, families with relatively higher income but with many people living in their household still fell below the federal poverty guideline (Department of Health and Human Services, 2022).

The average PSS-10 score was 18.17 (SD = 6.30, range = 2 – 32). Prior to log transformation, the average HCC level was 7.84 pg/mg (SD = 11.976, range = 0.95 – 76.48). SBP ranged from 101 – 157 mmHg, and DBP ranged from 58 – 116 mmHg. Twenty-seven individuals (42.9%) had blood pressure measurements $\geq$ 120/80 mmHg. The average mean arterial pressure (MAP) was 92.6 mmHg (range: 56.8 – 129.5 mmHg).

Table 3.2

Sample Characteristics

	N	%	Mean (SD)
Age			29.71 (5.08)
Sex (Female)	61	96.8	
Hispanic	6	9.5	
Race			
White or Caucasian	38	60.3	
Black or African American	14	22.2	
Asian or Pacific Islander	1	1.6	
American Indian or Alaskan Native	2	3.2	
Mixed Race	7	11.1	
Other	1	1.6	
Marital Status			
Single (Never married)	32	50.8	
Married or partnered	29	46.0	
Separated, Divorced, or Widowed	2	3.2	
Annual Family Income			
$19,999 or under	32	50.8	
$20,000 - $29,999	13	20.6	
$30,000 - $49,999	16	25.4	
$50,000 or more	2	3.2	
Employment Status			
Not employed	23	36.5	
Employed part-time	17	27.0	
Employed full-time	23	36.5	
Highest Education Level			
Less than high school graduate	10	15.9	
High school graduate	20	31.7	
Some college (at least one year or specialized training)	20	31.7	
Technical school or community college degree	9	14.3	
Bachelor's degree	3	4.8	
Graduate or professional degree	1	1.6	
Number of Children			
1	12	19.0	
2	17	27.0	
3	20	31.7	
4	6	9.5	
5	5	7.9	
6	2	3.2	
9	1	1.6	

Covariates

Age demonstrated a statistically significant association with SBP ($r = 0.25$, $p = 0.047$) and a near-significant association with DBP ($r = 0.23$, $p = 0.075$). Additionally, race had a significant association with HCC ($F = 4.68$, $p = 0.023$). These variables were entered as covariates in subsequent path analysis models.

Bivariate Relationships

Table 3.3 shows the means, standard deviations, and bivariate relationships among perceived stress, problem-focused coping, emotion-focused coping, avoidant coping, HCC, SBP, and DBP. Perceived stress was positively and significantly correlated with problem-focused ($r = 0.31$, $p = 0.02$), emotion-focused ($r = 0.34$, $p = 0.01$), and avoidant coping, with the association between perceived stress and avoidant coping being the largest ($r = 0.54$, $p < 0.01$). Problem- and emotion-focused coping were largely associated with each other ($r = 0.74$, $p < 0.001$), and avoidant coping had a greater association with emotion-focused coping ($r = 0.47$, $p < 0.001$) than problem-focused coping ($r = 0.33$, $p = 0.01$). Perceived stress was negatively but not significantly associated with HCC ($r = -0.14$, $p = 0.27$). Although not statistically significant, there was a small, positive correlation between HCC and SBP ($r = 0.21$, $p = 0.10$).

Table 3.3

Bivariate Relationships among Perceived Stress, Problem-Focused Coping, Emotion-Focused Coping, Avoidant Coping, Hair Cortisol Concentration, Systolic Blood Pressure, and Diastolic Blood Pressure (N = 63)

Variable	Mean	SD	2	3	4	5	6	7
1. Perceived Stress	18.17	6.303	.306*	.338**	.540**	-.142	.148	.104
2. Problem-Focused Coping	5.016	1.466		.736**	.325**	.047	.024	-.015
3. Emotion-Focused Coping	4.243	0.956			.468**	-.129	.057	.018
4. Avoidant Coping	3.008	0.892				.182	-.009	-.093
5. Hair Cortisol Concentration	0.70	0.358					.210	.148
6. Systolic Blood Pressure	121.99	13.608						.804**
7. Diastolic Blood Pressure	77.92	11.699						

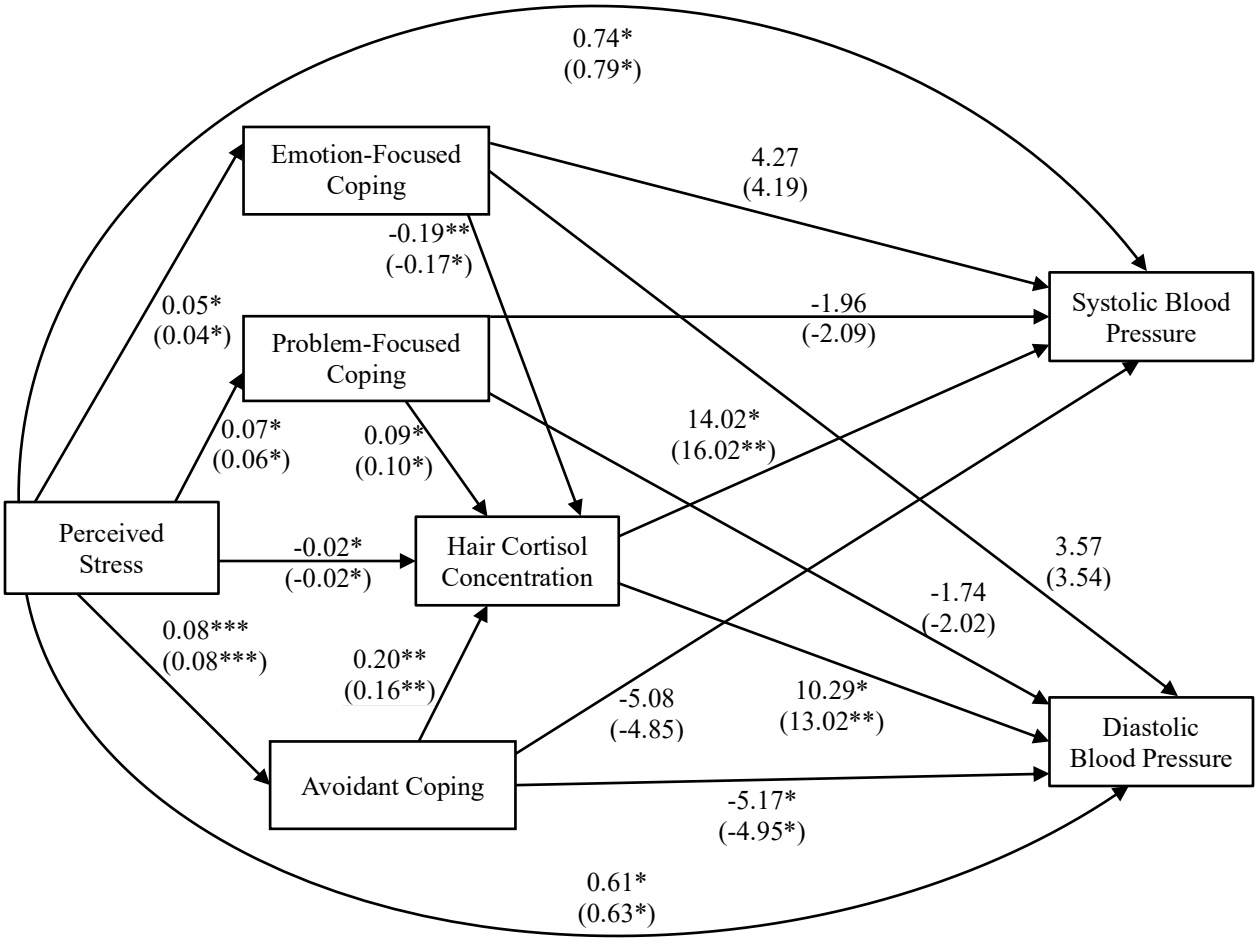
*$p < 0.05$, **$p < 0.01$

Path Analysis

Perceived stress was negatively associated with HCC (B = -0.02, p = 0.02), but had positive, direct effects on both SBP (B = 0.74, p = 0.03) and DBP (B = 0.61, p = 0.04; see Figure 3.2). HCC was also significantly and positively associated with SBP (B = 14.02, p = 0.01) and DBP (B = 10.29, p = 0.03). The path model explained about 14.4% and 12.7% of the variances in SBP and DBP, respectively. Standardized direct effects can be found in Figure 3.3.

Figure 3.2

Path Model Displaying Unstandardized Direct Effects between Variables

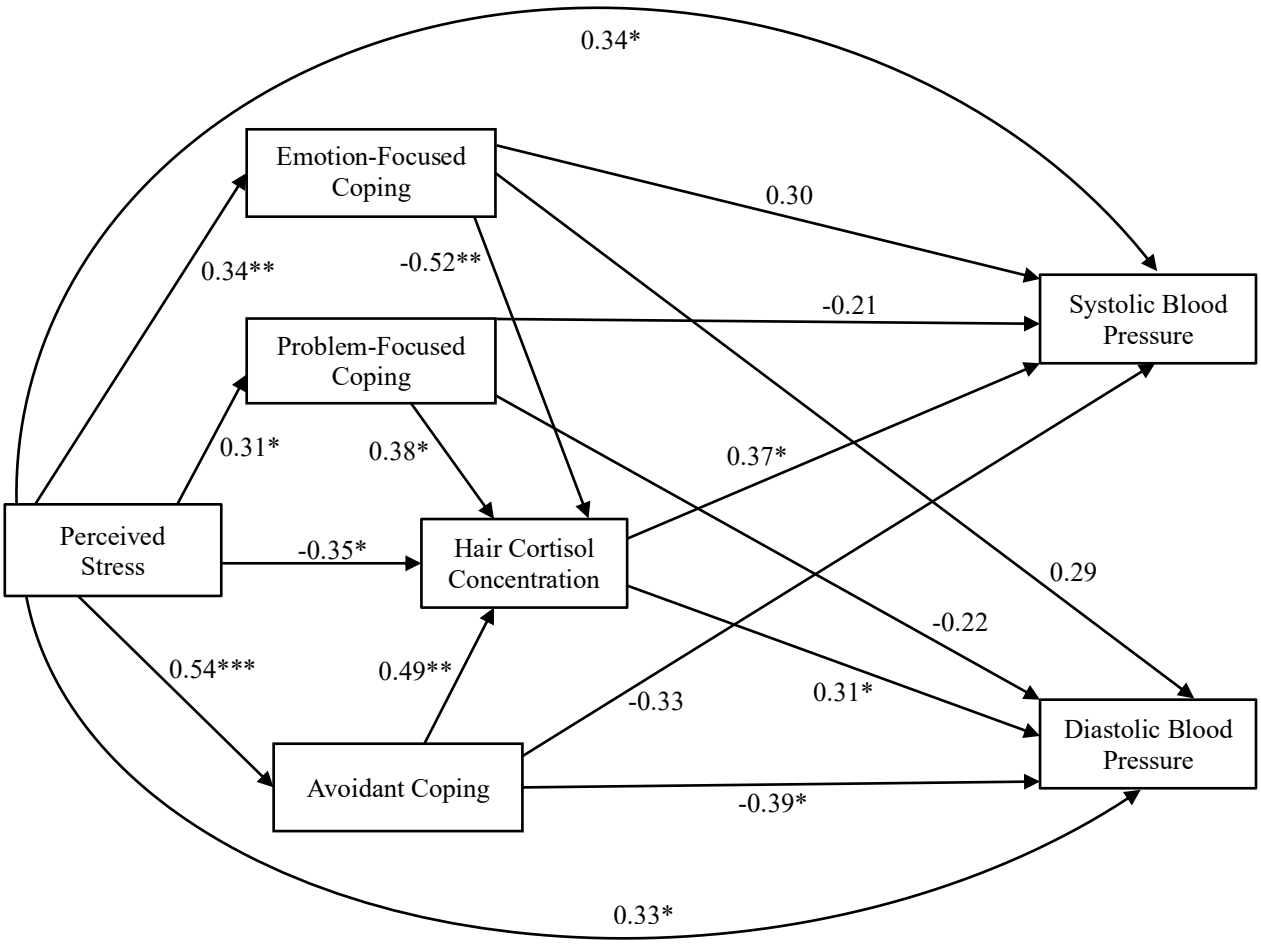


Note. Estimates = unstandardized B (estimates adjusted for age and race in parentheses). PROCESS Macro version 4 Model 80 allows for only one dependent variable; therefore, the

figure displays the model with SBP as the dependent variable and the model with DBP as the dependent variable superimposed onto one another
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 3.3

Path Model Displaying Standardized Direct Effects between Variables



*$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Emotion-Focused Coping

Perceived stress had a positive direct effect on emotion-focused coping ($B = 0.05$, $p = 0.01$). Emotion-focused coping was negatively associated with HCC ($B = -0.19$, $p = 0.01$) and positively but non-significantly related to SBP ($B = 4.27$, $p = 0.15$) and DBP ($B = 3.57$, $p = 0.17$; see Figure 3.2). There was a negative, indirect effect of perceived stress on SBP through

emotion-focused coping and HCC (B = -0.14, 95% CI: -0.309, -0.007; see Table 3.4). However, this became non-significant after adjusting for race and age (B = -0.12, 95% CI: -0.289, 0.003; see Figure 3.3). There was a negative, but non-significant effect of perceived stress on DBP through emotion-focused coping and HCC (B = -0.10, 95% CI: -0.233, 0.004; see Table 3.5).

Problem-Focused Coping

Similar to emotion-focused coping, perceived stress had a significant, positive direct effect on problem-focused coping (B = 0.07, p = 0.01). Problem-focused coping was positively related to HCC (B = 0.09, p = 0.03), and negatively but non-significantly associated with SBP (B = -1.96, p = 0.27) and DBP (B = -1.74, p = 0.26). The indirect effect of perceived stress on SBP through problem-focused coping and cortisol was statistically significant (B = 0.09, 95% CI: 0.002, 0.245), and remained significant after adjustment for age and race. In contrast, the effect of perceived stress on DBP through problem-focused coping and cortisol was not statistically significant (B = 0.07, 95% CI: -0.001, 0.193).

Avoidant Coping

As demonstrated in Figure 3.2, perceived stress was significantly associated with avoidant coping, which was positively related to HCC (B = 0.20, p = 0.002). Avoidant coping was negatively related to SBP (B = -5.08, p = 0.06) and DBP (B = -5.17, p = 0.03). There was a statistically significant indirect effect of perceived stress on SBP through avoidant coping (B = -0.39, 95% CI: -0.878, -0.007). This association became insignificant after adjusting for age and race (B = -0.38, 95% CI: -0.875, 0.002). Additionally, the indirect effects of perceived stress on both SBP and DBP through avoidant coping and HCC were significant (see Tables 3.4 and 3.5).

Table 3.4

Indirect Effects (Paths to SBP)

Effects	Standardized Estimate (β)	Unstandardized Estimate (*B*)	Boot SE	Bootstrap 95% CI
Perceived stress → SBP via problem-focused coping	-0.06	-0.14	0.16	-0.432, 0.220
Perceived stress → SBP via emotion-focused coping	0.10	0.22	0.19	-0.150, 0.621
Perceived stress → SBP via avoidant coping	-0.18	-0.39	0.22	-0.875, 0.005
Perceived stress → SBP via HCC	-0.13	-0.28	0.17	-0.661, 0.013
Perceived stress → SBP via problem-focused coping and HCC	**0.04***	**0.09***	0.06	0.002, 0.245
Perceived stress → SBP via emotion-focused coping and HCC	**-0.06***	**-0.14***	0.08	-0.309, -0.007
Perceived stress → SBP via avoidant coping and HCC	**0.10***	**0.21***	0.10	0.043, 0.427
Adjusted for Race and Age				
Perceived stress → SBP via problem-focused coping	-0.06	-0.13	0.14	-0.380, 0.196
Perceived stress → SBP via emotion-focused coping	0.09	0.19	0.16	-0.108, 0.541
Perceived stress → SBP via avoidant coping	-0.18	-0.38	0.22	-0.875, 0.002
Perceived stress → SBP via hair cortisol concentration	-0.11	-0.25	0.17	-0.617, 0.046
Perceived stress → SBP via problem-focused coping and hair cortisol concentration	**0.05***	**0.10***	0.06	0.002, 0.248
Perceived stress → SBP via emotion-focused coping and hair cortisol concentration	-0.06	-0.13	0.08	-0.289, 0.003
Perceived stress → SBP via avoidant coping and hair cortisol concentration	**0.09***	**0.20**	0.10	0.030, 0.404

Note. SBP = systolic blood pressure; HCC = hair cortisol concentration

Table 3.5

Indirect Effects (Paths to DBP)

Effects	Standardized Estimate (β)	Unstandardized Estimate (*B*)	Boot SE	Bootstrap 95% CI
Perceived stress → DBP via problem-focused coping	-0.07	-0.12	0.14	-0.368, 0.191
Perceived stress → DBP via emotion-focused coping	0.10	0.18	0.16	-0.137, 0.498
Perceived stress → DBP via avoidant coping	**-0.21***	**-0.40***	0.17	-0.780, -0.112
Perceived stress → DBP via HCC	-0.11	-0.20	0.14	-0.513, 0.009
Perceived stress → DBP via problem-focused coping and HCC	0.04	0.07	0.05	-0.002, 0.193
Perceived stress → DBP via emotion-focused coping HCC	-0.06	-0.10	0.06	-0.233, 0.004
Perceived stress → DBP via avoidant coping and HCC	**0.08***	**0.15***	0.08	0.015, 0.332
Adjusted for Race and Age				
Perceived stress → DBP via problem-focused coping	-0.07	-0.13	0.12	-0.340, 0.171
Perceived stress → DBP via emotion-focused coping	0.09	0.16	0.14	-0.108, 0.438
Perceived stress → DBP via avoidant coping	**-0.21***	**-0.39***	0.16	-0.771, -0.124
Perceived stress → DBP via HCC	-0.11	-0.20	0.14	-0.505, 0.032
Perceived stress → DBP via problem-focused coping and HCC	0.04	0.08	0.06	0.000, 0.210
Perceived stress → DBP via emotion-focused coping and HCC	-0.05	-0.10	0.06	-0.240, 0.003
Perceived stress → DBP via avoidant coping and HCC	**0.09***	**0.16***	0.08	0.018, 0.332

Note. DBP = diastolic blood pressure; HCC = hair cortisol concentration

Discussion

To our best knowledge, this study is the first to assess the relationships among perceived stress, coping strategies, hair cortisol concentration, and blood pressure among a young, low-income sample. Results showed that perceived stress was negatively related to HCC. This finding was consistent with prior studies among low-income parents (Hollenbach et al., 2019; Ling et al., 2020). Additionally, although one might expect low-income individuals to have high levels of stress, wide ranges in perceived stress scores and HCC levels suggest that some individuals may have become habituated to their environment, thus normalizing stress and obscuring links between subjective and objective measures of stress. Although not measured in this study, some individuals may have also experienced early life adversity, chronic poverty, or generational poverty, which have been linked to dysregulated stress responses and physiologic dysfunction (Dich et al., 2014; Lovallo, 2013; Nelson et al., 2020). Negative findings between perceived stress and HCC could also be due to differences in timeframe being measured; the Perceived Stress Scale captures perceived stress over the past month, while three centimeters of hair captures cumulative stress over the past three months. Future studies aimed at assessing the association between perceived stress and HCC may consider taking shorter measurements of hair (e.g., 1 cm) to reflect one month of stress exposure which would then be synchronized with the timeframe measured by the Perceived Stress Scale.

As expected, HCC was positively correlated with both SBP and DBP. This is consistent with a recent meta-analysis among various populations demonstrating positive associations of HCC with SBP, DBP, and hypertension status (Pageau et al., 2023). The current study contributes to the growing body of knowledge within this field of research since prior studies have not assessed the association between HCC and blood pressure within this low-income population.

Similarly, higher perceived stress was associated with higher SBP and DBP. This is somewhat consistent with findings from large, diverse cohort studies, which observed that those with higher stress had higher odds of having high blood pressure (Gawlik et al., 2019; Spruill et al., 2019).

Interestingly, direct associations between problem-focused coping and HCC were positive. There was also a significant indirect effect of perceived stress on SBP through problem-focused coping and HCC. This is in contrast to another study which observed an inverse relationship between problem-focused coping and salivary cortisol output among older adults (O'Donnell et al., 2008). In addition to the differences in sample characteristics and cortisol measures used between that study and the current one, it is also critical to consider the importance of context when interpreting the discrepant results. Young adults living in poverty experience unique stressors and circumstances compared to those of higher income. Although problem-focused coping strategies are often viewed as "adaptive" in a general context (Ben-Zur, 2009), they may not always be helpful for this population given the types of stressors they experience. This may be especially true when some planning and active coping efforts (e.g., budgeting) are ineffective or intrinsically stress-inducing. In other words, some stressors experienced by those with low income may not be able to be addressed directly and attempts to do so may not alleviate stress and subsequently contribute to negative health outcomes.

In contrast, emotion-focused coping was significantly and negatively related to hair cortisol concentration. There was also a negative indirect effect of perceived stress on SBP through emotion-focused coping and HCC. Prior studies in other populations measuring individual emotion-focused coping strategies have found similar associations. For example, Schnell (2020) observed that religiosity was associated with lower salivary cortisol and blood pressure reactivity in response to stress. In another study, individuals with higher levels of social

support had lower salivary cortisol levels (Rosal et al., 2004). Findings from the current study suggest that emotion-focused coping strategies may be somewhat protective for this population as far as mitigating the physiologic effects of perceived stress. Dealing with the emotional state itself, whether it be through religion, emotional support, humor, or self-blame, could provide one with the opportunity to process the situation and regulate one's emotions and decrease cortisol output over time.

Not surprisingly, use of avoidant coping strategies was positively related to HCC, and the association was the largest compared to emotion- and problem-focused strategies. This is in line with prior research that has shown that individuals who report increased use of avoidant coping strategies have higher HCC than those who use other coping strategies (Serwinski, 2017). Use of avoidant coping has also been linked to increased risk for hypertension (Batayeh et al., 2023). This data further supports the notion that ignoring a stressor may be the least adaptive means of coping and can potentially lead to negative health outcomes. Additionally, because participants in this study were mostly single, low-income, and taking care of multiple young children with limited resources, avoidant coping strategies may seem like the easiest and least challenging response to stress. However, because avoiding a stressor does nothing to address it or one's emotions surrounding it, stress persists, and may result in continued elevated cortisol output.

After adjustment for age and race, some associations between variables became non-significant, but only by a very small margin. Additionally, the effect sizes did not considerably change. However, the direct effect between HCC and SBP and DBP became notably larger after adjustment. This is likely because both HCC and blood pressure have been shown to be related to age and race. For example, Black hair types have been shown to have higher hair cortisol

concentration than White, Latinx, or mixed-race hair (Moody et al., 2022). Additionally, among young adults, hypertension prevalence is highest among Black individuals (Parcha et al., 2020).

The path model explained about 14.4% of the variances in SBP and 12.7% in DBP. There are numerous factors that affect blood pressure, including but not limited to dietary salt intake, dietary fat intake, alcohol consumption, physical activity level, and family history (World Health Organization, 2023), that were not measured in the model. However, the model was not intended to predict changes in blood pressure, so the small variances were not of concern. Rather, the primary aim was to assess the relationships between the variables within the model through interpretation of the regression coefficients.

Limitations

Findings from this study should be interpreted within the context of its limitations. First, the somewhat small, convenience sample may limit the generalizability of the results. Additionally, the cross-sectional nature of this study limits causal inference. Future research with larger samples and with longitudinal, repeated measures designs are needed to establish temporal precedence. Ecological momentary assessments (EMAs) may be particularly useful within this field of research to identify coping strategies utilized, cortisol output, and blood pressure changes acutely during stressful experiences and chronically over time (Joseph et al., 2021).

This study is also limited because the PSS-10 only measures stress in general and not in terms of specific stressors. It is important to consider that data collection occurred in 2021 and 2022, when nationwide events including the COVID-19 pandemic, inflation spikes, and social unrest were ongoing and may have contributed to this population's stress beyond their "normal" level. Future studies may inquire about specific stressors to provide context and insight into factors influencing their level of stress. Participants in this study were also not asked about recent

pregnancy, birth, or other acute trauma, which could affect their HCC (King et al., 2022; Marceau 2020). Because the timescales measured by the PSS-10 and a 3-cm hair sample are incongruent, findings on associations between the two constructs should be interpreted with caution as well, as a person's stress level can change from month to month. Additionally, the Brief COPE asks individuals how they cope with stress from a dispositional perspective; however, certain ways of coping may be specific to certain stressors, and therefore this information may not have been captured.

The 2017 ACC/AHA guidelines recommend an average of ≥ 2 readings on ≥ 2 occasions for the most accurate blood pressure measurement (Whelton et al., 2018). However, returning on a second occasion for a second measurement added an additional burden to parents participating in the original trials; therefore, measurements were taken on only one occasion and may not be reflective of an individual's typical resting blood pressure. However, multiple measurements were taken during the assessment period using a validated device and were taken following established clinical guidelines (Whelton et al., 2018).

Implications

Based on this study's findings, nurses are encouraged to ensure that patients, especially those belonging to vulnerable groups, are aware of factors such as stress that can contribute to elevated blood pressure early on in life. It is also important to regularly assess patients' stress levels as well as coping strategies typically used and educate patients on strategies that may be more adaptive. Promotion of emotion-focused coping strategies in clinical and public health settings may contribute to improved well-being within this vulnerable population.

Conclusions

Overall, findings from this study provide evidence supporting the importance of coping on the association between stress and health outcomes within a low-income population. Avoidant coping appears to be particularly problematic, and efforts to increase the use of other coping strategies appropriate for the circumstances may be effective in reducing cortisol output and subsequently lowering blood pressure. Furthermore, findings suggest that emotion-focused coping may be more beneficial to this population than problem-focused coping, likely due to the context and types of stressors experienced by young adults living in poverty. However, future work is needed to confirm these findings and measure these constructs over time to fully capture the complex associations between chronic stress, coping, and blood pressure.

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CHAPTER 4: STRESS EXPERIENCES AND COPING STRATEGIES AMONG LOW-INCOME PARENTS WITH YOUNG CHILDREN: A MIXED METHODS STUDY

Introduction

Young adults, parents, and those living in low-income households experience higher levels of stress than the average American (American Psychological Association, 2015). Consequently, those who identify with all three of these experiences are subject to the highest levels of stress due to their significant hardships related to parenting with limited finances, food insecurity, and living in unstable housing and unsafe neighborhoods (Laraia et al., 2017; Ling et al., 2019; Wadsworth, 2012). In one study among residents living in poverty in South Bronx, New York (mean age = 35 years), significant stressors involved financial concerns, housing, family health, family conflict, child safety, and employment conditions (Kaplan et al., 2013). Shonkoff (2020) reported that young, low-income Hispanic mothers' (mean age = 32.7 years) stressors involved having limited time to accomplish activities, handling child misbehavior issues, managing children's weight and food intake, and a lack of money. When left unmanaged, persistent exposure to these many stressors can contribute to adverse health consequences, including development of chronic illnesses (Guidi et al., 2021; O'Connor et al., 2021).

Being young (18 – 39 years old) and in poverty are associated with numerous life stressors affecting health and well-being (American Psychological Association, 2017; Gooding et al., 2020). Prolonged stress exposure may contribute to early development of inflammatory and cardiovascular diseases (CVD), metabolic syndrome, Type 2 diabetes mellitus (T2DM), and immune system dysregulation (O'Connor et al., 2021). Several studies have observed increases in risk for CVD development and mortality among those living in low-income households or experiencing substantial income decreases (Bombard et al., 2012; Elfassy et al., 2019; Lazzarino

et al., 2013). Therefore, it is critical to focus on stress as an important indicator of health, especially in young, low-income groups who tend to experience high levels of stress.

Despite experiencing similar poverty-related stressors, including limited income, food and job insecurity, supporting young children with truncated resources, and living in disadvantaged neighborhoods, not all young, low-income adults report similar levels of stress. According to the 10-item Perceived Stress Scale (PSS), a wide range of total scores (12-37) were observed in different young, low-income populations (Bloom et al., 2012, 2013). The national average is estimated to be 15.52-16.14 (Cohen & Janicki-Deverts, 2012), but literature has reported mean scores of 25.7 and 27.5 in Head Start parents with preschoolers (Na et al., 2021) and among young, low-income, rural women (Bloom et al., 2012), respectively. Typically, young, low-income populations report higher levels of stress than the national average, yet significant variation exists in self-reported levels of stress among these individuals. Possible explanations for the wide variations in levels of perceived stress among this population include sociodemographic characteristic differences in race, sex, relationship status, and number of children, as well as differing ideations of stress itself, perceptual differences in the level of burden of different stressors, and varied ways of coping with stress (American Psychological Association, 2017; Robins & Kliewer, 2019; Shonkoff et al., 2020). Understanding in greater depth how young, low-income adults describe their stress and ways of coping may help to inform the development of future effective tailored interventions to help this vulnerable population cope with stress.

Existing research has investigated different stressors and coping processes experienced by young, low-income adults (Bloom et al., 2013; Broussard et al., 2012; Hustedt et al., 2017). One qualitative study among 84 Early Head Start families noted that parents with a higher level

of perceived family stress reported more stressors related to parenting, economic status, and family functioning than families with a lower level of perceived stress (Hustedt et al., 2017). However, this study did not describe the coping strategies that parents used in response to their different levels of self-reported perceived stress. One mixed-methods study among 24 young women with low-income identified both participants' major stressors (financial stress, poor housing conditions, unreliable transportation, and job insecurity and instability) and coping strategies (substance use, religion, self-distraction, avoidance, and having a resilient attitude toward their situation; Bloom et al., 2012), but it failed to compare the differences according to women's variant levels of perceived stress. There have been no studies to the authors' knowledge that describe young, low-income parents' conceptualizations of stress and how they cope with it, while comparing those findings between individuals reporting low stress levels with those reporting high stress levels.

How an individual conceptualizes stress and perceives it as affecting their health may also influence how they cope with stress. Some participants may understand the effects of stress on their health, mainly through engagement in unhealthy behaviors (e.g., smoking and alcohol use), but others may view these behaviors as necessary for managing stress (Kaplan et al., 2013). In response to these stressors, individuals can initiate different coping activities varying from pursuing hobbies, walking their dog, and exercising, to using alcohol and tobacco, unhealthy eating, violence and aggression, and withdrawing (Kaplan et al., 2013). This body of evidence provides some foundation for understanding the predominant stressors and means of coping with stress experienced by young, low-income adults and how they perceive stress as affecting their health. However, it is critical to understand how this information may vary by their self-reported stress levels to distinguish the qualities of those with lower stress from higher stress.

Understanding how this population describes their stress and coping experience and the impact of stress on their health may help to explain variations in perceived stress levels. Additionally, identifying the various coping strategies applied in response to different levels of perceived stress can help inform tailored intervention development for managing stress according to participants' perceived stress levels. Therefore, the purpose of this study was to describe and compare stress conceptualizations of young, low-income adults with low- versus high-stress levels, how they cope with stress, and how they perceive stress as impacting their health. This study was guided by McEwen's Allostatic Load Model (McEwen, 1998), which describes how differences in the way individuals perceive and interpret stressful situations can impact the way they cope and influence subsequent effects on health.

Methods

Design

This a qualitatively driven explanatory sequential mixed methods study employing interpretive phenomenological analysis (IPA). IPA is a qualitative method of inquiry aimed at exploring individuals' lived experiences and how they make sense of them (Smith et al., 2009).

Sample and Setting

To be eligible for this study, participants had to (a) be the primary adult caregiver (18 - 39 years old) of a child between the ages of 3-5 years old, (b) have an annual income that falls within the 2022 federal poverty guideline (Department of Health and Human Services, 2022), (c) be able to read, understand, and speak English, and (d) have access to a telephone.

Recruitment and Data Collection

Participants were recruited using ResearchMatch (researchmatch.org), a free and secure online research study-match tool funded by the National Institutes of Health (NIH) Clinical and Translational Science Award (CTSA) program.

Phase 1

Eligible individuals were emailed an institutional review board (IRB)-approved recruitment message through the ResearchMatch system, at which point they could choose to allow their contact information to be shared or not. Individuals who voluntarily released their contact information received a link to a Qualtrics survey within the recruitment message containing consent information, a demographic survey, and the 10-item Perceived Stress Scale (PSS-10).

Demographic Survey. The demographic survey included questions about age, sex, race, ethnicity, household income, education level, employment status, household composition, number of children, pregnancy status, marital status, and state of residence (see Appendix A). Household income, household composition, number of children, and state of residence were used to determine poverty status (Department of Health and Human Services, 2022).

10-item Perceived Stress Scale (PSS-10). The PSS-10 was used to measure self-reported stress. The PSS-10 is a classic stress assessment instrument measuring general stress (rather than specific stressors) with good reliability and validity (Cronbach's $\alpha > 0.70$; Lee, 2012). Participants were asked to rate items assessing how often they find their lives to be uncontrollable, unpredictable, and overwhelming over the last month. Examples of questions from the scale include, "In the last month, how often have you been upset because of something that happened unexpectedly?" and, "In the last month, how often have you felt that you were unable to control the important things in your life?" Items are measured on a 5-point Likert scale with responses ranging from 0 – "Never" to 4 – "Very Often." A higher sum score indicates a higher level of perceived stress (Cohen & Janicki-Deverts, 2012; See Appendix B).

Phase 2

A total of 63,284 accounts were contacted through ResearchMatch, and 942 individuals responded to the survey. Individuals were excluded for various reasons, including: (a) having an annual family income above the federal poverty level (n = 354), (b) providing duplicate responses (n = 352), (c) providing non-credible responses (n = 68), (c) submitting incomplete surveys (n = 61), (d) reporting having no children (n = 41), (e) reporting having children outside the 3 – 5 year old age range (n = 19), (f) reporting being older than 39 years old (n = 8), and (g) not providing contact information (n = 5).

The 34 remaining participants were contacted according to their preferred contact method and invited to complete one-on-one interviews via telephone. Seventeen people were considered non-responders after three contact attempts with no response. The remaining 17 individuals were successfully interviewed and divided into "high" and "low" stress groups based on the median PSS-10 score of the group. Interviews were conducted from May to September 2022.

Semi-Structured Interview. A semi-structured interview guide was developed and used to collect qualitative data (see Appendix C). Semi-structured interviews are a flexible and versatile qualitative data collection tool. They allow for reciprocity between the interviewer and participant, as the participant can shape the direction of the interview and introduce new ideas throughout the conversation (Smith, 1995). All interviews were conducted by L. P., a BSN-prepared doctoral student. The interview consisted of an explanation of the purpose of the study, a statement of informed consent, and open-ended questions to explore individuals' conceptualization and experiences of stress, ways of coping, and their perceptions of the effects of stress on health. Questions inquired about how individuals define stress, describe the stressors in their lives, what they typically do in response to stress, and how they perceive stress impacting

their health. Probing questions were used to elicit more detailed and in-depth responses. Interviews were conducted via telephone, audio recorded, and transcribed verbatim using a professional transcription service. Recruitment and interviews continued until data collection did not result in new codes or themes (Guest et al., 2020).

Data Analysis

Descriptive statistics, including means, medians, standard deviations, ranges, frequencies, and percentages, were calculated to describe the study sample and PSS-10 scores. Atlas.ti version 9 was used for qualitative data storage management and analysis. Data was analyzed following IPA guidelines (Smith et al., 2009). Smith et al. (2009) notes that IPA guidelines are not meant to be prescriptive, but flexible steps with room for adaptation.

The first author (L. P.) engaged in a close, analytic reading of participant quotes. Transcripts were read carefully, multiple times while memos were recorded. Analytic memos included exploratory notes and initial interpretations of participant quotes. Quotes within transcripts were analyzed and coded inductively, using key words and phrases to capture the essential quality of the text. Inductive coding allows the investigator to be open to what the participant wants to say, rather than attempting to force-fit data into pre-existing codes (Miles et al., 2020). Following an idiographic approach, transcripts were looked at in detail one at a time before moving on to others (Smith, 1995). After all transcripts had been analyzed and a preliminary list of codes were developed, transcripts were then deductively coded according to established theoretical constructs of stress and coping (Carver, 1997; Lazarus & Folkman, 1984; McEwen, 1998). Codes were then grouped together used in combination with memos to develop initial themes (Smith et al., 2009). Visual network diagramming in Atlas.ti was used to aid in

determining themes. Lastly, themes were organized into categories based on stress and coping theoretical constructs.

Rigor and Reflexivity

This study was carried out according to quality and validity criteria described by Yardley (2000). Coherence between the study's research question and IPA methods were evaluated prior to data collection. Sensitivity to context was demonstrated through thorough reading and understanding of IPA literature, close attention to the recruitment and interview processes, and consideration of the investigator-participant relationship. To ensure commitment and methodological rigor, authors L. P. and E. S. met every two weeks to discuss each stage of the analysis. During meetings, L. P. and E. S. discussed emerging codes and themes using visual models and analytic memos. To ensure transparency, L. P. used reflexive memos to acknowledge her personal bias and experiences as a female, registered nurse, and doctoral student in effort to focus primarily on the data (Jootun et al., 2009). Participants did not know the researcher prior to meeting but were aware of the purpose of the study.

Results

Seventeen participants were included in this study, and all were female (see Table 4.1 for pseudonym information). Over half of the total sample was Caucasian (58.8%) and one participant identified as Hispanic (5.9%). Approximately 35.3% were single (never married; n = 6), most had a high school diploma or equivalent (n = 11, 64.7%), and over half of the women lived in the southern United States (n = 9, 52.9%). Most participants (n = 9, 52.9%) reported an annual family income below $20,000, eight (47.1%) did not work, and seven (42.2%) had four or more children (see Table 4.2).

Based on the median PSS-10 score of the sample, participants in the low- and high-stress groups had scores ranging from 2-24 (mean = 16.8) and 25-39 (mean = 29.6), respectively. In this study, the scale demonstrated very good reliability (Cronbach's $\alpha = 0.94$). The average duration of telephone interviews was 31 minutes (range: 15 – 57 minutes).

Table 4.1

Participant Pseudonyms

Pseudonym	Age	PSS-10 score	Group
Asha	26	24	Low
Danielle	39	20	Low
Emily	32	2	Low
Isabel	26	10	Low
Jasmine	36	19	Low
Lindsey	39	18	Low
Rachel	29	21	Low
Simone	27	20	Low
Bethany	33	32	High
Chelsea	30	31	High
Georgia	31	25	High
Hannah	24	29	High
Kate	32	30	High
Maya	33	39	High
Nadia	34	25	High
Tyra	28	26	High
Zoe	36	27	High

Table 4.2

Sociodemographic Characteristics

	Total (n = 17)		High-Stress Group (n = 9)		Low-Stress Group (n = 8)	
Variable	**Mean ± SD**					
PSS-10 Score	23.4 ± 8.6		29.3 ± 4.4		16.8 ± 7.2	
Age (years)	31.4 ± 4.6		31.2 ± 3.6		31.6 ± 5.7	
	n	**%**	**n**	**%**	**n**	**%**
Sex (Female)	17	100	9	100	8	100
Hispanic	1	5.9	0	0	1	0
Race						
African American	5	29.4	3	33.3	2	25
Asian	1	5.9	0	0	1	12.5
Caucasian	10	58.8	5	55.6	5	62.5
Mixed Race	1	5.9	1	11.1	0	0
Marital Status						
Single (Never Married)	6	35.3	3	33.3	3	37.5
Married	5	29.4	3	33.3	2	25
In a Domestic Partnership	3	17.6	1	11.1	2	25
Divorced	3	17.6	2	22.2	1	12.5
Annual Family Income						
Less than $9,999	1	5.9	1	11.1	0	0
$10,000 - $14,999	5	29.4	1	11.1	4	50
$15,000 - $19,999	3	17.6	1	11.1	2	25
$20,000 - $24,999	5	29.4	5	55.6	0	0
$25,000 - $39,999	3	17.6	1	11.1	2	25
Employment Status						
Unemployed	3	17.6	2	22.2	1	12.5
Disabled	1	5.9	0	0	1	12.5
Homemaker	4	23.5	2	22.2	2	25
Student	2	11.8	1	11.1	1	12.5
Self-Employed	1	5.9	0	0	1	12.5
Employed Part-Time	2	11.8	1	11.1	1	12.5
Employed Full-Time	4	23.5	3	33.3	1	12.5
Education Level						
High School Diploma or Equivalent (e.g., GED)	11	64.7	5	55.6	6	75
Bachelor's Degree	4	23.5	4	44.4	0	0
Master's Degree	2	11.8	0	0	2	25
Number of Children						
1	4	23.5	2	22.2	2	25
2	4	23.5	2	22.2	2	25
3	2	11.8	1	11.1	1	12.5
4	6	35.3	4	44.4	2	25

Table 4.2 (cont'd)

More than 4	1	5.9	0	0	1	12.5
U.S. Region						
Midwest	4	23.5	3	33.3	1	12.5
Northeast	2	11.8	1	11.1	1	12.5
South	9	52.9	5	55.6	4	50
West	2	11.8	0	0	2	25

Stress Conceptualization and Context

The primary conceptualization among all participants was that stress was an unpleasant state characterized by mental strain and negative emotions in response to a stressor. The most common stressors across both low- and high-stress groups were financial strain and pressure of raising their children. Participants in the high-stress group identified additional stressors that were not as prevalent in the low-stress group, including children's difficult behavior, job dissatisfaction, and transportation barriers due to long travel distance and lack of vehicles. A list of stressors with representative quotes can be found in Table 4.1A in Appendix D.

Additionally, participants across both groups listed a variety of physical manifestations in response to stress, including shortness of breath, stomach discomfort, headaches, and restlessness. Differences between groups included feeling flushed or hot in the low-stress group and tension and a rapid heart rate in the high-stress group. See Table 4.2A in Appendix E for a list of physical manifestations with representative quotes.

Mental Strain

Mental strain was identified as an important part of how this group of low-income parents with young children conceptualized stress. Although both the low- and high-stress groups described experiences associated with mental strain, they were articulated differently by both groups.

Low-Stress Group Mental Strain: Perseverative Cognition – "I can't stop thinking about it"

The theme under mental strain that emerged among participants in the low-stress group was that of perseverative cognition, or "the repeated or chronic activation of the cognitive representation of stress-related content" (Brosschot et al., 2005). This was characterized by continuous racing and repetitive thoughts. Asha described questions running through her mind in stressful situations:

> *"I keep replaying the situation again and again, in my mind, like breaking it down. "What did I do wrong? What did I say?" Or if I talk to the person again, what would I say to them?"* (Asha, Low-Stress Group)

Similar to how Asha described replaying situations "again and again," Rachel echoed this sentiment, expressing a lack of control over her thoughts:

> *"When I start thinking about it constantly, and I can't stop thinking about it like every second, every day, it starts to be stressful when I can't think...stop thinking about that one situation or whatever's going on."* (Rachel, Low-Stress Group)

Like Asha, Rachel expressed struggling with pervasive thoughts. Not only did Rachel describe thinking repetitively about the stressor, but she also stated that constantly thinking about a challenging situation augmented her stress. She could not let go of thoughts easily, and their persistent nature caused her mental distress. For some individuals, the strain of having a cluttered mind created barriers to improving their situation. Jasmine described how being overwhelmed with stressful thoughts was a hindrance to her:

> *"Like, with this on my mind, if I didn't have all this stuff going on, I could be focused on more positive things, things that benefit me, that help me. Right now, I can't clear my mind because I have negative things on my mind. That's what's overtaking everything."* (Jasmine, Low-Stress Group)

The word "overtaking" suggests a level of power that her thoughts possessed. The influence extended beyond Jasmine's mind and into other aspects of her life, the consequences of which involved keeping her from putting energy toward bettering her life.

High-Stress Group Mental Strain: Brain Fog – "I can't think clear"

In contrast to the low-stress group, individuals in the high-stress group expressed trouble focusing, irrational decision-making, and difficulty with forming thoughts altogether. Nadia illustrated how she perceives thoughts in her mind when under stress:

> "*It's almost as if it was like bugs skittering across water, like it just...thoughts, logical thoughts, just skitter across. And usually, I fixate on a word or a feeling. […] But as far as thoughts, I wouldn't say there's really anything thoughtful that happens when I'm stressed."* (Nadia, High-Stress Group)

For Nadia, thoughts are fleeting, seemingly coming as quickly as they go. This is in contrast to the ruminative nature of thinking described by the low-stress group. She also acknowledged that she was unable to think logically when feeling stressed. This may lead to a feeling of incompetence or uselessness adding to their mental strain, as described by Bethany:

> *"So, when I get stressed, […] I can't think clear. My head is just foggy. I make quick, irrational decisions because I'm just so stressed. I'm just like, you know, screw it, you know? […] Stress tends to make me feel incompetent. Like I, it makes me feel…like I get so stressed out, I get so worked up that I'm just not good for anybody or anything. You know what I mean? Like, I can't, I can't think, I can't focus when I'm stressed out."* (Bethany, High-Stress Group)

Negative Emotions

In addition to experiencing a mental strain associated with stress, participants in both groups also expressed feeling negative emotions when under stress. Both groups described feelings of despondence. Additionally, in the low-stress group, participants discussed angry emotions, and those in the high-stress group expressed feelings of anxiety.

Negative Emotions Across Both Groups*: *Despondence – "I feel sad, hopeless"

Despondent feelings were experienced equally and with similar intensity across groups, and often associated with being overwhelmed and sometimes thoughts of self-harm.

> *"When I'm stressed out? I'm normally sad. There are times where I've been like thinking about suicide when I get really, really, really overwhelmed I feel like sometimes I feel like*

> *my kids are better off without me. Sometimes it can get really, really deep. Like it's no hope. So, I feel sad, hopeless."* (Georgia, High-Stress Group)

Georgia noted that she was usually sad when stressed, indicating that this was a familiar emotion for her. She also described feelings of overwhelm, hopelessness, and thoughts of suicide. For Georgia, her most severe stressor was the idea of failing her children and thus feels as if they would be better off without her. She mentioned several times throughout her transcript that she lives in a "constant state of stress," which feeds her dark thoughts. Distressing feelings were not exclusive to women in the high-stress group, as depicted by Jasmine:

> *"Stress is draining. It empties me I just don't have like any energy or fight for anything. I just don't, I just feel drained. I feel like it's the end and I'm okay with it. I'm just okay. […] I just try a lot. I try hard, so hard, and I'm just not getting anywhere. […] And he doesn't want to be bothered with his daughter and what I go through. And then I start having suicidal thoughts. But good thing I got my daughter to balance me out. But then she'd be looking at me worried because she could understand something's going on. Like something not right. 'You're not always like this. You're not always crying. Mama that's not you.' She'll be like, 'why are you crying?' It's just a toxic relationship and I have my daughter watching it go on and it's nobody's fault but mine."* (Jasmine, Low-Stress Group)

The stress of an abusive ex-partner, being unemployed, and being a single parent to two children coalesced to leave Jasmine feeling empty, hopeless, and accepting of the feeling that "it's the end." However, her nine-year-old daughter was a source of strength and helps to offset these feelings. Still, she felt guilt for exposing her to a dysfunctional situation and being reliant on her, likely building upon her existing stress. Maya also identified her children as a source of strength when feeling sad and overwhelmed by stress. Additionally, she echoed other individuals' thoughts about death:

> *"Like, me wishing that I'd just die or something, or something bad would just happen to me. Where I ain't gotta worry about, you know, like dealing with everything. […] Or sometimes I think about my kids, and I be like, well, they don't have anybody, so, I need to stick around for them."* (Maya, High-Stress Group)

The ambiguity in "wishing that I'd just die or something" suggested a more apathetic attitude toward her current situation compared to Jasmine and Georgia. She was seemingly indifferent towards what happens to her yet still wishes something would, with the notable difference of not mentioning self-harm. Like Jasmine, she viewed her children as a reason to persevere.

In sum, both groups experienced despondent feelings. This included feelings of sadness, depression, and hopelessness. However, there were differences in emotions experienced by each group, including anger and anxiety.

Low-Stress Group Negative Emotions: Anger – "It just explodes"

Feelings of anger and rage were expressed much more frequently in the low-stress group compared to the high-stress group. For Lindsey, she voiced feeling angry and its consequences regularly in response to stress, citing her upbringing as having influence over her current reactions:

> *"Day to day, usually, if I'm stressed, I lash out. Yell, get mad, kick stuff, hit stuff, not people, just slam stuff around a little bit. And I know that's bad. And I grew up in a house where there were a lot of outbursts and people did hit people and people did throw things at each other and that kind of thing. And I try not to, but that's the way, because it's how I grew up, that it most of the time comes out. And I've tried different things. I've tried like a "No Yelling Challenge" it was called or...but unless I'm being really intentional about it, it's...yeah. It just explodes."* (Lindsey, Low-Stress Group)

Lindsey's clarification of "not people" when describing how she hit and kicked things as part of her emotional reaction demonstrates awareness of what she deemed acceptable behavior versus not. She was raised in a violent environment, but it was important that she condemned that behavior and clarified that, for her, that is not something she did. Her reference to needing to be intentional about her behavior also suggested difficulty with emotional self-regulation. Lindsey expressed awareness that it is "bad" to thrash around when angry; however, she struggled to

control it, resulting in explosions. Like Lindsey, Jasmine also responded to stress in a volatile manner:

> *"When I'm stressed, I fuss a lot. I scream and I holler. […] And I as I feel it coming on, that's part of it, the heat. I start warming up in my chest and as soon as I get hot enough, my chest is just soaking wet. Screamin' and hollerin'."* (Jasmine, Low-Stress Group)

Jasmine articulated an eruptive reaction to stress, beginning with yelling and agitation. A warm sensation developed in her chest, continuing to build until she became drenched from emotional sweating. This description demonstrated an inability to assuage her reaction as anger took over, similar to Lindsey's account.

High-Stress Group Negative Emotions: Anxiety – "Overwhelming feeling of doom"

Descriptions of anxiety and panic arose primarily amongst individuals in the high-stress group. When asked about thoughts that come to mind when experiencing stress, Chelsea described feelings rooted in anxiety:

> *"I feel like I'm dying. That's about it. Like if I'm like having a panic attack, I feel like that, like I can't think of anything. But really, it's just in general, like just doom kind of feeling, like an overwhelming feeling of doom, just like everything bad is gonna happen. So, anything bad that can happen is gonna happen."* (Chelsea, High-Stress Group)

In this excerpt, Chelsea stated, "I can't think of anything," reflecting to the earlier theme of "brain fog" in the high-stress group. However, as she continued, she described herself catastrophizing. Chelsea closely related stress to panic and anxiety, suggesting that she experienced increased severity or even chronicity of stress. Similar to Chelsea, Kate articulated feelings of panic when under stress, especially when things did not go to plan:

> *"And I tend to just kind of panic because it's not what I had intended or planned. I don't really know how to explain that better if that makes sense. I do know that, you know, I get very anxious because of things that go unplanned. And, and so the anxiety in itself can cause some stress 'cause it's like I'm trapped in my thoughts, if that makes sense."* (Kate, High-Stress Group)

Interestingly, Kate noted that "anxiety in itself can cause some stress," suggesting that she conceptualized anxiety as an antecedent to stress. Because stress and anxiety have a dynamic relationship (Bystritsky & Kronemyer, 2014), it is logical that individuals may view one as influencing the other and describing them as similar concepts.

In summary, both groups associated stress with several types of negative emotions. Participants in both groups experienced despondent feelings, such as sadness and hopelessness, about equally. Additionally, those in the low-stress group expressed feelings of anger, while women with high stress levels described more anxious emotions.

C**oping**

Coping strategies, identified via inductive analysis, were then grouped into three theoretically based, deductively created categories: emotion-focused, problem-focused, and avoidant coping (Carver et al., 1989; Lazarus & Folkman, 1984; Roth & Cohen, 1986). Emotion-focused coping strategies involve the regulation of stressful emotions, problem-focused coping involves managing or modifying the stressor, and avoidant coping involves utilizing efforts to disassociate from the stressor (Carver et al., 1989; Lazarus & Folkman, 1984; Roth & Cohen, 1986).

Emotion-Focused Coping Across Both Groups: Acceptance – "Accept the situation for what it is" and Positive Reframing – "It's gonna get better"

Individuals in both the low- and high-stress reported using emotion-focused coping strategies, including in the forms of acceptance (acknowledgment of the reality of a stressful situation) and positive reframing (adjusting one's thinking to make a situation seem more positive; Carver, 1997).

Acceptance. Although difficult for many participants, acceptance was a common coping strategy used across both groups.

> *"Sometimes I just say that I have to accept the situation for what it is. I try to say that most of the times, sometimes it's not that easy. Sometimes I just cry. It's a lot of different things that I kinda…breathe, tell myself to breathe, I can get through this, stuff like that. […] I think with time I'm finding acceptance with my stress level being so high. I'm just finding ways to cope with it versus lashing out at people that I don't really need to. So, I'm thinking about it before I lash out or thinking about it before I say something that may hurt another person because my stress level is so high."* (Georgia, High-Stress Group)

The stress of raising her four children and being financially unstable weighed heavily on Georgia. However, she saw acceptance as a preferred option to getting angry and lashing out at others when stressed. Her tone implied empathy for others, as she viewed anger as unnecessary and harmful to others. This suggested that her way of coping with stress may have been driven by external motivators, specifically concern for the impact of her behavior on her children and other people. Rachel also described accepting her stress as an alternative option:

> *"I thought maybe I could control my level of stress, but I realized that I just, I couldn't do it, it just was something that overcame me. And while there was things that I thought I could do to manage that stress, while there was things that I could do to kind of prevent stress before it came on, there was nothing I could do to permanently eliminate stress. And I was like…I couldn't just be like, "Oh, my life is completely stress-free now." And I realized that it was just always gonna be some level of stress. So my perception changed at that point because I almost had to like embrace it in a weird way, embrace it so that I could learn how to deal with it better and learn how to handle it better."* (Rachel, Low-Stress Group)

For Rachel, acceptance was described as a last resort because she realized there was nothing she could do to permanently eliminate all her stress (referring to the stress of finances and being a single parent to two children). However, she felt that "embracing" it would allow her to learn better ways to cope. In this way, acceptance was a positive way of coping for her, as it was one of the first steps to allowing her to find other adaptive strategies for handling her stress.

Positive Reframing. In addition to acceptance, several participants reported that they tried to think more positively about stressful situations to cope with them.

> *"Like I'm able to either see the silver lining or, you know, 'cause I can, I can think outside the box, you know, I try to think of it as, okay, 'Well what is this problem or what is this thing trying to teach me?' You know? And sometimes I try to, I tell myself, 'Well, maybe it's trying to teach me patience, or maybe it's trying to teach me being more loving or kind or forgiving or this, that, or the other.' You know, I, I, I just try to think, I try to see what the message is, the underlying message or 'What can I learn from this?'"* (Danielle, Low-Stress Group)

Danielle described herself as trying to find lessons in stressful situations and asking herself questions to think more positively about the situation. She taught herself to see the bright side of things and used that to adjust her way of thinking about the stress in her life, including her relationship with her incarcerated ex-partner, financial debt, addiction recovery, and the pressure of being a positive role model for her four children. Like Danielle, Hannah also noted trying to think positively. Hannah acknowledged that her biggest stressor is the stress of "invasive or intrusive thoughts," particularly about her two children and constant worry over them and their safety. She described how she used positive reframing to alter her cognitions to combat her negative thoughts:

> *"Just a lot of positive manifestations. Just constantly, like, 'That's not gonna happen. He's [her son's] totally fine,' or 'It's totally fine, or 'All you have to do is this,' and I'll repeat it over and over and over again. Just the more you speak positively, the more positivity you'll bring in based on, like, your own emotional reaction to positive thoughts."* (Hannah, High-Stress Group)

Her use of the words "constantly" and "over and over and over again" indicated that her stress was persistent, and positive reframing is something Hannah had to do continually to mitigate her stress. She justified using this strategy with her statement about how she believed speaking positively attracts positivity.

Low-Stress Group Emotion-Focused Coping: Use of Emotional Support – "He helps me calm down" and Religion – "God is always there"

Participants in the low-stress group tended to use emotional support (seeking moral support, understanding, or sympathy) and religion (turning to faith or spirituality; Carver, 1997) more than those in the high-stress group.

Low-Stress Group Emotion-Focused Coping: Use of Emotional Support. Participants in the low-stress group reported seeking emotional support, especially from family, friends, and their partners. Isabel spoke about the support she received from her aunt:

> *"Sometimes just being so stressed and like I...one time I called my aunt and just told her what was going on. I don't really open up or reach out to people. And doing that really helped because she came from a very understanding point of view and she made me feel better and helped me just calm down and not cry and be so emotional. And I think that was a good way to handle my stress just actually reaching out to someone instead of just carrying it by myself and letting it affect me so much."* (Isabel, Low-Stress Group)

Although Isabel mentioned that she does not typically open up to others, she realized that this instance of talking on the phone with her aunt was beneficial to her. Feeling understood and getting help to calm down lifted a weight off her. Similarly, Emily found herself reaching out to others for emotional support, including God, her husband, and friends:

> *"So, God is good for relationships when I can't talk to anybody else. My husband is great when I need to talk about my kids or work or pretty much anything. My friends are good when I just need a light-hearted, someone that can resonate with me a little bit more…or just get my mind in a different place."* (Emily, Low-Stress Group)

Emily noted under which circumstances she turned to various sources of support, based on what she needed. Her words indicated that she was aware of the level and type of support she could get from her husband, friends, and God, and how they would help her cope with her stress.

Low-Stress Group Emotion-Focused Coping: Religion. Participants who turned to religion tended to have lower levels of perceived stress than higher levels of stress. This was manifested in the form of prayer and talking to God.

> *"And I guess really just kinda sometimes having a higher power is a support for me because sometimes if it gets really bad, I just kinda sit down and I just say out loud, 'Can you please,' like talking to God. I just say, 'Can you please just help me get past this.' Sometimes I just...I don't know what else to do, I don't know where else to turn. So sometimes I'll just say that and it makes me feel better, and I just kind of hope that maybe the feeling kind of washes over me where it's like I feel just a little bit better and it just like 'Okay, I gotta let this go. Can you please just help me get through this or please just help me calm down and just stop stressing.'"* (Rachel, Low-Stress Group)

Rachel described herself imploring with God to provide her with guidance, support, and peace when her stress was at its highest. This provided her with a sense of calm and feeling like she was able to overcome her adversity. Like Rachel, Danielle turned to her faith to help alleviate her stress:

> *"Oftentimes the best, the best thing I can do is to walk away, go to a meeting, listen to some of my worship music, pray, journal. When I say that, I pray like, not only is it like in my head or vocally, not, not vocally really, like, it's just kind of like an inside prayer or internal prayer. But my journaling is like, those are like my prayers to Him. And then when I feel like I'm not in the solution and I'm in the problem, you know, like I call out to Him and I feel, you know, pain shared, is pain lessened."* (Danielle, Low-Stress Group)

Through listening to worship music and praying, she felt a burden lifted – "pain shared is pain lessened." This was cathartic for her, allowing her to release her stressful thoughts and ease feelings of distress.

Problem-Focused Coping Across Both Groups: Instrumental Support – "She always gives the best advice"

Both groups reported utilizing instrumental support (seeking information, assistance, or advice from others; Carver, 1997), a problem-focused coping strategy.

Use of Instrumental Support. Use of instrumental support was highly prevalent among both groups. Participants reported receiving support from their family, friends, current partners, and ex-partners in the forms of advice and tangible support. Georgia expressed how instrumental support helped her handle her stressors:

> *"I mean, my kid's dad is pretty much amazing. He does literally anything I ask him to do. But he's only one person as well. And I feel guilty at times where I have him doing basically so much to a point where I'll be like, 'Thank you but that's - it is a lot,' because my oldest two children is not by him, but he still step in. And if I need him to take 'em to school, he do it, whatever I ask him to do. So, he's amazing. But he's only one person. It's only so much he can do."* (Georgia, High-Stress Group)

Georgia's ex-partner and father of one of her children was a great source of instrumental support for her. He assisted with whatever she needed which alleviated much of her stress. However, she stated that she felt some guilt receiving the amount of help that he provided, and although very grateful, she acknowledged that no individual could relieve her of all her stress. Isabel also described receiving valuable support, but from her mother:

> *"Definitely like my mom, she is…she lives like 30 minutes away and sometimes to be able to just go to her house and not really have to worry about making dinner or cleaning up or even keeping an eye on my daughter 24/7. It is a huge stress relief to be able to go and just...it's like a mini vacation for a day or two. I can just go and relax and recharge and stuff. So that's a really great way that I deal with my stress. Sometimes I'll go there maybe once a month. And she has a yard too, and yeah, it's just wonderful."* (Isabel, Low-Stress Group)

Isabel's mother provided an escape to which her and her children could retreat and reenergize. When she was there, she was free of responsibilities of everyday life, providing a temporary relief and allowing her to relax.

In contrast to Georgia and Isabel, Kate sought instrumental support in the form of guidance:

> *"Probably my best friend. So, she, she is very good at listening and then she has no problem telling me when I'm wrong, which I need to hear sometimes […] So she's very, she's very good at listening, but then she's also very good at solving things. So usually, she's the first person I call."* (Kate, High-Stress Group)

Kate identified her best friend as someone she could talk to freely and receive welcomed advice. She relied on her friend to help her deal with her stress in the form of helping her find ways to address and deal with problems.

Low-Stress Group Problem-Focused Coping: Active Coping – "Problem, find a solution, solve it"

Notably, low-stress individuals articulated using active coping (taking steps in attempt to circumvent, eliminate, or improve the situation; Carver, 1997) more than the high-stress group. As described by Simone:

> *"I am a problem solver, so I don't want to go through all the extra stuff. Problem, find a solution, solve it. My first thing is just to try to find a solution and tell myself that I can work it out."* (Simone, Low-Stress Group)

Simone stated that finding a solution to her problem was the first thing she does, not wanting to "go through all the extra stuff," which might have involved getting upset, talking to others, disengaging, or ignoring the situation. She addressed the situation directly and intentionally to deal with the problem and eliminate the stress associated with it.

Rachel also indicated that she coped with stress by problem-solving, especially by addressing potential issues to mitigate her stress in the future:

> *"Budgeting, I'll try and budget and manage my money before it gets to the point that I'm like, 'Okay, well now I have no money.' So that I hope – in hopes that that won't be a stressor for me. I just generally try and manage my whole life before it gets to the point where it's stressful, even though that doesn't happen really all the time, but I do try to do that. I try and stop the stress before it happens, or at least lessen it. The things that make me stressful, I guess I try and prepare for them to manage my stress."* (Rachel, Low-Stress Group)

The word "prepare" suggests that Rachel was aware of and anticipates certain stressors. She knew that financial strain could become a major stressor for her, and so by budgeting, she was ideally able to eliminate the stress of running out of money. Additionally, Rachel mentioned that she "manages her whole life" before it becomes stressful, suggesting that stress consumed a large portion of her life, and she needed to take proactive measures to prevent them from causing her stress.

Avoidant Coping Across Both Groups: Behavioral Disengagement – "I'll shut down completely" and Self-Distraction "I'll occupy my mind away from what's going on"

Participants from both the high- and low-stress groups reported utilizing avoidant coping strategies, including behavioral disengagement (decreasing one's effort to deal with a stressor) and self-distraction (using alternative activities to mentally disengage from a situation; Carver, 1997). This was about equally prevalent across both groups.

Behavioral Disengagement. Almost every participant in this study discussed their tendency to disengage or "shut down." Many described sleeping, ignoring the situation, and isolating themselves. Nadia described her response to stress involves avoiding eye contact and physical touch:

> *"But I know when I'm stressed, I avoid eye contact and I avoid physical contact and I tend to lay down and curl up into a little ball. It's just really pathetic, but yeah."* (Nadia, High-Stress Group)

Nadia described herself assuming a fetal-like position, perhaps as an instinctual reaction in effort to protect herself from further stress. She spoke negatively about it, similar to how Hannah depicted her methods of disengaging in a negative light:

> *"Like literally doing nothing. Doing nothing. I have to kind of zone out. That's another thing is I used to be able to face my problems pretty head on. Now, confrontation doesn't happen as much anymore. The way I cope is like by ignoring, which I know is terrible. But like avoid anything really for a short period of time. It just kinda get it all outta my head and then I can let it leak in later to try and deal with it."* (Hannah, High-Stress Group)

Asha voiced a similar strategy for dealing with stress:

> *"I kind of procrastinate and sleep a lot. Because I'm like, well I don't really wanna think about the issues, so yeah, I procrastinate a lot and I just keep sleeping. I don't wanna get up or do anything. So that really has been bad for me and not healthy at all."* (Asha, Low-Stress Group)

Nadia, Hannah, and Asha described the need to both mentally and behaviorally disengage to stop themselves from thinking about their stress. Interestingly, all women acknowledged that they

believe that their behavior was wrong – "pathetic," "terrible," and "not healthy at all." They were aware that their behavior was not aligned with what they perceived to be adaptive coping. Rachel described a similar experience with behavioral disengagement and explained why it became maladaptive for her:

> *"Sometimes if I just let it like, go, I just try ignoring it and it keeps just building up and building up, I just kind of, how do I put it? Like, I don't do anything, I guess. Like I'm not productive with anything. Like I won't shower for like three days. I won't clean the house for days and things will just be all over. So, I'll become unproductive. And then that ultimately makes it worse. Because then I'm like overloaded with more things than the original situation that made me stressed because now, I'm overloaded with all these other things that I ignored while I was stressed because I was down and out and I was just laying in my bed or sitting on the couch, watching TV. So now all these other things added up that I didn't take care of because I was stressed. So now it's worse."* (Rachel, Low-Stress Group)

By ignoring the stressful situation at hand, Rachel disengaged completely and neglected other parts of her life requiring attention, which created additional feelings of overwhelm and stress. This captured how stress and coping are sometimes cyclic in nature. Interestingly, Rachel previously described herself utilizing active coping strategies, the apparent opposite of behavioral disengagement, in effort to prevent stress. She noted in this excerpt that if she "lets it (stress) go*"* without actively addressing it, it would continue to build to the point where she was could not handle it and lead her to disengage. Thus, active coping may be important initially, as behavioral disengagement can become a later-stage strategy when stress becomes overwhelming. Kate shared a similar sentiment about how feeling overwhelmed with stress would lead her to a breaking point, causing her to withdraw:

> *"It's just like when one thing piles on top of the next, on top of the next, on top of the next. And you're just like one person. If becomes to the point where it's just completely overwhelming. And usually that's at the point where like, I, I'm just like, 'I'm done. I'm done. I've had enough. I can't handle this no more. I'm done.' And so, and there are some points where like I will just kind of like throw my hands up and I'm like, 'Nope, I'm done.' Usually that's my cue of like, I'm, I can't handle anything else. Sometimes I'll come into my*

> *room, and I'll lock the door in my room so that I can just be left alone for a little bit."* (Kate, High-Stress Group)

Regardless of perceived stress level, the majority of participants spoke of using behavioral disengagement as a coping strategy, whether as part of their initial reaction to stress or as something they would tend to do as stress continued to build.

Self-Distraction. Related to behavioral disengagement but seemingly more adaptive in comparison, self-distraction was used by many participants to cope with stress. As described by Danielle, *"You know, sometimes it's just distracting yourself or busying yourself or delaying, you know, like just, just finding different ways to distract yourself sometimes"* (Danielle, Low-Stress Group). This took a variety of forms for participants, including screen time, exercise, self-care activities, going outside, and keeping busy with chores and other tasks.

> *"I try to find things on TV, something funny that will make me laugh. Comedy, I'm a big comedy fan. I try to find comedy shows on TV or YouTube or something, I'll find a comedy show and listen to it. And once I get that big laugh in, it's like a relief."* (Jasmine, Low-Stress Group)

Maya also mentioned using screen time to distract herself, but in a different way:

> *"My kids and I might watch TV to get my mind off things […] Watching a movie would [make me feel better], but it can't be like an emotional movie. It'd have to be like some action or something. […] I just have to like, try to occupy my mind. Keep my mind occupied on something so I won't think about stuff. […] To manage my stress, I take my kids to the park. I have my, uh, I go walking around the little track with my daughter in the stroller. To like, you know, keep my mind off stuff. I focus on walking."* (Maya, High-Stress Group)

For Jasmine, she liked to watch comedy shows to provide her with a cathartic laugh. This provided her with relief, perhaps feelings of happiness that she had been lacking, and a temporary distraction from her stress. Like Jasmine, Maya also used television to distract herself. Her goal was to mentally disengage, regardless of genre; however, she noted that she would not watch "emotional" movies, likely because they would bring her attention back to her stress and

negative emotions. She also stated that she distracted herself by taking her kids outside to the park or to go for walks, like Isabel:

> *"Definitely staying busy. I just like cleaning, baking, taking on extra tasks. I take my daughter out just to parks or just doing anything. Exercise a little bit, like that can help if I have time to myself. But mainly just doing tasks. I'm always busy. […] I think it feels like if I'm losing control, these are things that I can have control over. [..] And if I don't feel like I have control over what's going on, I like to make sure things are in order and in place and yeah. Make sure everything's together. Clean and tidy and stuff like that."* (Isabel, Low-Stress Group)

Isabel emphasized that "staying busy" and "doing tasks" were important to distract herself and alleviate her stress. This was a common theme amongst participants, and many reported engaging in activities to distract themselves. Furthermore, Isabel noted that completing tasks provided her with a sense of control when she felt like stress was taking over and things were coming undone. For all participants, self-distraction was a popular coping strategy, providing them with short-term peace, contentment, and sense of control over other aspects of their life.

The Impact of Stress on Health

Because stress has been linked to a multitude of health problems especially among low-income populations (American Psychological Association, 2017), participants were asked how they perceived stress as affecting their health. Findings showed that those who identified health changes attributed to stress were almost entirely in the high-stress group.

Health Decline – "It's taking a toll"

Physical changes suggesting declining health that high-stress participants noted included brain weakness, migraines, and cardiovascular changes.

> *"High blood pressure. I, I feel like that's some, like, stress and stuff. […] I went to the doctor and they told me that my blood pressure was high and I was like, that's kind of weird 'cause I never had high blood pressure ever, but I'm supposed to go back in three months so they could see like where my levels is at. […] I think it was like 156 over 91 maybe. Yeah, I don't know, it was kinda high. […] Usually when I would go it would be*

> *like 117 over, um, something. I never remember the bottom number; I remember the top one though."* (Maya, High-Stress Group)

Maya described seeing her doctor a couple of months prior, who told her that her blood pressure was high and felt like it was caused by "stress and stuff." She seemed surprised and mentioned that it was more elevated than normal, but stated nonchalantly, "Yeah, I don't know, it was kinda high," giving the impression that she was not worried about it. In contrast, Chelsea, who had a congenital heart defect, noted that she was concerned that stress had adversely impacted her heart:

> *"Um, badly. It [stress] has taken a real toll on like my heart condition that I do have. It's just made my heart a lot weaker, and it's just made my brain a lot weaker too. I just don't feel as like mentally stable as I used to. I'm having to like, work really hard to get back at that."* (Chelsea, High-Stress Group)

Like Maya, Chelsea observed an impact on her cardiovascular health but with a greater degree of unease. She also noted that stress had made her brain feel weaker and she did not feel as mentally stable as she used to be. Chelsea was aware of changes happening within her mind and body and could identify differences between her present versus past self. She also indicated that it would require work to strengthen her mind, which was echoed by Nadia:

> *"I've had such a stress-prone personality and emotional personality for so long that if a brain adapts to that, which I'm sure it does, that my poor brain is stuck in a rut, and that it's gonna take a monumental effort to retrain my brain to cool down the hormones it releases due to stress and the fact that I'm constantly stressed. I know it's damaging my body far more than if I just let things go. So, yeah, it's...I'm sure I would be a lot healthier if I wasn't so stressed."* (Nadia, High-Stress Group)

Nadia described herself as having a "stress-prone personality" to which her brain had to adapt. She believed it would take a great deal of work to rehabilitate her brain and decrease her stress hormone reactivity. Although she did not mention the names of the hormones she was describing, she is likely referring to corticotropin-releasing hormone (CRH), adrenocorticotropic hormone (ACTH), and cortisol, indicating some level of knowledge of the stress response and its

impact on the body. Nadia recognized that her body was being damaged by stress and would likely be healthier if she were able to manage it better.

***Health Concerns - "If** my stress doesn't get better, what more could happen?"*

Participants in both groups voiced a number of concerns related to their health and how stress could impact it in the future. Common across both groups was the concern for their general health and risk of developing chronic illnesses. Some identified stress as an underlying cause of illness (e.g., high blood pressure or cardiovascular disease). Others linked stress to harmful health behaviors, such as unhealthy emotional eating or smoking, especially in the low-stress group. In line with the above findings about health changes, the high-stress group described concerns related to cardiovascular diseases, neurodegenerative diseases and cognitive problems, and early death (see Table 4.3).

Table 4.3

Health Concerns and Representative Quotes

	Both Groups
General Health and Disease	*Just because, before my whole heart situation and tension headaches, I didn't know stress could affect you that much. Just about things in that category. You know, if my stress doesn't get better, what more could happen? And I'm hoping it gets better. Like I, I'm going to try definitely after this phone call, but you know, what more could happen, right?* (Tyra, High-Stress Group) *Pretty much what I just said, like my family, not having me around, not having them around if I'm having sick all the time, or if I'm having to go to the hospital for things and I mean, stress and stuff causes all sorts of like things wrong with people and they don't realize it, like people die from stress. Like, I'm, that's also something that stresses me out, so, you know what I mean? Like, yeah. It seems like a catch-22 sometimes. It's a vicious cycle.* (Chelsea, High-Stress Group) *Yeah, I think maybe if it keeps going like that. I'm not able to, you know, meditate or do yoga or get medicine, I think it might be going on like this, you know I'm concerned I might gain a lot of weight and then, like, the other diseases that come with it, like diabetes and stuff, it's possible I may get it too, so yeah.* (Asha, Low-Stress Group) *Obviously, like, the fear of like feeling run down so we don't wanna end up having problems where I'm so tired from all the stress that I just don't wanna deal with things anymore. And then I mean like of course it's gonna potentially impact other health problems 'cause my body feels it, so that means that my health problems obviously are impacted. I just don't really know the extent, if that makes sense.* (Kate, High-Stress Group)

Table 4.3 (cont'd)

Low-Stress Group	
Behavior-Related Illnesses	*I would just be concerned that over many years of stress and the way I handle stress and like just stress in general, I would worry that over many years, it would affect me by like again, those things that I do when I'm stressed, like the smoking is probably one of the biggest ones, like smoking obviously affects my health in many ways like my lungs, but it also affects my skin and my pores and the way my blood runs through my body. So me just smoking more when I'm stressed is gonna have a bad effect on my health, which is related to the stress, so that would be bad. And then just not really taking care of myself, I guess, just not doing things that you would think an average person while living a healthy life would like to do when they're healthy and stress-free. I think when I'm stressed, I really don't take care of myself as well as I'd like to, and then over many years of doing that, that would probably have a bigger effect on my health negatively.* (Rachel, Low-Stress Group) *I have a history of cancer that runs very rampant on my father's side. And I think that if I don't take care of myself, I'm just going to let a genetic disease kill me. I think I might just let my body deteriorate. I might catch cancer, 'cause I smoke cigarettes a lot.* (Jasmine, Low-Stress Group)
High-Stress Group	
Shortened Life Expectancy	*That I won't live longer. I won't live to life…what is it? Is it live to meet life's quota, age quota? I won't live a long life. That's how I feel. I just won't live 'til... I can't remember what's the age for a woman to live, but I don't think I would be nowhere near it because my stress level is so high.* (Georgia, High-Stress Group) *Oh, gosh, if I die soon, it's because of stress. That's for sure.* (Nadia, High-Stress Group)

Table 4.3 (cont'd)

Cardiovascular Health	*But me having stress, high blood pressure, just things with my health that just don't…like, stress, having a heart attack due to my stress levels. Stuff like that.* (Georgia, High-Stress Group) *High blood pressure, maybe, like I said, the facial wrinkles. Stress around your eyes and stuff.* (Zoe, High-Stress Group) *'Cause at 23 I had a subarachnoid hemorrhage on the left side of my head, and it's 'cause my blood pressure was up, so, the ways that it has, stress has affected it is, is affecting my blood pressure. It's um, caused my blood pressure to be high and of course I had a stroke, and um, I'm scared that stress not only like, hurts my mind, it hurts my heart, you know, cause my anxiety goes up, so I breathe really hard and my heart rate goes up and I felt, you know, a lot of different concerns over it.* (Bethany, High-Stress Group) *Well, certainly I don't wanna have high blood pressure, so that's the one that I hear about all the time which is, hey, you know, people that are under stress long term, they can develop all of these health conditions.* (Kate, High-Stress Group)
Brain Health and Cognition	*Well, I am actually really worried about how it affects my brain, because I've noticed that when I'm stressed, it's almost as though I lose the ability to think critically. […] And I am worried that my body, my bones, and my brain, especially my brain might... This might be something that when I'm 70 years old, I have Alzheimer's early because I treated my brain and body so badly, and just constant whatever neurons or whatever fires when I'm stressed, and I was just never calming it down. […] I kind of see myself going senile in 30 years. I wouldn't be surprised, anyway. And I'd be like, "You know, that was probably preventable if I wasn't such a freak about stress." But I'm trying now. I'm like, "It might not be too late." I'm trying really hard.* (Nadia, High-Stress Group) *I never wanted to be one of those older people who's just like, out of it or, you know, can't do anything for themselves and just talking out the side of their neck all the time because they're so sick. And I just don't want to be one of those people.* (Tyra, High-Stress Group)

Discussion

There is limited research available that describes how young, low-income parents with young children conceptualize stress, how they cope with it, and how they perceive stress as impacting their health. The purpose of this study was to describe and compare these experiences and conceptualizations between groups of young, low-income parents who report low stress levels with those who report higher levels of stress. See Table 4.3A in Appendix F for comparisons of study findings between and across groups.

Stress is generally considered a threat to homeostasis, which can be adaptive in situations requiring enhanced motivation and performance (i.e., eustress) and maladaptive when persistent and unresolved (i.e., distress; McEwen & Stellar, 1993; O'Connor et al., 2021; Selye, 1978). In this study, participants' narratives revealed that they generally conceptualize stress as a distressing phenomenon associated with mental strain and negative emotions in response to taxing stimuli.

Consistent with prior qualitative and mixed-methods studies among low-income parents, women from both groups reported financial strain and pressure of raising children as major stressors (Kaplan et al., 2013; Lange et al., 2017; Marcil et al., 2020). Participants in the high-stress group expressed a number of additional salient stressors, including the stress of children's difficult behavior, job dissatisfaction, and transportation barriers. These sources of stress were also reported in other studies among low-income parents (Jacoby et al., 2017; Kaplan et al., 2013; Lange et al., 2017). However, these studies did not compare findings between individuals within their samples, so it is not known if these are stressors typically associated with higher-stress levels or other differentiating characteristics. However, it is logical that when assessing perceived stress using the PSS-10 (which aims to measure the degree to which situations in a

person's life are appraised as stressful; Cohen et al., 1983), those with higher scores may perceive a greater number of situations and circumstances in their life as stressful.

Markedly distinct between the two groups was how participants in each group experienced mental strain. Individuals in the low-stress group experienced mental strain in the form of racing and repetitive thoughts, indicating perseverative cognition. In contrast to this pattern of ruminative thinking, participants in the high-stress group experienced brain fog, defined as a "subjective experience of difficulties with word finding, concentration, and memory" (Kverno, 2021). Brain fog has been described as a persistent, subclinical form of cognitive dysfunction, often accompanied by a general feeling of being overwhelmed with anxiety and depressive symptoms (Kverno, 2021). These emotions were evident among participants' accounts, as described in the next category, "negative emotions."

Although results from this study are qualitative in nature, these findings may be personal accounts supporting McEwen's Theory of Allostatic Load, which posits that, over time, chronic stress leads to "wear and tear" on the brain and body (McEwen & Stellar, 1993). Inflammatory cytokines released in response to stress can have harmful effects on the brain in excess, including neuroinflammation and compromised hippocampal function affecting memory and other cognitive functions, which may be a potential pathway leading to brain fog (DiSabato et al., 2016; McEwen, 1998; McEwen & Gianaros, 2010; McEwen & Sapolsky, 1995). Thus, a potential explanation for this difference between the low- and high-stress groups is that individuals in the high-stress group may be experiencing symptoms of allostatic load (e.g., brain fog) while the low-stress group was not, potentially due to differences in vulnerability, resilience, and the way they perceive and adapt to stress (Kverno, 2021; McEwen, 2016, 2017).

Both groups also associated stress with negative emotions, especially feelings of despondency. This was not surprising, as sadness and depressive symptoms have established links with stress (Lazarus, 2006; LeDoux, 2003). In the low-stress group, participants described experiencing emotions of anger, while those in the high-stress group discussed feelings of anxiety. Participants in each group also reported physical manifestations consistent with these emotions; those in the low-stress group describing anger reported feeling flushed or hot, and the high-stress group individuals described feeling tension and tachycardia associated with anxiety. Both anxiety and anger are associated with stress, as well as contributors to depression (Bystritsky & Kronemyer, 2014; Spielberger & Reheiser, 2009). Because anger and anxiety are closely related within the context of stress, differences in emotions between groups could be attributed to factors such as upbringing and dispositional traits (e.g., negative affect; Blake & Grafman, 2004; Watson & Clark, 1984). In other words, participants in the low-stress group who described having angry emotional reactions when stressed also related this to growing up in dysfunctional households where angry behavior was commonplace.

Consistent with prior literature and stress and coping theories, individuals in this study described using multiple types of coping (Carver et al., 1989; Lazarus, 1993; Roth & Cohen, 1986). Across both groups, individuals described use of avoidant and emotion-focused coping strategies more often than problem-focused coping strategies. Behavioral disengagement and self-distraction (avoidant coping strategies) and acceptance and positive reframing (emotion-focused coping strategies) were used by participants in both the low- and high-stress groups. Avoidant strategies provide a temporary escape and short-term relief from stress but are likely not useful for long-term management of stress (Carver et al., 1989; Wadsworth, 2012). Furthermore, avoidant coping, especially behavioral disengagement, has been associated with

long-term consequences, including depression and poorer health outcomes among those with chronic diseases (Evers et al., 2003; Livneh, 2019; Murberg et al., 2004; Rayburn et al., 2005). Acceptance and positive reframing on the other hand may be more adaptive, especially for this population. For example, one study showed that low socioeconomic status individuals benefit from using strategies like positive reframing due to the nature of their stressors often being uncontrollable (Chen & Miller, 2012). Because some of these stressors may not be able to be actively dealt with, viewing the situation from a more positive perspective allows the individual to place value on their ability to accept and adjust one's mindset about the stressors in their life (Chen & Miller, 2012). Altogether, encouraging acceptance and positive reframing while mitigating use of behavioral disengagement and self-distraction may be beneficial for those living in poverty, regardless of stress level.

Distinct from the high-stress group, participants in the low-stress group described using emotional support, religion, and active coping, suggesting that these strategies may help to alleviate feelings of distress. Similar findings were noted in a qualitative study among low-income single mothers (Broussard et al., 2012). Active coping has been associated with positive outcomes, especially among low-income adults (Mayo et al., 2022). However, for groups experiencing poverty-related stressors, the ability to actively cope is contingent upon the type of stressor and its suitability for this type of strategy. Not all stressors may be able to be handled this way, and other coping strategies may need to be utilized. Religion has been shown to buffer the effects of stress on health and has been associated with overall well-being (Lorenz et al., 2019; Wadsworth, 2012; Whitehead & Bergeman, 2020). For religious or spiritual individuals, engaging in prayer or other religious activities may mitigate stress. Relatedly, seeking emotional support has been shown to improve resilience to stress which may be associated with better

health outcomes and improved well-being (Ozbay et al., 2007). However, it is important to note that not all individuals have sources of emotional support available. Therefore, promoting a variety of emotion-focused coping strategies among this population, especially those experiencing high levels of stress, could be an effective means of mitigating the negative consequences of stress on the mind and body.

Only the high-stress group described experiencing negative health changes attributable to stress, including brain weakness, migraines, and cardiovascular changes. This group also expressed concerns for their health in the future, especially regarding cardiovascular diseases, neurodegenerative diseases and cognitive problems, and premature death. In one study using nationwide data, findings showed that those who described experiencing greater stress and perceived stress as affecting their health negatively had a 43% increased risk of premature death (Keller et al., 2012). This underlies the importance of early intervention for those experiencing high levels of stress and for people who experience health decline attributable to stress.

Limitations

This study has some limitations. First, it is important to note that even though participants were divided into groups based on having "low" or "high" levels of stress, individuals in the low-stress group still likely experience generally higher levels of stress compared to higher-income populations. Furthermore, the cutoff value dividing participants into low- and high-stress groups was based on the sample's median score rather than an established value. This is because the PSS-10 is not a diagnostic instrument and therefore has no cutoff values for low or high stress levels. However, prior literature has suggested using the median value to dichotomize the data if needed (Al-Sowygh, 2013; Kovar et al., 2021). Additionally, the group of 17 non-responders had a higher average PSS-10 score than the 17 individuals in the included sample

(27.5 vs 23.4). This suggests that these individuals may have been too stressed to participate in the study, and experiences from this population may be missing.

Although the study was not targeting females, the final sample included only women as they happened to be the only ones who met other eligibility criteria and responded to interview invitations. Non-female individuals may have described different experiences. Lastly, IPA aims to understand individuals' experiences and relies on in-depth interviews with participants to obtain rich accounts of their experiences. Due to the personal and often difficult nature of the topic of this study, participants may not have always been comfortable discussing certain parts of their experiences, and therefore important information may have been lost. However, conducting the interviews via telephone (rather than in person or video call) may have reduced this risk. Telephone interviews provide a sense of pseudo-anonymity which positions them as well-suited for collecting data on difficult topics (Trier-Bieniek, 2012).

Conclusions

This study demonstrated the differences in conceptualizations of stress, experiences of coping with stress, and perceptions of the impact of stress on health between young, low-income parents with low versus high levels of self-reported stress. The participants in this study conceptualized stress as a mental strain, which was experienced differently by both groups. They also associated stress with negative emotions, with anger being specific to the low-stress group, anxiety to the high-stress group, and despondence being common across both groups. Both groups use behavioral disengagement, self-distraction, instrumental support, acceptance, and positive reframing to cope with stress. Participants in the low-stress group described using additional strategies, including religion, emotional support, and active coping. Although perceived stress levels cannot be linked with the use of specific coping strategies, findings from

this study suggest that individuals with low levels of stress may use some strategies distinct from high-stress individuals. Therefore, encouraging the use of more forms of emotion- and problem-focused coping may be beneficial to this population.

Implications for Future Research

Additional research is needed to validate these findings and determine which specific coping strategies, including those used by low-stress individuals, may be most adaptive for stress management. This could lead to the design of interventions targeted at promoting use of appropriate and adaptive coping strategies to improve resilience and promote mental and physical health within this group. Findings from this study suggest that emotion-focused coping and problem-focused coping may be more beneficial for this population than avoidant coping strategies. However, interventional studies that aim to reduce stress by promoting emotion- and problem-focused coping strategies are needed to determine any influence on long-term stress levels and health outcomes.

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APPENDIX A: Demographic Survey

1. What is your age in years? ___

2. What is your sex?
    a. Male
    b. Female
    c. Other
    d. Prefer not to say

3. What is your race?
    a. African American
    b. Asian
    c. Caucasian
    d. Native American
    e. Native Hawaiian or Pacific Islander
    f. Two or more (please specify: ___)
    g. Other/Unknown
    h. Prefer not to say

4. Do you identify as Hispanic or Latino(a)?
    a. Yes
    b. No
    c. Prefer not to say

5. What is your primary language?
    a. English
    b. Spanish
    c. Other (please specify: ____)

6. How many children do you have?
    a. 0
    b. 1
    c. 2
    d. 3
    e. 4
    f. More than 4
    g. Prefer not to say

7. How many children are between the ages of 3 and 5 years old?
    a. 0
    b. 1
    c. 2
    d. 3
    e. 4
    f. More than 4

g. Prefer not to say

8. Including yourself, how many people currently live in your household?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5
    f. More than 5
    g. Prefer not to say

9. How many household members are people under the age of 18?
    a. 1
    b. 2
    c. 3
    d. 4
    e. More than 4
    f. Prefer not to say

10. What is your annual household income?
    a. Less than $9,999
    b. $10,000 - $14,999
    c. $15,000 - $19,999
    d. $20,000 - $24,999
    e. $25,000 - $29,999
    f. $30,000 - $34,999
    g. $35,000 - $39,999
    h. $40,000 - $44,999
    i. $45,000 - $50,000
    j. More than $50,000
    k. Prefer not to say

11. What is your current employment status? (Select all that apply)
    a. Employed full-time
    b. Employed part-time
    c. Unemployed
    d. Looking for work
    e. Self-employed
    f. Homemaker
    g. Disabled
    h. Student
    i. Retired
    j. Prefer not to say

12. What is the highest degree or level of school you have completed?
    a. Less than a high school diploma

b. High school diploma or equivalent (e.g., GED)
c. Bachelor's degree (e.g., BA, BS)
d. Master's degree (eg., MA, MS, Med)
e. Doctorate (e.g., PhD, MD/DO, PsyD)
f. Other (please specify) ___
g. Prefer not to say

13. What is your marital status?
    a. Single (never married)
    b. Married
    c. In a domestic partnership
    d. Separated
    e. Divorced
    f. Widowed
    g. Prefer not to say

14. Are you currently pregnant?
    a. Yes
    b. No
    c. Prefer not to say

15. Do you have access to a telephone?
    a. Yes
    b. No

16. Where do you currently live?
    a. One of the 48 contiguous states or the District of Columbia
    b. Alaska
    c. Hawaii

APPENDIX B: 10-item Perceived Stress Scale (PSS-10)

1. In the last month, how often have you been upset because of something that happened unexpectedly?
2. In the last month, how often have you felt that you were unable to control the important things in your life?
3. In the last month, how often have you felt nervous and "stressed"?
4. In the last month, how often have you felt confident about your ability to handle your personal problems?
5. In the last month, how often have you felt that things were going your way?
6. In the last month, how often have you found that you could not cope with all the things that you had to do?
7. In the last month, how often have you been able to control irritations in your life?
8. In the last month, how often have you felt that you were on top of things?
9. In the last month, how often have you been angered because of things that were outside your control?
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Scaling: 0 = Never; 1 = Almost Never; 2 = Sometimes; 3 = Fairly often; 4 = Very often

Items: 10

Scoring:

Reversed Items: 4, 5, 7, 8

Total Perceived Stress: Sum Items: 1, 2, 3, 4R, 5R, 6. 7R, 8R, 9, 10

APPENDIX C: Semi-Structured Interview Guide

Hello, my name is Lauren. I am a student from Michigan State University conducting a research study about stress experiences in people's lives and how they cope with it. Today you are being asked to complete in an individual phone interview which should take approximately 30 - 45 minutes. Possible risks of participating in this study include feelings of distress over discussing your life stressors. In exchange for completing this telephone interview with me, you will receive a $20 e-gift card. Your participation is voluntary and if you do not want to answer any of the questions, please let me know. You can also ask to stop at any time.

If you have concerns or questions about this study, such as scientific issues or how to do any part of it, please contact the researcher (Lauren Pageau; pageaula@msu.edu; 1355 Bogue Street C360L East Lansing, MI 48824). If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 4000 Collins Rd, Suite 136, Lansing, MI 48910.

Do you have any questions?

Your information will remain confidential. This interview will be recorded and transcribed and any identifiable information of yours will be removed so no one will be able to identify you. Do I have your permission to record this interview?

(If no, thank them for their time and end the call. If yes, proceed).

Thank you. Continuing with this interview means you agree to participate.

By proceeding with the interview, you voluntarily agree to participate in this research study.

1) Do you ever feel stressed?
   a) If answer is "yes" → Could you tell me about a time where you felt stressed?
   b) If answer is "no" → How do you feel when you are in difficult or stressful situations?

2) How would you describe stress?
   a) In your understanding, what is "stress?"
   b) What does the word "stress" mean to you?

3) Tell me about the stress in your life.
   a) What is going on in your life when you feel stressed?
   b) What would you say makes a situation stressful for you?
      i) What are your stressors? What cause your stress?

4) When you are feeling stressed, what thoughts run through your mind?
   a) What do you say to yourself when you are feeling stressed? Describe how you feel.
   b) Please describe any other emotions you have when you are feeling stressed.

5) How does your stress vary for different stressors (e.g., kids/schooling, job change, relationships, health, pandemic)?
    a) What is your stress like in relation to kids? In relation to work? In relation to finances? In relation to the pandemic?

6) How does stress affect your daily life? Like your daily routine, work, family?

7) Can you describe a time when you felt overwhelmed with stress?
    a) How often do you feel overwhelmed with stress?
    b) What is that feeling like?

8) When you feel stressed, what things make you feel better?
    a) What things make you feel worse?

9) What do you usually do to manage your stress?
    a) Can you describe a time when you feel like you managed stress well?
    b) What about a time when you didn't manage it well?
    c) Which tends to happen more often?

10) What kind of support do you have for dealing with your stress (e.g., friends, family, spouse, counselor)?
    a) Who do you find provides you with the best support?
        i) Why is that?

11) When you are feeling stressed, what do you feel in your body?
    a) What physical signs of stress do you notice?
    b) Describe the way your body feels when you are feeling stressed.

12) When you are stressed do you generally notice a physical sensation or emotions/thoughts about stress first?

13) How do you feel stress has affected your health?
    a) What concerns do you have about how stress may affect your health?

14) How has your perception of stress changed over time?

Thank you very much for participating in this interview today. We greatly appreciate your time and sharing your thoughts on this topic.

APPENDIX D: Stressors and Representative Quotes

Table 4.1A

Stressors and Representative Quotes

Both Groups	
Pressure of Raising Children	*So, the most stressful thing is my kids. Raising my kids correctly and making sure I'm making the right decisions on raising them, that is the highest stress level because they are being raised off of like how I grew as a parent and when things don't go right, it really stresses me out because it falls back on me regardless of if they have a father or not, everything still falls back on me and the choices that I made to have them and bring them into this world. Sometimes I really feel like I'm failing them. So that's what causes the most extreme stress that I feel like I'm failing my kids.* (Georgia, High-Stress Group) *Being a mom, I only stress when I think like I'm not doing good enough, like maybe I could be teaching him more or something like that.* (Tyra, High-Stress Group) *I recently just had a baby so getting all of that together, almost sleep deprived that brings stress, 'cause you need to be alert to take care of a baby. Since it's just added stress, just mostly just having the baby, that's my biggest stressor right now. Not him himself, but just trying to get everything organized and make sure he's well taken care of and making sure my son is okay.* (Simone, Low-Stress Group) *Like I had said, I have two, I have two kids, I'm a single mom, so I stress a lot just about them, in general. Not like that things go on with them necessarily, but just, I just feel like I worry about them. Like when they're not with me, whether I'm dropping them off at daycare or they're going to their grandma's house or whatever, I just get stressed about them. I just sometimes worry about them getting hurt or things happening to them. And that's another stressor for me.* (Rachel, Low-Stress Group)

Table 4.1A (cont'd)

Financial Strain	*I'm not really to the point where I'm financially stable. I'm constantly trying to... I'm looking for better opportunities, like I went to school, finished with my bachelor's for social work and then now it's like, I can't even find a decent job to provide for them, so that causes an extreme stress level as well. So financially, I'm not in a good place but I still try to provide for my children so that stress of providing their daily needs is something that I just think about every day that causes stress.* (Georgia, High-Stress Group) *Um, my financial situation yeah 'cause I'm living paycheck to paycheck, trying to make my, pay my bills and stuff but.* (Maya, High-Stress Group) *I mean, I'm make enough money to pay my bills, but that's it. Like living paycheck to paycheck.* (Bethany, High-Stress Group) *So, I think things that I really get stressed out about are financial things, because I always feel like I'm like right on that budgeting line where it's like one month I might not be able to afford a thing or something. It's like, I never feel like I'm comfortable in a position where it's like, I don't have to worry about something. And I think financially the stress from financial stuff is a big one for me. […] Like the financial stuff is probably on the level of very high stress, like all the time constantly.* (Rachel, Low-Stress Group) *And right now, as far as my stress levels goes, it's, it's magnified by a million because I have a decade or more worth of things that have been neglected. I've got bills that I have that haven't been paid, I don't have my license. I have like $5,000 worth of tickets, you know, like I'm, I'm basically an adult child right now, and I'm trying to make a way for myself and trying to relearn a lot of things and, and I'm trying to learn how to just, just live life on life's terms with, and, and with all this stress, it's, it's, it's, it's difficult, you know, with the cost, the cost of living, and I'm living off of my disability and you know.* (Danielle, Low-Stress Group)

Table 4.1A (cont'd)

	High-Stress Group
Children's Difficult Behavior	*Then any time I see my daughter, it's always a little bit stressful because she doesn't nap and is very needy.* (Nadia, High-Stress Group) *Because like, their father's not in their life. He don't want to, you know, take care of them, do anything with them, you know, so I'm with my kids 24/7. If I'm not at work, I have them all the time, which there's nothing wrong with it, but sometimes mothers need breaks too, so. And my son is a handful. He's very hyper. He, and then he…he is very bad.* (Maya, High-Stress Group) *I would say my kids interrupt a lot. Like there's all kinds of unexpected accidents that I run into with them, especially with the potty training and stuff. And that delays, you know, sometimes I'm late for work and then that really stresses me out. Cause somebody's gotta wait for me to get there. The kids don't listen. That drives me crazy.* (Zoe, High-Stress Group)
Transportation Barriers due to Long Travel Distance/Lack of Vehicle	*Literally every day I transport my kids to and from school, which is like, I'm gonna say an hour- to two-hour process every single day.* (Georgia, High-Stress Group) *Besides that, and having to work, just like juggling all the, all kinds of stuff, and trying to keep it all straight. Like, my doctor's appointments are like an hour and a half away.* (Zoe, High-Stress Group) *I don't drive or have my license and so I take public transportation to get around, which can be stressful. There are times where I'll be late to appointments and have to either reschedule my appointments or sit and wait. So that's stressful.* (Kate, High-Stress Group)

Table 4.1A (cont'd)

Job Dissatisfaction	*As I stated, I'm [an employee at a company] and I was getting a lot of feedback about not taking on as much clients as I should, between that and one of my daughters having a mental health crisis, and just having a new baby. I just was ready to end it all. […] But that day I was just fed up with everything. I contacted [employer], let them know this isn't gonna work anymore. I wanna quit. I turned my phone off for the day and I just was not in a good mental space. So I kind of just was ready to drive my car into a lake. And I had to literally go home, just shut my phone off, and just tell 'em I quit. I actually quit that day. And then they talked me back in. Talked me to come back the next week.* (Georgia, High-Stress Group) *Dealing with different people and their attitudes and at the same time dealing with my own problems. Dealing with managers and not showing favoritism towards certain people. It just takes a toll on me. Especially, especially the customers because, oh, the customers, they'll come here with their attitudes. Probably going through something too, not knowing if you are going through anything and they're coming there trying to take it out on you. And it's just like, you know, just too much.* (Maya, High-Stress Group) *I work a job from home that, while I absolutely love the company, there is no ability to move up in the company at all because I'm a work from home employee, so that's stressful.* (Kate, High-Stress Group)

APPENDIX E: Physical Manifestations of Stress and Representative Quotes

Table 4.2A

Physical Manifestations and Representative Quotes

	Both Groups
Shortness of Breath	*Just like an almost breathless feeling sometimes or like I've run a race, but without moving.* (Emily, Low-Stress Group) *I can't breathe at times when I get too stressed out.* (Georgia, High-Stress Group) *I think it depends on how stressful the situation is because I've gotten to the point where I have to stop and concentrate on my breathing 'cause I can't really breathe. […] And if it's really severe, I will feel it in my chest and have a hard time breathing.* (Isabel, Low-Stress Group)
Restlessness	*I would say I feel like, I say I'm nervous. I'm just really nervous. I'm anxious. I just can't stop moving. […] Yeah, fidgety. I don't want to sit still. I don't want nobody around me. I don't want y'all asking me no questions.* (Jasmine, Low-Stress Group) *I squirrel really bad too. Like when I'm sitting there, you know, getting everything together to cook supper and the next thing you know I'm cleaning the house, and the next thing you know, I'm keeping myself and my mind busy so I don't think about it.* (Bethany, High-Stress Group) *It's just restlessness that I cannot sleep certain times 'cause I'm just thinking, thinking, thinking. So, a lot of restlessness in my body, overexerted my body.* (Asha, Low-Stress Group) *I know I don't, but it's not for lack of trying, put it that way. I just don't sleep well. Yeah, I fall asleep real easily, but I'm just very restless.* (Nadia, High-Stress Group) *I'll pace, I walk back and forth.* (Rachel, Low-Stress Group) *The only thing I do when it gets like that, is I, I'll tap my foot. It'll be shaking.* (Bethany, High-Stress Group)

Table 4.2A (cont'd)

Stomach Discomfort and Headaches	*Yeah. It makes my stomach hurt, because I think not being able to control it, […] then it makes me get queasy, not so much as nauseous, but it's like, my stomach is in there doing flips or something who knows how that works. 'Cause I know what you think sometimes it makes you feel a certain way too. So positive thoughts.* (Simone, Low-Stress Group) *So everything affects my body eventually. My stomach don't be at ease. I feel nauseous or I'll have a headache, which make me not wanna do anything either. Just do anything.* (Georgia, High-Stress Group) *And a lot of it comes out and my guts hurt, my head hurt, my body kind of assumes a bad posture. That kinda thing.* (Nadia, High-Stress Group) *And then sometimes I'll get... Just because of the stress I'll get just sick to my stomach.* (Rachel, Low-Stress Group) *I don't know if you ever heard like an animal in distress, like those, those that piercing noise or sound that you hear from it. I, I feel like I have that, that, high frequency noise going on between my head, like I'm just screaming internally on the inside. And like I, it's like I'm screaming really inside my head and it's those days when I'm overwhelmed because I've got - I'm just spent.* (Danielle, Low-Stress Group)
Low-Stress Group	
Flushed and Feeling Hot	*For me it's more so, I get a funny feeling in my stomach. It's kind of like butterflies in your stomach and you get really flushed or hot, not so much as sweating, but just really hot or flushed or a hot flash comes over you or something like that.* (Simone, Low-Stress Group) *I feel heat. My body goes to sweating. I get like overheated. I get so sweaty. I get upset.* (Jasmine, High-Stress Group) *My hands are like sweaty. My palms are sweaty, I'll pace, I walk back and forth. I feel powerless, I'll feel like I'm helpless. I feel like nobody's listening to me. I feel, like sick to my stomach. It's a bad feeling.* (Rachel, Low-Stress Group)

Table 4.2A (cont'd)

	High-Stress Group
Tension	*Tension. Lots and lots of tension. Like my muscles are tense and my I feel like my heart races but mostly just the muscle tension. And I feel like I'm gonna explode. That's the best way I could explain it.* (Kate, High-Stress Group) *I like, kind of like I'm about to like burst.* (Chelsea, High-Stress Group) *I have a lot of, like, my body tenses up. I tend to freeze.* (Hannah, High-Stress Group)
Tachycardia	*A lot of it is physical, and it starts in my head. But generally, I'd say it's pressure, it's a rapid heartbeat, it's a feeling of a loss of control, of being overwhelmed.* (Nadia, High-Stress Group) *Just like tingly and, heart racing, and sometimes I feel numb.* (Chelsea, High-Stress Group) *Rapid heartbeat, sweating. I, I get headaches after.* (Zoe, High-Stress Group)

APPENDIX F: Comparisons of Findings Between and Across Groups

Table 4.3A

Comparison of Findings Between and Across Groups

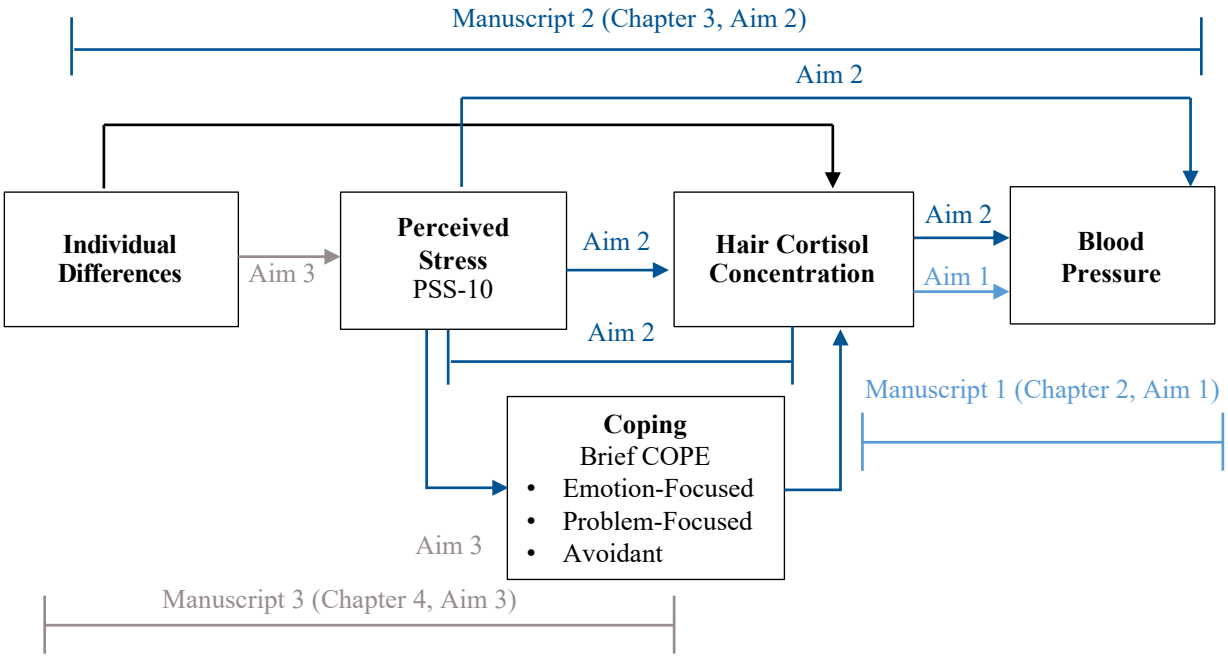
Category	Both Groups	Low-Stress Group	High-Stress Group
Stressors	• Pressure of raising children • Financial strain		• Children's difficult behavior • Job dissatisfaction • Transportation barriers due to long travel distance/lack of vehicle
Mental Strain		• Perseverative cognition	• Brain fog
Negative Emotions	• Despondency	• Anger	• Anxiety
Emotion-Focused Coping	• Acceptance • Positive reframing	• Use of emotional support • Religion	
Problem-Focused Coping	• Use of instrumental support	• Active coping	
Avoidant Coping	• Behavioral disengagement • Self-distraction		
Physical Manifestations of Stress	• Shortness of breath • Stomach discomfort • Headaches • Restlessness	• Flushed/feeling hot	• Tension • Tachycardia
Health Decline			• Brain weakness • Migraines • Cardiovascular changes
Health Concerns	• General health and disease	• Behavior-related illness	• Shortened life expectancy • Cardiovascular health • Brain health and cognition

CHAPTER 5: CONCLUSIONS

This multiple-manuscript dissertation aimed to address a central theme: the impact of stress and coping on blood pressure among young, low-income adults. McEwen's Allostatic Load Model (1998) was used as a guiding framework for this dissertation. This model includes the following constructs: individual differences, perceived stress, behavioral responses (e.g., personal behavior), physiologic responses (e.g., cortisol and catecholamine release), and allostatic load (e.g., hypertension, cardiovascular disease [CVD], type 2 diabetes). The model was adapted for this work to include sociodemographic factors (a representation of individual differences), coping strategies (inclusive of behavioral responses), HCC (an example of physiologic responses), and blood pressure (characteristic of hypertension, an example of allostatic load; see Figure 5.1).

Figure 5.1

Adapted Theoretical Model with Dissertation Aims and Operationalization of Constructs



Overview of Manuscripts

Manuscript 1 (Chapter 2, Aim 1)

Aim 1 of this dissertation was to comprehensively examine and quantitatively synthesize evidence on the relationship between HCC and blood pressure. Manuscript 1 reports findings of a systematic review and meta-analysis that was conducted to address this aim. Based on the adapted model, it was hypothesized that HCC (physiologic responses to stress) would be positively associated with blood pressure (allostatic load). Small, positive, and statistically significant associations were observed between HCC and blood pressure (SBP and DBP). Findings also showed that HCC was associated with higher odds of being hypertensive. Thus, findings supported the hypothesis based on the adapted model that chronic stress exposure measured by HCC is associated with elevated blood pressure. Findings underscore the adverse effects of chronic stress on cardiovascular health and risk for developing CVD over time. Despite these important findings, there was a gap in understanding the influence of HCC on blood pressure among young, low-income adults, which led to the work completed in Manuscript 2.

Manuscript 2 (Chapter 3, Aim 2)

Findings from Manuscript 1 suggested that HCC may be an important risk factors of high blood pressure, however no studies in the review focused on young, low-income adults (Pageau et al., 2023). Therefore, Manuscript 2 sought to address Aim 2 of this dissertation, which was to examine the associations among perceived stress, HCC, coping, and blood pressure among a sample of young, low-income adults. Path analysis modeling was used to determine the relationships among these constructs.

In line with findings from the meta-analysis in Manuscript 1 and in support of the hypothesis based on the adapted theoretical model, this study found that HCC was positively

associated with SBP and DBP. This finding confirms the presumption that chronic stress may be a risk factor for high blood pressure, especially within this population.

Results also showed that emotion-focused coping was negatively associated with HCC, indicating that emotion-focused coping strategies may be more adaptive than other coping strategies. Problem-focused and avoidant coping were positively associated with HCC, suggesting that these types of strategies may be less useful for this population. Furthermore, avoidant coping and HCC partially and significantly mediated the relationship between perceived stress and SBP and DBP. This finding highlights the potential harmful effects that avoidant coping may have on cardiovascular health.

Perceived stress measured by the PSS-10 was not positively associated with HCC as hypothesized and therefore did not support the adapted model. This was not completely surprising as prior studies have observed inconsistent relationships between self-reported stress levels and objectively measured stress levels (Bowers et al., 2018; Kalra et al., 2007; Ling et al., 2020). Different measurement timescales (one month for the PSS-10 and three months for HCC) may contribute to these inconsistencies. However, findings were consistent with results observed in similar populations (Hollenbach et al., 2019; Ling et al., 2020), and therefore suggest that factors such as income, socioeconomic status, and generational poverty are important factors to consider when attempting to measure stress in young, low-income groups.

Interestingly, PSS-10 scores varied widely for this group (range: 2 – 32), which brought to light that although these individuals had similar circumstances related to being low-income, not all reported similar levels of stress. Reasons for this may be attributable to how individuals describe and conceptualize stress itself and how they cope with it. This led to the work completed in Manuscript 3.

Manuscript 3 (Chapter 4, Aim 3)

Aim 3 of this dissertation was to describe and compare stress conceptualizations of young, low-income adults with low- versus high-stress levels, how they cope with stress, and how they perceive stress as impacting their health. A qualitatively driven explanatory sequential mixed methods study employing interpretive phenomenological analysis (IPA) was used in Manuscript 3 to address Aim 3.

Findings revealed that both groups experience stress as a mental strain associated with negative emotions. High-stress individuals reported a lack of thoughts as well as anxious feelings, while low-stress individuals described overthinking and feelings of anger. Both groups described using emotion-focused and problem-focused coping strategies, and avoidant coping predominated in the high-stress group. Additionally, the low-stress group tended to use more emotion- and problem-focused coping strategies than the high-stress group. Results from this study generally supported the hypothesis based on the adapted theoretical model that a person's perceived stress is influenced by their individual differences and impacts the coping strategies they use.

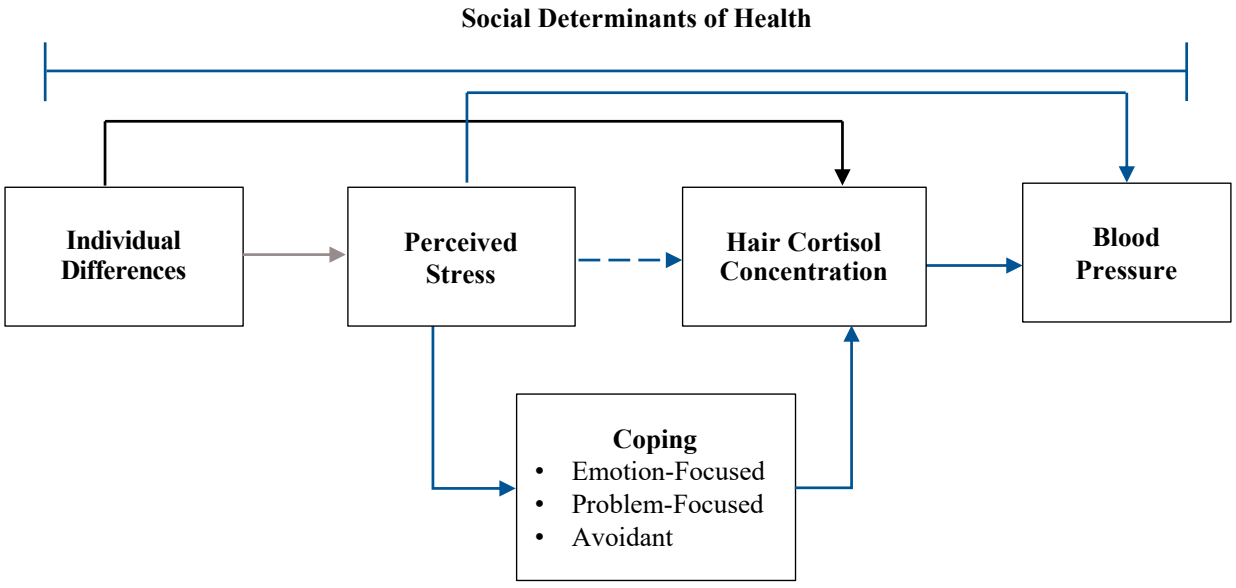
Findings from this manuscript align somewhat with the results from Manuscript 2 which found that of the three types of coping, higher perceived stress levels were most strongly and positively associated with avoidant coping. Furthermore, the low-stress group described using more emotion-focused coping strategies, which had the smallest association with perceived stress and were associated with lower HCC levels in Manuscript 2. The study described in Manuscript 3 gave deeper insight into why certain types of emotion-focused coping may be more effective for this population, thus providing a more comprehensive understanding of their stress and coping experiences.

Theoretical Model Adaptations

Overall, results from the three studies within this dissertation generally support the adapted model; however, it may be better suited for the general population rather than for those living in poverty. Specifically, negative associations between perceived stress and HCC could be attributable to 1) habituation to the environment and stress normalization and/or 2) dysregulated physiologic dysfunction resulting from early life adversity and/or chronic poverty. Integration of these factors into the model, along with modifications linking perceived stress and HCC, is warranted. Additionally, findings from this work indicate that the model necessitates the incorporation of poverty-specific social determinants of health – including but not limited to economic stability, transportation, and social and community context – as factors affecting all constructs: individual differences, perceived stress, HCC, coping strategies, and blood pressure (see Figure 5.2).

Figure 5.2

Adapted Theoretical Model with Modifications



*Dashed arrow indicates potential for positive or negative association

Contribution to Science

Chronic stress and early-onset hypertension among young, low-income adults is an under-recognized and understudied health problem, and research is needed to comprehensively understand the contributing factors (Niiranen et al., 2020). This population experiences high levels of stress over time which may contribute to high blood pressure at a young age. Results from Chapters 2 and 3 of this dissertation demonstrated that HCC has the potential to be used as a predictor of high blood pressure and cardiovascular risk. As a non-invasive measure of chronic stress, HCC may be used more widely in research and healthcare environments to better understand how chronic stress contributes to CVD and other health conditions. Furthermore, findings from Chapters 3 and 4 highlighted the vast variation in how individuals living in poverty perceive their level of stress (PSS-10 scores ranged from 2 – 34 in Chapter 3 and 2 – 39 in Chapter 4). This emphasized the role that coping and other factors may play in mitigating the influence of stress on a person, regardless of their circumstances. Findings from Chapter 4 expanded upon these insights and elucidated the complexity of how stress and coping are experienced by different people, providing the groundwork for future research aimed at tailored stress-management interventions for individuals living in poverty. Overall, this dissertation contributes to science by filling the gaps in our understanding of the complex relationships among stress, coping, and blood pressure among young, low-income adults. Findings from these studies provide the foundation for future work aimed at understanding and mitigating the effects of stress on blood pressure.

Implications

Research Implications

There are several implications for research arising from this dissertation. First, although Manuscript 2 contributes important findings among young, low-income adults, there is still a paucity of research focusing on stress and early-onset hypertension among this population. It would be valuable to investigate these constructs over time within this population. For example, an ecological momentary assessment (EMA) study design would allow for multiple sampling of individuals' current thoughts (perceived stress), behavior (coping strategies), and biological data (cortisol levels, ambulatory blood pressure monitoring [ABPM]) in real time and in their natural environments, increasing ecological validity and limiting recall bias. ABPM and salivary cortisol samples could be collected by participants and compared with HCC samples and in-office blood pressure measurement between three-month periods to capture a comprehensive picture of how perceived stress, coping, cortisol, and blood pressure change in response to stressful situations and to each other. Additionally, to expand upon the results of this dissertation, future research in this field should pay special attention to sex differences between men and women as well as compare findings between low- and high-income individuals. This data may provide critical insights into potential factors contributing to perceived stress, how different populations cope, and cardiovascular health disparities.

Summative findings from this dissertation underline the need for interventions incorporating stress management to reduce blood pressure and prevent risk for early-onset hypertension. Implementing these findings into the community setting with reach to young, low-income groups is particularly important. Some community-based studies have proven effective, including the Los Angeles Barbershop Blood Pressure Study (LABBPS; Victor et al., 2018) and

the Faith-Based Approaches in the Treatment of Hypertension (FAITH) trial (Schoenthaler et al., 2018), which includes a stress management component. However, these intervention studies were limited to predominately low-income Black adults, so expanded implementation research into diverse low-income communities is needed.

It is also important to note that these community-based studies were conducted among individuals with diagnosed hypertension. When implementing hypertension management programs or conducting research, it is critical to address high blood pressure at the primary prevention level. Therefore, there is an important need to scale these types of interventions to reach young adults who are at risk or who already have high blood pressure and are unaware.

Policy Implications

Findings from this dissertation showed that many young, low-income individuals report high levels of stress and would benefit from mental health services and preventive health care. Policies which establish comprehensive mental health programs tailored for low-income adults, especially those with young children, are needed in more communities. These programs may include affordable or free counseling services, support groups, and education on parenting skills, stress management, and coping strategies. Policies which help to provide free transportation would improve accessibility to mental health programs and preventive healthcare providers for this population. Additionally, policies which expand subsidized childcare programs and extend operating hours would allow parents with the flexibility to access these services.

Practice Implications

Findings from this dissertation inform many opportunities for nurses to adopt into their practice, especially at the prevention levels. First, early detection of hypertension through screening at healthcare appointments is critical to reduce risk of further damage to the

cardiovascular system (Lackland, 2017). Similarly, because findings from Manuscript 1 showed that chronic stress may contribute to high blood pressure, nurses and nurse practitioners can implement regular screenings for high levels of stress. Although not a diagnostic instrument, the Perceived Stress Scale may help to identify high-stress individuals who may be at risk of developing hypertension. For those experiencing substantial stress, nurses may also take the opportunity to educate patients about hypertension, lifestyle behaviors influenced by stress that are associated with hypertension, and how to choose strategies to cope with stress that are most adaptive and appropriate for handling their stressors.

Conclusions

In conclusion, findings from this dissertation showed that young, low-income adults experience significant stress which is associated with elevated blood pressure. Promoting adaptive emotion-focused coping strategies within stress management and hypertension prevention interventions may be one effective mechanism to address this pressing health problem. This dissertation contributes to science by advancing our understanding of the associations among psychological factors, including perceived stress and coping, and physiological outcomes such as long-term cortisol output and blood pressure. Findings from this dissertation can help to inform the design of future studies investigating stress and its influence on cardiovascular outcomes in low-income populations, as well as inform the design of interventions targeted at mitigating the negative effects of stress on health.

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