Intergenerational Mechanisms of Resilience Promoting Child Biobehavioral Health in Low-Income, Mexican-Origin Families

by

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ABSTRACT

Elevated rates of exposure to multi-level chronic stressors (e.g., poverty, discrimination, acculturative stress) place low-income, Mexican-origin individuals in the United States at elevated risk for adverse psychological and physical health across the lifespan. Despite exposure to contextual risk factors, many individuals maintain positive biobehavioral health. In particular, despite greater exposure to sociodemographic risk factors, more recently immigrated Mexican-origin individuals in the U.S. may demonstrate more positive biobehavioral health, warranting consideration of specific cultural values and practices that confer and maintain positive health across generations. Parental cultural socialization is an understudied mechanism in promotive pathways of parent-child processes and child biobehavioral health. Across three generations of Mexican-origin families in the United States – maternal grandmothers, mothers, children – the current study (1) identified a multidimensional measure of child biobehavioral health across psychological and biological indicators, (2) evaluated the intergenerational transmission of grandmother-mother cultural socialization, (3) evaluated the effect of maternal cultural socialization on child-perceived parenting and child biobehavioral health, and (4) evaluated child cultural orientation as a moderator of the effect of maternal cultural socialization on child-perceived parenting and child biobehavioral health. Findings highlight the complex and nuanced relations among parental cultural socialization, individual cultural orientation, child perceptions of parenting, and child biobehavioral health among low-income, Mexican-origin families in the United States.

DEDICATION

To the *Las Madres Nuevas* families, without whom this research would not be possible. It has been a privilege and honor to conduct research in partnership with three generations of your families and watch your children grow throughout my graduate school career. Thank you for sharing yourselves, your families, and your stories with us.

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CHAPTER 1

INTRODUCTION

Since 2000, the population of Mexican-origin families living in the United States has increased by over 75% (Noe-Bustamente, Flores, & Shah, 2019). Nearly 25% of foreign-born residents living in the United States have emigrated from Mexico, more than any other country of origin (Statista Research Department, 2021). The process of immigration confers both risk and opportunity for individuals and families, across generations, with important implications for children's emerging biobehavioral health, encompassing physical and mental health. In the United States, Mexican-origin children are more than twice as likely to live in poverty at the family level (Kids Count Data Center, 2017), and more than five times as likely to live in a high-poverty neighborhood than their non-Hispanic White peers (Kids Count Data Center, 2019). Mexican-origin children and families living in the United States may also experience frequent discrimination, racism, and other acculturative stressors (e.g., fear of deportation), which can negatively impact health across the lifespan (Ayon, 2015; Doane, Sladek, & Adam, 2018; Potter et al., 2019; Sanders-Phillips et al., 2009).

Exposure to chronic stressors, such as those associated with poverty or discrimination, compromises health via the cumulative effect of dysregulated physiological systems and allostatic load (McEwen, 2017), including cardiometabolic dysfunction (Jensen et al., 2017; McGrath et al., 2006; Suglia et al., 2018; Williams et al., 2018), dysregulated inflammatory responses (Jensen et al., 2017), and poor mental health (Mendoza et al., 2017; Yoshikawa et al., 2012). The autonomic nervous (ANS) system and hypothalamic-pituitary-adrenal (HPA) axis are largely responsible for

psychobiological processes underlying the stress response system (Bush & Roubinov, 2021). Following stimulus to a stressor, the sympathetic nervous system immediately activates a neurochemical response, the release of epinephrine, which causes multi-system changes throughout the body commonly referred to as the "fight or flight" response, including increased heart rate, more rapid breathing, the constriction of blood vessels, and the tightening of muscles (Chu et al., 2021; Tindle & Tadi, 2020). The parasympathetic nervous system, contrastingly referred to as the "rest and digest" response, inhibits arousal and promotes recovery from stress, acting almost as a brake to the sympathetic nervous system's gas pedal (Chu et al., 2021; Tindle & Tadi, 2020). While the ANS is fast-acting in response to a stressor, the HPA axis produces a slightly delayed (by minutes) hormonal cascade, which culminates in the release of cortisol (Bush & Roubinov, 2021; Rotenberg & McGrath, 2016).

In the context of an acute stressor, the cascading, coordinated, and interactive responses of the ANS and HPA axis, which span the release of hormones, neurotransmitters, cytokines, and other acute-phase reactant proteins (Johnson, Abbasi, & Master, 2013), aim to prepare an individual for adaptive maintenance of bodily homeostasis (Pervanidou & Chrousos, 2011). Their coordination and interaction are thought to contribute to adaptive vs. maladaptive responses to stress that compound to underlie physical and mental health (Rotenberg & McGrath, 2016). In the context of chronic stressors, prolonged activation of these stress response systems puts the body in a prolonged state of arousal, with associated physiological and psychological costs required

to achieve bodily homeostasis (i.e., allostatic load), with eventual wear and tear compromising subsequent biobehavioral health (Shonkoff et al., 2012).

A life course approach to chronic disease epidemiology highlights the importance of identifying longitudinal trajectories of preclinical phenotypes (i.e., early childhood biobehavioral health functioning) to understand how risk *and* resilience processes contribute to the development of disease across the lifespan (Ben-Shlomo, Cooper, & Kuh, 2016; Vasan, Zachariah, & Xanthakis, 2020). Early childhood exposures and experiences are thought to exert particularly long-lasting influence on pathways of health across the lifespan given the developing brain and body's heightened susceptibility to external influence (Danese et al., 2009), warranting investigation of pathophysiological pathways of biobehavioral health beginning early in life. Differential exposures to chronic stressors (e.g., poverty, discrimination, acculturative stress) during childhood are thought to contribute to racial and ethnic health disparities emergent in subsequent adulthood, across domains of cardiometabolic risk, immune function, and mental health (for review see Doane et al., 2018).

The majority of existing research, particularly during childhood, evaluate isolated measures of biobehavioral functioning (e.g., individual indicators of mental health or physical health, such as behavior problems or blood pressure). Recent reviews call for measurement of *multi-system* biobehavioral functioning across biological and psychological domains and emphasize that isolated measures of functioning cannot adequately capture positive or negative child adjustment in the context of risk (Bush & Roubinov, 2021; Masten et al., 2021). Multi-system approaches that incorporate multiple

indicators of interacting biological systems will contribute to our understanding of connections between psychosocial processes, pathophysiological pathways, and subsequent physical and mental health outcomes (Doane et al., 2018). Among a sample of adults, McCaffery and colleagues (2012) demonstrate this multi-system measurement approach by providing novel evidence that a single second-order factor of allostatic load underlays common variability among first-order factors of inflammation, blood pressure, lipids, insulin resistance, adiposity, and vagal tone. King et al. (2019) found support for a unidimensional factor structure of allostatic load among a sample of adolescents aged 12-18 years, in which allostatic load was directly influenced by each indicator variable (including creatine, albumin, body mass index, c-reactive protein, HDL cholesterol, LDL cholesterol, triglycerides, Epstein-Barr viral index, glycated hemoglobin, glucose, insulin, systolic blood pressure, white blood cell count, and waist circumference). Similar multi-system measurement work among young children remains to be explored. Vastly diverse measurement of allostatic load and holistic biobehavioral health limits comparison across studies and developmental periods. For example, McCaffery et al.'s (2012) allostatic load factor model is contrasted with Brody et al.'s (2014) allostatic load risk index (across indicators of cortisol, epinephrine, norepinephrine, blood pressure, CRP, and BMI), and other measures that look at individual biomarkers, with implications for empirical research (Howard & Sparks, 2016).

Particularly relevant to measurement of child adaptation among diverse populations, the inclusion of biological indicators may mitigate bias introduced by an overreliance on culturally based psychosocial measures of resilience (Masten, 1999;

Masten et al., 2019). Adaptive psychosocial functioning may be culturally subjective, such that what is considered adaptive functioning in one culture may be deemed maladaptive in another culture. Therefore, biological measures contribute to our ability to objectively define and distinguish levels of functioning. Similarly, children facing chronic stress may appear resilient as demonstrated by outward positive adjustment, but exhibit dysregulation across biological systems, suggesting there may be a cost to positive psychological adjustment in the context of chronic stress (Brody et al., 2013), and supporting the separation of biological and psychological outcomes in models. The opposite may also be true, such that outward psychological dysfunction may be accompanied with inward adaptive physiological functioning. For example, Dich and colleagues (2017) noted that, in the context of risky environments, higher negative emotionality was associated with more behavior problems among children, but higher negative emotionality also buffered the harmful effect of cumulative risk on allostatic load.

To capture and unravel such complex relations and mitigate the introduction of bias, the current study will measure child biobehavioral health across multi-system domains of cardiometabolic, inflammatory, and psychological functioning. Cardiometabolic, inflammatory, and psychological dysfunction have each been independently linked with abnormal activation of stress-sensitive systems and are well documented risk factors for subsequent adult health and disease (Chrousos & Gold, 1992; Danese, 2009). Several indicators of childhood cardiometabolic, inflammatory, and

psychological functioning will be evaluated in the current study, each with long-term implications for lifespan health, and psychosocial determinants during early childhood.

Mexican-origin individuals living in the U.S. exhibit higher prevalence of cardiometabolic risk factors, including obesity, dyslipidemia, prediabetes and diabetes, increasing rates of prehypertension and hypertension, and overall lower rates of cardiometabolic screenings and treatment (Rodriguez et al., 2014), placing them at elevated risk for development of cardiovascular disease across the lifespan. Racial-ethnic cardiometabolic health disparities emerge early in life. As early as infancy and toddlerhood, Mexican American children are nearly two times more likely to fall at or above the 95th percentile for weight-for-height compared to non-Hispanic peers, and these disparities continue throughout childhood and adolescence (Ogden et al., 2012). Multifaceted risk factors (i.e., behavioral, environmental, genetic) place children at elevated risk for unhealthy levels across these cardiovascular indicators early in life. Lower socioeconomic status is strongly predictive of early cardiovascular disease risk (e.g., high blood pressure, high cholesterol, type 2 diabetes, and high BMI; Hamad et al., 2020). Differential rates of exposure to poverty compound the risk for poor cardiovascular health among racial and ethnic minority groups (Hamad et al., 2020; Rodriguez et al., 2014; Shenassa et al., 2020). Indicators of cardiometabolic health in the current study will include blood pressure (systolic, diastolic), non-fasting glycated hemoglobin (HbA1c), blood glucose, plasma triglycerides (TG), high-density lipoprotein (HDL) cholesterol, body mass index (BMI; kg/m^2), waist circumference, and cardiovagal functioning.

Inflammatory biomarkers have received a growing amount of empirical attention in recent years for their documented association with chronic stress exposure, and physical and mental health across the lifespan (Del Guidice & Gangestad, 2018). Indicators of inflammation in the current study will include interleukin-6 (IL-6) and c-reactive protein (CRP), given well-documented association with psychosocial determinants and subsequent health outcomes. Elevated levels of IL-6, a proinflammatory cytokine, emerge during the acute phase of infection and serve to notify the body of an infectious agent (Velazquez-Salinas et al., 2019). Upregulation of IL-6 may also play a role in the exacerbation of chronic disease (Velazquez-Salinas et al., 2019). Under the regulation of IL-6, CRP is produced by the body's liver as part of the acute-phase or early inflammatory response (Johnson, Abbasi, & Master, 2013). IL-6 and CRP play important roles in the body's adaptive immune response. However, exposure to chronic stressors may result in systemic inflammation, or prolonged overproduction or upregulation of IL-6 and CRP (Yamamoto, Okazaki, & Ohmori, 2011). Elevated levels of serum IL-6 and CRP may serve as key mechanisms underlying the effect of stress on subsequent disease (Jankord et al., 2010).

Several psychosocial stressors predict elevated IL-6 levels in the short- and long-term, including retrospective childhood maltreatment and adversity (Carpenter et al., 2010), family-level financial hardship (Kokosi, Flouri, & Midouhas, 2020), everyday and lifetime discrimination (Kershaw et al., 2016), and internalizing disorders (de Baumont et al., 2019). Similarly, elevated CRP levels have been linked with multiple domains of psychosocial stress (Johnson et al., 2013), prenatal and early childhood adversity (Slopen

et al., 2015), residence in neighborhoods with high levels of crime or poverty (Broyles et al., 2012), and higher frequency of everyday discrimination (Lewis et al., 2010). Many of the longitudinal studies examining the effect of childhood psychosocial stressors on subsequent biomarkers indicative of systemic inflammation evaluate IL-6 and CRP levels in adulthood. Much remains to be understood regarding predictors of early-in-life inflammatory functioning how these pathophysiological processes unfold throughout development.

Childhood internalizing (i.e., depressive, anxiety, and somatic symptoms) and externalizing symptoms (i.e., conduct and behavior problems) are similarly associated with early-life adversity and subsequent health dysfunction across the lifespan. Thus, low levels of internalizing and externalizing symptoms will be conceptualized to contribute to holistic child biobehavioral health. A growing body of empirical work highlights the validity of mental health symptoms emerging during early childhood, with the documented longitudinal continuity and increased symptom severity into school-age, adolescence, and adulthood (Luby et al., 2014; Whalen et al., 2021). Prenatal and early-life exposure to chronic stressors compromise children's emerging self-regulatory capacity, with deleterious implications for emerging mental health (Evans & Kim, 2012). Alternative psychosocial stressors, like exposure to discrimination (Berkel et al., 2010) or acculturative stress (Holleran & Jung, 2005), are also documented to negatively impact mental health among older Mexican American youth. Adult mental health and coping behaviors may be one mechanism underlying the effect of exposure to early life adversity on adult physical health (Monnat & Chandler, 2015), again warranting longitudinal

investigation of psychological adjustment earlier in life within a life course epidemiological framework.

A growing body of work documents emerging relations among cardiometabolic, inflammatory, and psychological risks early in life. Recent findings suggest that poorer psychological functioning (higher levels of internalizing and externalizing symptoms) is associated with poorer cardiometabolic health (Qureshi et al., 2019) and elevated inflammatory markers (de Baumont et al., 2019; Slopen et al., 2013) during childhood. Elevated inflammatory markers have also been associated with cardiovascular risk factors among youth, including adiposity, HDL-cholesterol, and atherosclerosis (Cook et al., 2000; de Baumont et al., 2019; Jarvisalo et al., 2002). Positive outward psychosocial functioning in concert with inward biological functioning (e.g., low levels of internalizing and externalizing symptoms, coupled with healthy inflammatory levels and low cardiometabolic risk) may serve as an indicator of holistic child adaptation in the context of risk. Longitudinal studies beginning early in life provide opportunity to examine early-life psychosocial processes affecting biobehavioral health indicators during childhood, with implications for long-term health outcomes.

Despite exposure to multi-level (e.g., individual, family, neighborhood, etc.) chronic stressors, marginalization, discrimination, and socioeconomic inequalities, many families and children exhibit positive biobehavioral health. Importantly, a deficit perspective that focuses solely on risk fails to consider demonstrated resilience among families and alternative mechanisms that may simultaneously confer positive child biobehavioral health within the context of risk. In the context of chronic stressors,

positive biobehavioral health may serve as one indicator of child and family resilience and provide insight into identification of protective mechanisms relevant to prevention of subsequent maladaptive health outcomes (i.e., adult disease). Among Mexican American individuals in particular, immigrant generational status is often inversely related to biobehavioral health (McGlade et al., 2004; Padilla et al., 2009). Despite facing greater sociodemographic risk (e.g., family- and neighborhood level socioeconomic disadvantage, lower levels of educational attainment, less access to healthcare, more frequent discrimination, etc.), more recently immigrated Mexican-origin individuals often exhibit more positive biobehavioral health outcomes than U.S.- born individuals of Mexican origin, a phenomenon commonly referred to as the "Hispanic paradox" or immigrant paradox (Callister & Birkhead, 2002; de la Rosa, 2002). Paradoxical health outcomes are documented across the lifespan among Mexican-born individuals, seen as early as the immediate postnatal period in birthweight (Osypuk, Bates, & Acevedo-Garcia, 2010) through adulthood, across rates of past-year depressive and anxiety disorders, hypertension, cardiac disease, diabetes, asthma, and cancer compared to U.S. born peers (Gonzales et al., 2011; Ruiz, Steffen, & Smith, 2013).

At the individual level, familial and cultural factors are posited to explain paradoxical biobehavioral health outcomes, including alignment to traditional Mexican cultural values that guide cognition and behavior, familial support, and attitudes towards parenting and family in ways that promote positive parent-child relationships (Fox et al., 2018; Page, 2007). Prior work among Mexican origin adults in the U.S. found that U.S.-born individuals had higher allostatic load scores than their Mexican born counterparts, a

finding that was not better accounted for by English language use, social integration, or cultural assimilation (Peek et al., 2010). Doane et al. (2018) interpret this finding as evidence to suggest that it is not simply exposure to new cultural values and practices that confers risk via acculturative processes, but the loss of culturally-specific protective factors that erodes health. Thus, examination of specific cultural values and practices will strengthen our understanding of mechanistic pathways promoting biobehavioral health.

Less work has considered culturally based mechanisms promoting biobehavioral health during early childhood. However, the emerging field of cultural neurobiology provides evidence that culture and psychobiological processes are intertwined across the lifespan (Doane et al., 2018). Given the heritable nature of both biology and culture, parenting processes and the parent-child relationship may offer an informative lens through which we can aim to understand how cultural processes that get passed down across generations within a family can confer positive biobehavioral health among younger children. In general, positive, supportive parenting is one of the most empirically supported mechanisms through which positive adjustment is transmitted from one generation to the next (Luthar et al., 2015; Masten, 2014; Masten et al., 2021). For example, emotionally supportive parenting has been found to buffer the effect of psychosocial stressors (i.e., perceived racial discrimination during adolescence) on increased allostatic load in adulthood (measured by cortisol, epinephrine, norepinephrine, blood pressure, CRP, and BMI; Brody et al., 2014). Interventions targeting positive child adjustment in the context of adversity or chronic stress most frequently focus on promoting the quality of parenting (Masten & Cicchetti, 2016; Sandler et al., 2011). One

of the most powerful predictors of parenting behavior is how parents were parented themselves; indeed, a large body of research supports the intergenerational continuity of general parenting behaviors and styles (Belsky, Conger & Capaldi, 2009), although less work has specifically evaluated the transmission of parenting across three generations of Mexican origin families.

Importantly, parenting is embedded within broader contexts that confer both stressors and supports (Belsky, 1984). Parenting behavior and practices (e.g., how parents socialize children) reflect that individual's alignment to values and goals, shaped largely by cultural background and orientation, relevant to Mexican American families in the United States (Fuller & Garcia Coll, 2010; Gonzales et al., 2002). Concurrent and corresponding changes in alignment to traditional cultural values and parenting practices across the acculturative process are documented among Hispanic/Latinx families in the United States (Calzada, Fernandez, & Cortes, 2010), suggesting that parenting practices and parent-child interactions may change as individuals within the family unit acculturate. Much like parenting, cultural values, practices, and norms are transmitted from one generation to the next (Knight et al., 2011), a process known as cultural socialization (Calzada et al., 2011). Among Mexican origin families, maternal cultural socialization of her child (e.g., the degree to which mother is socializing her child to traditional Mexican American values) explained positive longitudinal effects of maternal alignment to cultural values on child alignment to cultural values (Knight et al., 2011). Just as individual alignment to cultural values is hypothesized to explain paradoxical health outcomes, parental cultural socialization may similarly confer positive adjustment

across multiple generations within a family to promote child biobehavioral health within the context of risk (Fox et al., 2018), by fostering the maintenance of values in the next generation. However, the process by which parents transmit cultural values, beliefs, and behaviors to their children as an intergenerational resilience mechanism is less understood. Only one study to our knowledge has examined cultural socialization practices across *three* generations of Mexican-origin families, finding that grandmother-mother cultural socialization predicted mother-child cultural socialization, which promoted young children's developmental competencies (Williams et al., 2020).

Two recurring aspects of parental cultural socialization of children among Mexican origin families in the United States are dimensions of *respeto* (respect) and independence. Qualitative work among Mexican American mothers suggests that women were most concerned with transmitting values of respect, family, and religion to their children (Calzada et al., 2010; Calzada, 2010). Values of respect emphasize obedience to parents and adults, proper manners and behavior (*bien educado*), and serve as values that aim to maintain harmony within the family and broader networks (Calzada et al., 2010; González-Ramos, Zayas, & Cohen, 1998). Socialization of respect is associated with more family cohesion and less family conflict, more authoritarian parenting, less encouragement of child autonomy and exploratory behavior, and lower levels of acculturation (Calzada et al., 2010; González-Ramos et al., 1998; Lorenzo-Blanco et al., 2012). Respect is contrasted with American values of independence, which emphasize and encourage child openness, autonomy, and assertiveness, and is associated with higher

levels of acculturation and more authoritarian parenting among Mexican origin mothers (Calzada et al., 2012; 2017).

Although respect has been described as "the foundation for successful child development" among focus groups with Mexican American mothers (Calzada et al., 2010), little work has evaluated the effect of parental cultural socialization of respect and independence on child biobehavioral health. Findings regarding the promotive effects of cultural socialization of respect vs. independence on children's emerging mental health (internalizing symptoms, externalizing symptoms, somatization symptoms) are mixed (Calzada et al., 2012; Calzada et al., 2017; Gil et al., 2000; Lorenzo-Blanco et al., 2012). For example, among Mexican origin mother-preschooler dyads, higher socialization of respect has been associated higher levels of authoritarian parenting and greater internalizing problems (Calzada et al., 2017). Contrastingly, higher child alignment to respect was associated with higher levels of family cohesion and lower levels of family conflict among a large sample of Hispanic youth (M_{age} = 13.97 years), with subsequent protective effects on depressive symptoms (Lorenzo-Blanco et al., 2012). Positive parent-child relationships may further underlie the link between parental cultural socialization and child biobehavioral health functioning (Tsai et al., 2015), such that child perceptions of parental behavior may serve as a mechanism in promotive pathways from cultural socialization to child biobehavioral health.

Further, mixed findings are consistent with a growing body of theoretical and empirical work supporting the notion that cultural values may confer opportunity and risk for individual biobehavioral health, dependent on the individual's broader relational,

familial, cultural, and developmental contexts (Calzada et al., 2014; Calzada & Sales, 2019). For example, although familism values may generally promote child biobehavioral health, familial responsibilities and expectations (e.g., translating for non-English-speaking family members or providing childcare) may contribute to added stress and subsequent risk of poor biobehavioral health as children age (Fuligni et al., 2009; Telzer, Gonzales, & Fuligni, 2014). Perhaps, a child's own cultural orientation or level of acculturation impacts the degree to which cultural socialization practices are perceived as promotive vs. harmful. Parental cultural socialization of traditional values may similarly confer risk and protection across development. Calzada et al. (2012) emphasize cultural values to be fundamental to parental childrearing goals of parents and call for future empirical work examining the longitudinal effects of socialization of respect and independence among Mexican origin youth across different developmental stages. Future work is needed to understand the role of cultural socialization and alignment to traditional cultural values across generations of Mexican-origin families, navigating the process of immigration to the United States, in relation to child perceptions of parenting and biobehavioral health.

Current Study

Across three generations – maternal grandmother (G1), mother (G2), and child (G3) – the current study evaluated intergenerational cultural mechanisms of resilience promoting biobehavioral health (measured across indicators of biological and psychological functioning) among a sample of Mexican-origin families in the United States facing socioeconomic disadvantage at the family and neighborhood levels.

Parental cultural socialization (of respect and independence) was evaluated as an intergenerational cultural mechanism promoting perceptions of parenting and child biobehavioral health. By taking a strengths-based approach, we can aim to identify and support existing protective mechanisms within children facing contextual risk and families navigating immigration to the U.S.

Preliminarily, the current project evaluated a multidimensional measure of child biobehavioral health at 7.5 years, informed by prior work among adults and adolescents which examined the factor structure of allostatic load indicators (King et al., 2019; McCaffery et al., 2012; see Figures 1 and 2). In line with prior work, a single second-order factor of allostatic load was hypothesized to emerge and underlie variatiation in first-order factors, including blood pressure (systolic, diastolic), inflammation (IL-6, CRP), adiposity (BMI, waist circumference), lipids (triglycerides, HDL), glycemic functioning (HbA1c, glucose), and cardiovagal functioning (mean resting heart rate, high-frequency heart rate variability). A separate psychological factor was hypothesized to emerge from internalizing and externalizing symptoms. The allostatic load factor was hypothesized to correlate positively with the psychological factor, such that higher allostatic load was expected to be associated with higher levels of mental health symptoms. The best-fitting measure of child biobehavioral health was to be used as the outcome(s) in models for Aims 2 and 3.

First, the current project evaluated the grandmother-mother transmission of cultural socialization practices via maternal acculturation (see Figure 3). More traditional grandmaternal cultural socialization of mother (higher cultural socialization of respect,

lower cultural socialization of independence) was hypothesized to predict lower maternal acculturation (higher Mexican orientation, lower Anglo orientation), which was expected to predict more traditional maternal cultural socialization of child (higher respect, lower independence).

Second, the current project evaluated child perceptions of parenting (child-perceived maternal warmth and rejection/harshness) as mechanisms underlying the effect of parental cultural socialization practices (independence, respect) on subsequent biobehavioral health (see Figure 4). Given mixed findings in existing literature, hypotheses reflected consistency with the Hispanic paradox framework. More traditional maternal cultural socialization of child (higher cultural socialization of respect, lower cultural socialization of independence) was hypothesized to predict higher child-perceived maternal acceptance and lower child-perceived maternal rejection/harshness. Higher child-perceived maternal acceptance was expected to predict greater child biobehavioral health, whereas higher child-perceived maternal rejection/harshness was hypothesized to predicted poorer child biobehavioral health.

Third, child acculturation level was evaluated as a potential moderator of the effect of parental cultural socialization on child-perceived parenting (see Figure 5). Among less acculturated children (higher Mexican orientation, lower Anglo orientation), higher maternal socialization of independence was hypothesized to predict higher child-perceived maternal acceptance. Among more acculturated children (lower Mexican orientation, higher Anglo orientation), higher maternal socialization of respect was hypothesized to predict higher child-perceived maternal rejection/harshness.

CHAPTER 2

METHOD

Participants

The current study utilized data from and contributed a unique grandparent component to an ongoing longitudinal study of 322, low-income, Mexican American mother-child dyads (*Las Madres Nuevas*; LMN). Eighty maternal grandmothers (hereafter referred to as grandmothers) were newly recruited and participated in novel data collection for the current study. At LMN study enrollment, mothers (G2) were between 18 and 42 years of age (M = 27.8; SD = 6.5); most women were born in Mexico (86%) and spoke Spanish as their primary language (82%); women had lived in the United States for approximately 12 years on average (range 0-32); modal family income was $10,001-$15,000 for an average household of four people: and most women were not first-time mothers (77.8%). See Table 1 for full maternal and child sample demographics at enrollment. See Table 2 for full grandmaternal sample demographics.

Procedure

LMN Study Procedure. Pregnant women (N = 322) were recruited from hospital-based, community prenatal clinics within the Maricopa Integrated Health System (MIHS) between 2010-2012. Eligibility criteria included: (1) self-identification as Mexican or Mexican American, (2) English or Spanish fluency, (3) at least 18 years of age, (4) low-income status (i.e., family income below $25,000 or eligibility for Medicaid or Federal Emergency Services coverage for the childbirth), and (5) anticipated delivery of a singleton birth with no prenatal evidence of health or developmental problems. The

study was approved by the Institutional Review Boards at Arizona State University and Maricopa Integrated Health System. Beginning prenatally, mothers and children participated in various home and laboratory visits and telephone surveys assessing biological, parent-report, child-report, and observational data. The current study used LMN data collected at the prenatal home visit, a phone survey at child age 4 years, and a laboratory visit at 7.5 years. The full LMN sample (N = 322) completed the prenatal home visit, 210 mothers (65.2% of the full sample) completed the 4-year phone survey, 230 dyads (71.4%) completed the 4.5-year visit, and 240 dyads (74.5%) completed the 7.5-year visit.

Current Study Procedure. Novel data collection with the grandmothers was approved by the Institutional Review Board at Arizona State University. During ongoing phone surveys with mothers as part of the parent study, LMN interviewers requested permission from mothers to contact the maternal grandmother of their child and gather contact information (via telephone, WhatsApp, etc. dependent on grandmother preference and residence in Mexico vs. United States). With mothers' approval, grandmothers were contacted by trained bilingual interviewers and invited to participate. Grandmother eligibility criteria included identification as Mexican or Mexican-origin and fluency in English or Spanish. Prior to beginning data collection with the grandmothers, interviewers completed CITI Human Research Subjects training, training in ethical dilemmas and safety, multiple practice phone surveys, and role plays. The interviewer read the informed consent form aloud in grandmother's preferred language (English/Spanish) and verbal consent was digitally recorded prior to beginning the

interview. Grandmother responses to survey items were entered into a computer-based survey system. Interviews lasted approximately 45 minutes and grandmothers were compensated $30 for the full telephone interview.

The primary measures used for phone surveys with grandmothers were translated into Spanish and adapted for cultural sensitivity in the same manner as for ongoing data collection with the LMN mothers. The following translation and adaptation activities were conducted for earlier LMN timepoints: (1) review and adaptation of items and protocols for local cultural adaptation, (2) translation and back-translation, and (3) field testing to ensure cultural sensitivity for our population (Behling & Law, 2000). At later timepoints, all measures not already available in Spanish were translated and back-translated by native Spanish speakers fluent in English and Spanish. Discrepancies were resolved by the principal investigators. See Table 3 for full list of measures.

Attrition

At the 7.5-year laboratory visit, 87% of the original 322 mother-child dyads enrolled in the study were retained. Due to shut down of in-person research activities because of the COVID-19 pandemic, only 181 participants completed the in-person laboratory portion of the 7.5-year visit. Participants with missing data for the in-person portion at the 7.5-year visit did not significantly differ statistically from those who participated across sociodemographic indicators, including child biological sex, family income or economic hardship, maternal country of birth, maternal age, or maternal education level (all p's > .05).

Measures

Child biobehavioral health.

Biological indicators. At the 7.5-year laboratory visit, child blood pressure (systolic and diastolic) was measured 3 times at 1-minute intervals while the child was seated and quiet, using an Omron HEM907XL automatic digital blood pressure monitor. The last two readings were averaged for data analysis.

Measures of mean heart rate and heart rate variability were obtained as indicators of cardiovagal functioning during a 7-minute resting period with the child seated quietly at a table watching a neutral video. Three electrodes were placed on the chest and abdomen to record continuous interbeat interval (IBI) and electrocardiogram (ECG) data using a computer-based ECG monitor. QRSTool software was used to extract the IBIs from the first 5 minutes of the 7-minute baseline period (Allen, Chambers, & Towers, 2007), and then imputed into CardioEdit and CardioBatch software (Brain-Body Center, 2007) to compute measures of mean heart rate and high-frequency heart rate variability (for children, 0.24 to 1.04 Hz; Quintana et al., 2016). The mean HF-HRV estimate was averaged from 30-second epochs throughout the 5-minute measurement period. Although HF-HRV has been critiqued for being more sensitive to respiration than other measures of heart rate variability, when participants are seated as in the current study, respiration is thought to exert little impact on resting sinus arrythmia or HF-HRV amplitude (Denver, Reed, & Porges, 2007).

Waist circumference (centimeters), an index for adipose tissue distribution, was measured with a measuring tape at the umbilicus level. Weight (lbs.) was measured using

a calibrated precision Tanita digital scale. Standing height was measured using a wall-mounted stadiometer. BMI was calculated from weight and height (kg/m^2).

At the end of the visit, capillary blood samples were obtained using a fingerstick method. Cardiometabolic indicators, including non-fasting glycated hemoglobin (HbA1c), glucose, plasma triglycerides (TG), and high-density lipoprotein (HDL) cholesterol, were assayed immediately using an Alere Cholestech LDX machine, which analyzed blood samples using Lipid Profile and GLU cassettes (Cholestech Alere Health Hayward, CA, USA). Fingerstick blood spots were also collected to measure inflammatory markers (C-reactive protein, CRP; interleukin-6, IL-6). Blood spots were left at air temperature overnight for drying. Within 24 hours, dried blood spots were stored in a freezer at -10 degrees Fahrenheit. Blood spots were then shipped for analysis to the University of Washington Department of Laboratory Medicine (UWLM) Clinical Chemistry and Biomarker Laboratory, assayed under the supervision of Dr. Alan Potter.

Psychological indicators. At the 7.5-year laboratory visit, mothers reported on child internalizing and externalizing symptoms using the 118-item Child Behavior Checklist (CBCL/6-18; Achenbach, 1991), which assesses children's behavioral, social, and emotional functioning. The current study will use the internalizing symptoms (anxious-depressed, somatic complaints, withdrawn; Cronbach's $\alpha = .82$) and the externalizing symptoms (aggressive behavior, rule breaking behavior; Cronbach's $\alpha = .89$) subscales. Respondents rate each behavior on a 3-point scale (0 = not true; 2 = very true or often true) as it occurs now or within the past two months. Sex- and age-based norms are available for standardized clinically significant levels of internalizing and

externalizing problems. The CBCL has been validated among Spanish-speaking and Hispanic/Latinx populations (Rubio-Stipec, Bird, Canino, & Gould, 1990). At 7.5 years, 14.5% and 7.2% of children were reported to have clinical levels of internalizing and externalizing symptoms respectively (using a T-score of 65 as a cutoff; Biederman et al., 2020).

Child report of maternal parenting. At the 7.5-year laboratory visit, children reported on their perception of maternal parenting using a revised version of the Child Report of Parenting Behavior Inventory – Mother (CRPBI; Schaefer, 1965). On the CRPBI, respondents assess the perceived frequency of their parents' parenting behaviors across domains of acceptance (8 items; e.g., "Your mother made you feel better after talking over your worries with her"), rejection (5 items; e.g., "Your mother acted as if you were in the way"), and harshness (7 items; e.g., "My mother screamed at me when I did something wrong") using a 5-item Likert scale (1 = almost never or never; 5 = almost always or always). Higher scores on each subscale indicate higher levels of perceived maternal acceptance (Cronbach's $\alpha = .71$) and rejection/harshness (Cronbach's $\alpha = .77$).

Cultural socialization of children. At the 4.5-year laboratory visit, mothers reported on her cultural socialization of her child using a shortened version of the Cultural Socialization of Latino Children (CSLC; Calzada, 2007; Calzada et al., 2012). Mothers rated the frequency with which they encouraged values of respect (12 items; Cronbach's $\alpha = .86$; e.g., "I tell my child to defer to adult wishes") and independence (7 items; Cronbach's $\alpha = .81$; "I encourage my child to tell me when he disagrees with me")

in their children. Higher scores on each subscale indicate higher maternal cultural socialization efforts with children.

Additionally, grandmothers retrospectively reported on her cultural socialization of mother using a modified version of the CSLC (e.g., When my child was growing up… "I told my child to defer to adult wishes" or "I encouraged my child to tell me when she disagreed with me"), which yielded similar subscales of respect (Cronbach's $\alpha = .83$) and independence (Cronbach's $\alpha = .71$).

Acculturation. At the 4-year phone call, mothers reported on her level of acculturation using the Acculturation Rating Scale for Mexican Americans – II (ARSMA-II; Cuellar, Arnold, & Maldonado, 1995). Mothers rated the frequency with which they aligned to Mexican orientation (17 items; e.g., "I like to identify myself as Mexican and/or Mexican American"; "I enjoy listening to Spanish language music") and Anglo orientation (13 items; e.g., "I like to identify myself as American"; "I enjoy listening to English language music) using a 5-item Likert scale (1 = not at all; 5 = extremely often or almost always). Higher scores on each subscale indicate higher Mexican (Cronbach's $\alpha = .87$) and Anglo (Cronbach's $\alpha = .93$) orientations.

At the 7.5-year laboratory visit, mothers reported on child alignment to cultural values using an adapted version of the ARSMA-II (Cuellar, Arnold, & Maldonado, 1995). Mothers rated the frequency with which children aligned to Mexican orientation (e.g., "My child likes to call him/herself Mexican and/or Mexican American"; "My child enjoys listening to Spanish language music") and Anglo orientation (e.g., "My child liked to call him/herself American"; "My child enjoys listening to English language music)

using a 5-item Likert scale (1 = not at all; 5 = extremely often or almost always). Higher scores on each subscale indicate higher child Mexican (Cronbach's α = .77) and Anglo (Cronbach's α = .80) orientations. A linear acculturation score was calculated by subtracting children's mean Mexican orientation score from their mean Anglo orientation score, creating a continuum from higher Mexican orientation (lower scores) to higher Anglo orientation (high scores) (Cuellar et al., 1995); average scores indicate bicultural orientation (similar level of Mexican and Anglo orientation).

Demographic variables and potential covariates. Similar to data collection from mothers, grandmothers reported on several sociodemographic variables, including grandmaternal country of birth (coded 0 = United States, Mexico = 1). At the prenatal visit, mothers reported on their country of birth (coded 0 = United States, Mexico = 1) and family income (1 = less than or equal to $5,000, 2 = $5,001 – 10,000… 20 = $95,001-$100,000, 21 = Over $100,000). Child biological sex (coded 0 = male, 1 = female) was collected from medical record and mothers confirmed information in first postpartum visit. Grandmother, mother, and child sociodemographic variables will be considered for inclusion in final statistical models.

Auxiliary variables. Given only 80 grandmothers participated in data collection (of the original sample of 322 families; of 262 actively participating families at time of data collection), potential auxiliary variables were evaluated for inclusion in the Aim 1 model to aid FIML methodology. Several variables were hypothesized to correlated with grandmother participation/missingness and therefore evaluated as potential auxiliary variables for inclusion in the final Aim 1 model. Correlation analyses were evaluated

among grandmother missingness (coded 1 = missing, 0 = participated/not missing) and potential auxiliary variables, including prenatal maternal report of family conflict/cohesion (when mother was growing up), maternal report of the female head of household when growing up (1 = biological mother, 0 = other), family income, and primary study variables for Aim 1 (maternal Mexican orientation, maternal Anglo orientation, maternal cultural socialization of respect, maternal cultural socialization of independence). Variables that were correlated with grandmother missingness were included as auxiliary variables for the final Aim 1 model.

Data Analyses

Preliminary analyses. Preliminary analyses included descriptive statistics and correlations among primary study variables and covariates. Preliminary analyses also included evaluation of potential demographic covariates (grandmother country of birth, mother country of birth, child biological sex, family income) for inclusion in primary models. Variables with significant relations ($p < .05$) to primary study variables or missingness were considered for inclusion in primary models.

Primary study variables were examined for non-normality, including outliers, skewness, and kurtosis. Any variables with non-normal skew or kurtosis were considered for log transformation. Cases with values more than 3 standard deviations from the mean on primary study variables were identified as potential outliers and evaluated for inclusion in final models. Any biological values outside of plausible range were also flagged and excluded from primary analyses presented. Primary models were evaluated

with and without outliers; if the pattern of significance or model fit changed significantly, outliers were excluded from final primary models.

All preliminary measurement work and primary analyses were conducted in Mplus version 8 (Muthén & Muthén, 1998-2017). Mplus uses all available values and maximum likelihood estimation among cases with missing data, an approach considered superior to pairwise or listwise deletion (Enders & Bandalos, 2001). Preliminary measurement analyses evaluated the factor structure of a multidimensional measure of biobehavioral health among the child sample across indicators of biobehavioral functioning (BMI, waist circumference, glucose, HbA1c, HDL cholesterol, triglycerides, average systolic blood pressure, average diastolic blood pressure, IL-6, CRP, heart rate variability, mean heart rate, internalizing symptoms, and externalizing symptoms). Exploratory factor analysis (EFA) was first conducted to identify the underlying factor structure of the biological and psychological indicators of child biobehavioral health. Examination of eigenvalues in the scree plot and parallel analysis were used to determine the suggested factor structures to test in the EFA. Robust maximum likelihood (ML) factor analysis and oblique geomin rotation was used to allow for correlations among factors.

Confirmatory factor analysis (CFA) was then conducted to evaluate the best-fitting model of child biobehavioral health supported by the EFA. Informed by prior empirical work examining allostatic load factor structure across the lifespan (King et al., 2019; McCaffery et al., 2012) and the results of the EFA, a series of confirmatory factor analyses (CFA) were conducted to evaluate the model fit of various factor structures of

multi-system biobehavioral health. Given vastly different possible ranges of values across biobehavioral indicators, all indicators were transformed to standard normal variables (mean = 0; SD = 1) to be in the same metric (consistent with King et al., 2019). Model fit was evaluated on fit indices including comparative fit index (CFI) ≥ 0.90 (Bentler & Bonett, 1980), standardized root mean square residual (SRMR) < 0.08, and root mean square error of approximation (RMSEA) ≤ 0.08 (Brown & Cudeck, 1993), Akaike information criterion (AIC), and Bayesian information criteria (BIC). Significant improvement across competing model structures was be determined by ≥.005 change in CFI, ≤ -.010 change in RMSEA, and change in BIC > 10 as strong evidence in favor of the model with the lowest Mplus BIC value given comparison of fit across non-nested model structures (Kass & Raftery, 1995).

Guided by existing empirical work, hypothesized potential factor structures included a unidimensional model of biobehavioral health (see Figure 6a), a multi-factor model of biobehavioral health (see Figure 6b), a multi-factor model of allostatic load without psychological indicators (see Figure 6c), a higher-order biobehavioral health factor with psychological indicators included (see Figure 6d), a higher-order allostatic load factor with psychological indicators excluded (see Figure 6e), and a higher-order allostatic load factor with a higher-order metabolic syndrome factor (see Figure 6f). Any latent factors with only two indicators were estimated by constraining commonality (standardized factor weights) to be equal.

Primary analyses.

Aim 1. Structural equation modeling (SEM) was used to evaluate the grandmother-mother transmission of cultural socialization practices (see Figure 3). This model evaluated the effect of grandmaternal cultural socialization of mother (independence, respect) on maternal cultural socialization of child (independence, respect) via maternal acculturation (Anglo orientation, Mexican orientation), controlling for maternal country of birth. Single-path mediation tests were evaluated by examining the statistical significance of the total indirect effect using bootstrap confidence intervals; if the 95% confidence interval did not include zero, the indirect path was considered statistically significant (MacKinnon et al., 2004).

Aim 2. SEM was used to evaluate the effect of maternal socialization of child (independence, respect) on child mental health and allostatic load, via child perceived maternal acceptance and child perceived maternal rejection/harshness, controlling for child biological sex and maternal country of birth (see Figure 4). Single-path mediation tests were evaluated by examining the statistical significance of the total indirect effect using bootstrap confidence intervals.

Aim 3. SEM was used to evaluate the effect of maternal cultural socialization of child (independence, respect), child acculturation, and the interaction of maternal cultural socialization practices and child acculturation, on child perceived maternal acceptance and maternal rejection/harshness and subsequent child mental health and allostatic load, controlling for maternal country of birth and child biological sex (see Figure 5). Single-path mediation tests were evaluated by examining the statistical significance of the total indirect effect using bootstrap confidence intervals. Significant interaction effects were

probed by evaluating the statistical significance of the simple slopes of the effect of maternal cultural socialization practices on child perceived parenting at average low (-1SD), and high (+1 SD) levels of child acculturation (Aiken & West, 1991).

CHAPTER 3

RESULTS

Preliminary results.

Descriptive statistics. Descriptive statistics (mean, standard deviation, and range) and correlations among primary study variables and covariates are presented in Tables 4-7 by primary aim. IL-6 and CRP values were log-transformed for preliminary and primary analyses presented; both raw data and log-transformed values are presented in descriptive tables. Given significant associations with at least one primary study variable (see Table 6 and 7), maternal country of birth and child biological sex were included in final primary models presented. Family income was not correlated with any primary study variable (all *p*'s > .05) and thus excluded from primary analyses. Although initially considered, grandmother country of birth was not included as a covariate given almost no variability (approximately 97% of grandmothers born in Mexico).

Outliers. Twenty-five outliers were identified (values more than 3 standard deviations from the mean) across primary study variables (maternal cultural socialization of independence, maternal cultural socialization of respect, child perceived maternal rejection/harshness, child perceived maternal acceptance) and child biobehavioral indicators (including BMI, CRP, triglycerides, IL-6, waist circumference, systolic BP, diastolic BP, mean heart rate, internalizing symptoms, and externalizing symptoms). The pattern (significance and direction) of primary results did not change when these cases were excluded from analyses; therefore, all cases were retained in analyses presented.

Auxiliary variables. Grandmother missingness was not correlated with any primary study variable or potential covariate, including maternal country of birth (r = -.081, p = .15), maternal Mexican orientation (r = .011, p = .87), maternal Anglo orientation (r = -.034, p = .61), maternal cultural socialization of respect (r = .072, p = .28), and maternal cultural socialization of independence (r = -.040, p = .54), and family income (r = -.063, p = .26). Neither family cohesion (r = -.088, p = .11) nor family conflict (r = .095, p = .09) were significantly correlated with grandmother missingness; however, directional relations were as hypothesized, such that higher family conflict and lower family cohesion trended towards associations with grandmother missingness. Given family cohesion and family conflict were highly correlated with one another (r = .601, p < .001), family conflict was chosen for inclusion as an auxiliary variable given its strongest correlation with grandmother missingness and theoretical justification.

Exploratory factor analyses. The first EFA evaluated the factor structure of BMI, waist circumference, glucose, HbA1c, HDL cholesterol, triglycerides, systolic blood pressure, diastolic blood pressure, mean heart rate, heart rate variability, IL-6, CRP, internalizing symptoms, and externalizing symptoms. Comparison of parallel analysis and the scree plot suggested evaluation of a one-, two-, three-, and four-factor solution. The first four sample eigenvalues were 3.874, 1.792, 1.602, and 1.367 respectively. The first four eigenvalues from parallel analysis were 1.886, 1.546, 1.423, and 1.328. Factors were considered significant if the associated eigenvalue is bigger than that derived from the random data (Horn, 1965). Across factor solutions, biological and psychological indicators tended to hang separately. The four-factor solution emerged as

the best theoretical and statistical fit of the data, RMSEA = .089 (90% CI: [.07, .107], CFI = .905, SRMR = .049. Within the four-factor solution, the first factor consisted of BMI (.957), waist circumference (.936), systolic blood pressure (.665), diastolic blood pressure (.379), triglycerides (.340), HDL cholesterol (-.298), and CRP (.399). Significant loadings onto the second factor consisted of internalizing symptoms (.708) and externalizing symptoms (.710). Significant loadings onto the third factor included IL-6 (1.643) and CRP (.324). Significant loadings onto the fourth factor included systolic blood pressure (.264), diastolic blood pressure (.367), heart rate variability (-.933), and mean heart rate (.833). Glucose and HbA1c did not significantly load onto any factor across any of the evaluated factor structures.

A second EFA evaluated the factor structure of BMI, waist circumference, HDL cholesterol, triglycerides, systolic blood pressure, diastolic blood pressure, mean resting heart rate, heart rate variability, IL-6, and CRP (excluding internalizing symptoms, externalizing symptoms, glucose, and HbA1c). The four-factor solution emerged as the best theoretical and statistical fit of the data, RMSEA = .052 (90% CI: [.00, .100], CFI = .993, SRMR = .020. Within the four-factor solution, the first factor consisted of BMI (.886), waist circumference, (.912), triglycerides (.482), and HDL cholesterol (-.347), and CRP (.318). The second factor consisted of systolic blood pressure (.818) and diastolic blood pressure (.682). The third factor consisted of triglycerides (.221), heart rate variability (-.848), and mean resting heart rate (.871). The fourth factor consisted of triglycerides (-.303), HDL cholesterol (.247), IL-6 (1.173), and CRP (.503). Overall, statistical findings from the EFAs suggested that cardiometabolic indicators tended to

hang together, however separation of factor structure into further domains (e.g., adiposity vs. blood pressure vs. inflammation, etc.) contributed to improved model fit.

Confirmatory factor analyses. Findings from the EFAs suggested (1) separation of psychological indicators and biological indicators and (2) exclusion of glucose and HbA1c from primary biobehavioral health models. Therefore, biological CFA models evaluated included a unidimensional model (A; see Figure 7), a unidimensional model with correlated residuals (B; see Figure 8), a multi-factor model (C; see Figure 9), a second-order factor (D; see Figure 10), and a two second-order factor model (G). Fit statistics for each model are presented in Table 8. Although all biological indicators loaded significantly onto the single allostatic load factor, the unidimensional model emerged as a poor fit of the data, RMSEA = .217 (90% CI: .197, .238), CFI = .537, SRMR = .159. The unidimensional model with correlated residuals emerged as a better fit of the data, RMSEA = .086 (90% CI: .061, .112), CFI = .938, SRMR = .097, however IL-6, resting heart rate, and heart rate variability no longer loaded significantly onto the allostatic load factor. The multi-factor model emerged as an adequate fit of the data, RMSEA = .090 (90% CI: .064, .115), CFI = .941, SRMR = .078; only the inflammation factor and lipids factor were not significantly correlated with one another ($p > .05$). Similarly, the second-order factor model emerged as an adequate fit of the data, RMSEA = .103 (90% CI: .080, .126), CFI = .909. All five first-order factors (inflammation, adiposity, lipids, blood pressure, cardiovagal) loaded significantly onto the higher-order allostatic load factor (all p's < .05). The second-order factor model with an additional second-order metabolic syndrome factor would not converge. Given the multi-factor

factor and second-order factor structures emerged as the two best theoretical and statistical fits of the data, they were further evaluated with the additional inclusion of the mental health indicators.

A second set of CFAs evaluated the two best-fitting models of allostatic load with the inclusion of the mental health factor: a multi-factor structure (E; see Figure 11) and the second-order allostatic load factor allowed to be correlated with the mental health factor (F; see Figure 12). Model F (see Table 8) emerged as the best theoretical and statistical fit of the data (as indicated by BIC difference > 10), RMSEA = .074 (90% CI: [.058, .091]), CFI = .912, SRMR = .094.

Primary results.

Aim 1. A fully saturated structural equation model evaluated the effect of grandmaternal cultural socialization of mother (independence, respect) on maternal cultural socialization of child (independence, respect) via maternal acculturation (Anglo orientation, Mexican orientation), controlling for maternal country of birth, and including family conflict as an auxiliary variable (see Table 9; Figure 13). Grandmaternal cultural socialization of respect (Est = .457, SE Est = .113, $p < .001$) and maternal country of birth (Est = .471, SE Est = .147, $p = .001$) were significant predictors of maternal Mexican orientation, which significantly predicted maternal cultural socialization of respect (Est = .182, SE Est = .086, $p = .036$). Maternal Anglo orientation was significantly predicted by maternal country of birth (Est = -1.502, SE Est = .187, $p < .001$), such that mothers born in the United States reported higher Anglo orientation, and grandmaternal cultural socialization of respect (Est = -.410, SE Est = .154, $p = .008$).

Higher grandmaternal cultural socialization of respect was associated with higher grandmaternal cultural socialization of independence (Est = .205, SE Est = .027, $p <$ .001). Maternal cultural socialization of respect was positively associated with maternal cultural socialization of independence (Est = .205, SE Est = .033, $p < .001$). The indirect effect of grandmaternal cultural socialization of respect on maternal cultural socialization of respect via maternal Mexican orientation was not statistically significant (Est = .083, SE Est = .046, $p = .073$, 95% CI: [-0.008, 0.174]).

Aim 2. A structural equation model evaluated the effect of maternal socialization of child (independence, respect) on child mental health and allostatic load, via child perceived maternal acceptance and child perceived maternal rejection/harshness, controlling for maternal country of birth and child biological sex (see Table 10; Figure 14). The model was an adequate fit of the data, RMSEA = .049 (90% CI: [.038, .060]), CFI = .897, SRMR = .079.

Higher maternal cultural socialization of independence predicted higher child perceived maternal acceptance ($\beta = .247$, SE = .093, $p = .008$) and lower child perceived maternal rejection/harshness ($\beta = -.278$, SE = .095, $p = .003$). Higher child cultural socialization of respect predicted higher child perceived maternal rejection/harshness ($\beta = .237$, SE = .094, $p = .012$). Neither child perceived maternal acceptance nor child perceived maternal rejection/harshness predicted child mental health or allostatic load (all p's > .05). Maternal country of birth predicted child mental health ($\beta = -.194$, SE = .083, $p = .019$), such that mothers born in the United States reported higher levels of child mental health symptoms. Child biological sex was associated with maternal cultural

socialization of respect (β = -.022, SE = .019, p = .029); mothers of male children reported higher socialization of respect. Maternal cultural socialization of respect was positively associated with maternal cultural socialization of independence (β = .204, SE = .027, p < .001).

Aim 3. A structural equation model evaluated the effect of maternal cultural socialization of child (independence, respect), child acculturation, and the interactions of maternal cultural socialization practices and child acculturation on child perceived maternal acceptance and maternal rejection/harshness and subsequent child mental health and allostatic load, controlling for maternal country of birth and child biological sex (see Table 11; Figure 15). The model was an adequate fit of the data, RMSEA = .047 (90% CI: .036, .056), CFI = .888, SRMR = .074.

Higher maternal cultural socialization of independence predicted higher child perceived maternal acceptance (β = .138, SE = .093, p = .010) and lower child perceived maternal rejection/harshness (β = -.273, SE = .096, p = .004). Higher maternal cultural socialization of respect predicted higher child perceived maternal rejection/harshness (β = .249, SE = .095, p = .008). Neither interaction term (the interaction of maternal cultural socialization of respect and child acculturation; the interaction of maternal cultural socialization of independence and child acculturation) significantly predicted child perceived maternal acceptance nor child perceived maternal rejection/harshness (all p's > .05). Neither child perceived maternal acceptance nor child perceived maternal rejection/harshness predicted child mental health or allostatic load (all p's > .05). Maternal country of birth predicted child mental health (β = -.186, SE = .084, p = .027),

such that mothers born in the United States reported higher levels of child mental health symptoms. Lower levels of child acculturation predicted higher child allostatic load (β = -.259, SE = .115, p = .024).

Child biological sex was associated with maternal cultural socialization of respect (β = -.045, SE = .020, p = .029) and child acculturation (β = -.072, SE = .030, p = .016); mothers of male children reported higher socialization of respect and higher levels of child acculturation. Maternal cultural socialization of respect was positively associated with maternal cultural socialization of independence (β = .204, SE = .027, p < .001).

Exploratory analyses. Exploratory analyses included two structural equation models which re-evaluated the Aim 3 model, replacing child acculturation (difference score calculation) with (1) child Mexican orientation and (2) child Anglo orientation as the moderating variables.

First, a structural equation model evaluated the effect of maternal cultural socialization of child (independence, respect), child Mexican orientation, and the interactions of maternal cultural socialization practices and child Mexican orientation on child perceived maternal acceptance and maternal rejection/harshness and subsequent child mental health and allostatic load, controlling for maternal country of birth and child biological. The model was an adequate fit of the data, RMSEA = .045 (90% CI: [.035, .055]), CFI = .890, SRMR = .074. The primary pattern of results remained identical. The interaction of maternal cultural socialization of respect and child Mexican orientation did not significantly predict child perceived maternal acceptance (β = .096, SE = .134, p = .48) nor child perceived maternal rejection/harshness (β = .064, SE = .137, p = .64). The

interaction of maternal cultural socialization of independence and child Mexican orientation did not significantly predict child perceived maternal acceptance (β = -.031, SE = .126, p = .80) nor child perceived maternal rejection/harshness (β = -.090, SE = .126, p = .47). Child Mexican orientation was significantly associated with several predictor variables. Higher child Mexican orientation was associated with higher maternal socialization of independence (β = .168, SE = .069, p = .016) and maternal country of birth in Mexico (β = .215, SE = .070, p = .016). Female children were reported to have higher Mexican orientation (β = .195, SE = .065, p = .016).

Second, a structural equation model evaluated the effect of maternal cultural socialization of child (independence, respect), child Anglo orientation, and the interactions of maternal cultural socialization practices and child Anglo orientation on child perceived maternal acceptance and maternal rejection/harshness and subsequent child mental health and allostatic load, controlling for maternal country of birth and child biological sex. The model was an adequate fit of the data, RMSEA = .044 (90% CI: [.033, .054]), CFI = .895, SRMR = .076. The primary pattern of results remained identical. The interaction of maternal cultural socialization of respect and child Anglo orientation did not significantly predict child perceived maternal acceptance (β = .217, SE = .132, p = .10) nor child perceived maternal rejection/harshness (β = .049, SE = .141, p = .72). The interaction of maternal cultural socialization of independence and child Mexican orientation did not significantly predict child perceived maternal acceptance (β = -.109, SE = .124, p = .38) nor child perceived maternal

rejection/harshness (β = -.182, SE = .129, p = .16). Child Anglo orientation was not significantly correlated with any other predictor variable (all p's > .05).

CHAPTER 4

DISCUSSION

Differential exposure to multi-level chronic stressors (e.g., poverty, discrimination, acculturative stress) places Mexican-origin individuals in the United States at elevated risk for adverse psychological and physical health across the lifespan. Children of immigrants, in particular, are at elevated risk for poor biobehavioral health given elevated exposure to culture-specific and transcultural stressors (Kim et al., 2018). Despite exposure to contextual risk factors, many individuals maintain positive biobehavioral health. In particular, despite greater exposure to sociodemographic risk factors, more recently immigrated Mexican-origin individuals in the U.S. have been documented to demonstrate more positive biobehavioral health (Callister & Birkhead, 2002; de la Rosa, 2002), warranting consideration of cultural values and practices that confer and maintain positive health across generations. Parental cultural socialization is an understudied mechanism potentially underlying intergenerational transmission of cultural orientation in promotive pathways of child health. Across three generations of Mexican-origin families in the United States – maternal grandmothers, mothers, children – the current study aimed to understand how culturally-based intergenerational mechanisms transmit within families to affect child biobehavioral health.

By integrating the immigrant paradox framework with a life course health developmental framework (Vasan et al., 2020), the aims of the current study were fourfold. First, multidimensional measures of child behavioral health were evaluated at child age 7.5 years, incorporating indicators of biological and psychological functioning.

An allostatic load factor and psychological factor were hypothesized to emerge separately, but correlate positively with one another, such that higher allostatic load was associated with higher levels of mental health symptoms. Second, maternal cultural orientation was evaluated as a mechanism underlying the intergenerational transmission of cultural socialization practices from grandmother to mother. More traditional grandmaternal cultural socialization (of mother) was hypothesized to predict more traditional maternal cultural socialization of child via maternal cultural orientation (higher Mexican orientation, lower Anglo orientation). Third, the current study evaluated the effect of maternal cultural socialization practices on child biobehavioral health via child perceived maternal parenting. More traditional maternal cultural socialization of child was hypothesized to predict more positive child-perceived maternal parenting and subsequently greater child biobehavioral health. Lastly, child cultural orientation was evaluated as a moderator of the effect of cultural socialization on child-perceived maternal parenting and subsequent biobehavioral health. Among less acculturated children, more traditional maternal cultural socialization was hypothesized to predict more positive child perceptions of parenting. Among more acculturated children, less traditional maternal cultural socialization was hypothesized to predict more positive child perceptions of parenting. Findings, discussed in further detail, support a nuanced understanding of consideration of contextual factors impacting intergenerational culturally based promotive pathways of child health.

Child Biobehavioral Health Outcome

In response to calls for incorporation of multi-system indicators of psychological and biological functioning in studies aiming to uncover the relation between psychosocial processes, pathophysiological pathways, and subsequent physical and mental health outcomes, the current study evaluated the factor structure of multiple biological and psychological health indicators to identify the best-fitting outcome measure of child biobehavioral health. Partially consistent with hypotheses, exploratory and confirmatory analyses supported separation of biological and psychological indicators into separate allostatic load and mental health factors, which were included as outcomes in primary study models.

Identification of allostatic load measurement has important implications for understanding developmental origins of lifespan health (Guidi et al., 2021), particularly among populations facing elevated exposure to chronic stressors during childhood and documented high rates of chronic health conditions in adulthood. A growing body of empirical work supports a factor structure approach to measuring allostatic load among adolescents and adults (King et al., 2019; McCaffery et al., 2012), yet no studies have replicated a similar factor structure among children. The current study extends support for measurement and use of an allostatic load factor among young children. Consistent with work among adults (Booth et al., 2013; McCaffery et al., 2012; Seeman et al., 2010), a second-order factor structure of allostatic load emerged as the best theoretical and statistical fit of the data, consisting of five first-order factors: inflammation (IL-6, CRP), adiposity (BMI, waist circumference), blood pressure (systolic, diastolic), lipids (triglycerides, HDL-C), and cardiovagal (heart rate variability, resting heart rate). Among

adolescents, a unidimensional model of allostatic load was found to be the best fit of the data (King et al., 2019; see Figure 2), inconsistent with the current analyses, which found a unidimensional model of allostatic load to be a poor fit of the data among children. Fit indices for the second-order model of allostatic load in the current study were comparable to best-fitting models among adolescents and adults (Booth et al., 2013; King et al., 2019; McCaffery et al., 2012).

McCaffery and colleagues (2012) also found evidence to support a sixth first-order factor, insulin resistance, which consisted of insulin and glucose indicators. In the current study, HbA1c and non-fasting glucose were evaluated in exploratory factor analyses and considered for inclusion in factor models. However, neither HbA1c nor non-fasting glucose correlated with any other biological indicator, nor were they correlated with one another as hypothesized. Although HbA1c and non-fasting glucose are both indicators of glycemic functioning, they capture different timescales of glycemic control. HbA1c reflects average blood glucose levels over the previous 2-3 months (CDC, 2023), whereas blood glucose captures blood sugar at the time of testing. Among adolescents, HbA1c and fasting glucose loaded significantly onto the allostatic load factor, but were among the weakest loadings (King et al., 2019). These biomarkers may not be strong contributors to allostatic load early in life.

Among the current sample of children, first-order adiposity and blood pressure factors emerged as the strongest loadings onto second-order allostatic load factor. Inflammation and lipid factors were the next strongest loadings. The cardiovagal factor loaded significantly onto the second-order allostatic load factor but had the smallest

loading. Indicators of metabolic dysregulation (BMI, waist circumference) were noted as the highest factor loadings in the unidimensional allostatic load factor among adolescents (King et al., 2019), consistent with the current study and prior work (Booth et al., 2013). Low-income, Mexican American children are at particularly elevated risk for cardiometabolic dysfunction across the lifespan (Ogden et al., 2012; Rodriguez et al., 2014), highlighting the importance of measuring allostatic load early in life among this population.

Across studies, there exists a lack of consistency in biological indicators evaluated for consideration in allostatic load factor outcomes. King and colleagues (2019) evaluated several additional indicators of allostatic load not included in the current study, including fasting glucose, insulin, creatinine, albumin, white blood cell count (WBC), and Epstein-Barr viral index (EBV), but did not include indicators of cardiovagal functioning (heart rate variability). Other studies with adults have incorporated hormonal biomarkers, such as epinephrine, norepinephrine, and salivary cortisol (Seeman et al., 2010). Booth and colleagues (2013) evaluated an additional inflammatory indicator, fibrinogen, but did not include measures of cardiovagal or glycemic functioning.

Variability in biomarkers included in factor models of allostatic load precludes generalizability across studies and developmental periods. Selection of allostatic load biomarkers may be particularly relevant among younger populations, given allostatic load represent cumulative physiological wear-and-tear on the body's regulatory systems from repeated allostasis (Wiley et al., 2017), and certain biological indicators may be quicker to dysregulate throughout longitudinal processes (King et al., 2019). Biological indicators

in the current study account for functioning across the cardiovascular, metabolic, and immune systems, reflecting downstream, secondary mediator processes (Wiley et al., 2017). Primary mediators, such as biological indicators associated with the HPA axis (e.g., cortisol, DHEA) and sympathetic adrenal medullary systems (e.g., norepinephrine, epinephrine), may be more likely to be dysregulated among younger populations (King et al., 2019; Wiley et al., 2017). Wiley and colleagues (2017) suggest that measures of allostatic load include at least one indicator from primary and secondary mediators. Similarly, a recent review suggests including at least one indicator from the neuroendocrine, cardiovascular, metabolic, and immune systems (Whelan et al., 2021). The current study's measure of allostatic load does not include a primary mediator. Future allostatic load measurement work, particularly among children, may aim to incorporate primary and secondary mediators.

Contrary to hypotheses, allostatic load and mental health factors were not correlated, suggesting that elevated allostatic load is not associated with maternal report of child internalizing and externalizing symptoms at child age 7.5 years. Interestingly, the current sample of children demonstrated low rates of clinically significant internalizing and externalizing symptoms, but high rates of cardiometabolic dysfunction at age 7.5 years (Perez et al., 2022). Empirical work highlights the importance of considering the presence of outward positive psychological adjustment and dysregulated physiological systems, noting that there may be physiological costs to psychological adaptation in the context of cumulative, chronic stressors (Brody et al., 2013), however this was not replicated in the current sample at child age 7.5 years. Evaluation of the multi-factor

model of biobehavioral health, which included the psychological factor (see Figure 11), highlights the lack of significant relations among psychological functioning and adiposity, blood pressure, lipids, inflammatory functioning, and cardiovagal functioning. Of all estimates, the positive relation between mental health and inflammatory markers was the strongest, though not statistically significant. Perhaps, a significant relation between allostatic load and psychological functioning may emerge as children age, given empirical support for documented relations among mental health and inflammatory, metabolic, and cardiovascular functioning during childhood (de Baumont et al., 2019; Slopen et al., 2013; Qureshi et al., 2019). Future longitudinal work may aim to uncover whether and how the relation between mental health and allostatic load emerges over time into later childhood, adolescence, and adulthood among low-income, Mexican American children. Understanding how the relation between allostatic load and psychological adjustment emerges and cascades is relevant to decision making about developmental timing of prevention and intervention efforts among this population.

Grandmother-Mother Transmission of Cultural Socialization

As hypothesized for Aim 1, greater grandmaternal cultural socialization of respect predicted higher maternal Mexican orientation and lower maternal Anglo orientation; higher maternal Mexican orientation subsequently predicted greater maternal cultural socialization of respect in childrearing of her own children. Results remained statistically significant even when controlling for maternal country of birth. Consistent with cultural socialization theories, findings suggest that parental cultural socialization practices both reflect aspects of parental ethnocultural identity and promote intergenerational alignment

to traditional Mexican cultural orientation. Prior work supports associations between parental cultural socialization of respect and lower parental acculturation (Calzada et al., 2010; González-Ramos et al., 1998; Lorenzo-Blanco et al., 2012; Romero, Cuéllar, & Roberts, 2000). Socialization of respect has been highlighted as a particularly important, if not one of the most important, socialization values during focus group studies with Mexican American parents (Calzada et al., 2010; Knight et al., 2010). Although limited work has examined grandmaternal-maternal transmission of cultural socialization practices (with specific regard to values of respect and independence), existing evidence supports the notion that cultural socialization processes impact how parenting is conferred intergenerationally within families (Williams et al., 2020). Mothers may place importance on parenting their children how their own mothers raised them in order to preserve traditional Mexican cultural values, particularly among Mexican-origin mothers navigating childrearing in a different country than they were raised (Calzada et al., 2010).

Contrary to hypotheses, grandmaternal socialization of independence was not significantly associated with maternal cultural orientation or subsequent maternal cultural socialization of independence of her own child. Greater grandmaternal cultural socialization of independence was expected to predict higher maternal Anglo orientation and higher maternal cultural socialization of independence. Focus groups with Mexican-origin mothers in the U.S. revealed stark cultural contrast between socialization of independence and respect (Calzada et al., 2010), highlighting independence and autonomy as important socialization values specific to American culture and inconsistent with Latino cultures. Although socialization of independence is theorized to be associated

with higher acculturation (Calzada et al., 2010), empirical findings suggest that the relation between maternal cultural orientation and cultural socialization of independence may be more complex among Mexican-origin mothers in the U.S. Socialization of independence has also been unexpectedly positively associated with ethnic cultural competence, ethnic identity, and Spanish language competence (Calzada et al., 2012; Kim et al., 2018); similarly, non-significant associations have been found between socialization of independence and U.S. identity, English language competence, and U.S. cultural competence (Calzada et al., 2017). Future studies may consider alternative predictors of parental cultural socialization of independence among this population, beyond cultural orientation, such as education (LeVine et al., 1991; Richman et al., 1992; Suizzo, Tedford, & McManus, 2019), support for childrearing, or parenting stress (Calzada et al., 2012).

Theoretical models of parental cultural socialization traditionally conceptualize independence and interdependence values as dichotomous, such that parents socialize children towards one set of values or the other. Enculturation and acculturation have been similarly theorized to differentially and dichotomously predict cultural socialization of independence and respect (Calzada et al., 2010). Alternatively, these values may exist as orthogonal, distinct dimensions, such that parents may promote *both* sets of values in their children (Kagitçibasi, 2007; Suizzo et al., 2019). Interestingly, in the current study, cultural socialization of independence and respect were significantly positively correlated among mothers *and* grandmothers. Further, mothers and grandmothers both strongly endorsed cultural socialization of respect and independence across the entire sample, as

illustrated by high mean levels on each variable (see Table 6). These findings coincide with a growing body of qualitative and empirical work supporting the notion that socialization of independence, autonomy, and self-reliance may be relevant socialization values among Mexican American parents (Calzada et al., 2012; Calzada et al., 2017; Delgado & Ford, 1998; Yau & Watkins, 2018), in addition to values of respect, interdependence, and obedience. Consistent with the bi-dimensional model of acculturation (Berry, 2005), a recent study with Mexican-origin adolescents and their parents explored person-centered parental socialization profiles, finding that an *Integrative-Authoritative* profile (high socialization of respect and high socialization of independence; high on warmth, monitoring, and reasoning; low on hostility) was actually the most common parenting approach and associated with adaptive adolescent outcomes (Kim et al., 2019).

Perhaps, strong endorsement of both socialization of respect and independence among the current sample of Mexican-origin mothers suggests they may be adopting values from American culture, integrating traditional Mexican childrearing values, and developing a bicultural parental socialization style. Considering these factors, it remains unexpected that grandmothers in the current study, who on average endorse high levels of enculturation and low levels of acculturation (and approximately one third of whom remain living in Mexico at the time of present-day data collection), retrospectively reported high levels of cultural socialization of respect *and* independence when raising their children. Consistent with a "healthy migrant" or selective migration hypothesis (Bostean, 2013), it is possible that mothers in the current study (all of whom were born or

immigrated to the U.S.) may have been more likely to be socialized by grandmothers endorsing high alignment to both respect and independence socialization values. The current study cannot address whether migrants differ from non-migrants with regard to the values toward which they were socialized during childhood. However, Calzada and colleagues (2012) similarly note that Mexican American mothers in their sample endorsed surprisingly high levels of socialization of independence given low levels of formal education, high levels of poverty, and low rates of acculturation, consistent with the current sample of grandmothers and mothers. Future work is needed to clarify both socialization of respect and independence as culturally congruent, orthogonal socialization practices among Mexican-origin caregivers in the United States.

Maternal Cultural Socialization, Child Perceptions of Parenting, and Child Biobehavioral Health

Findings from Aim 2 contribute to existing empirical work documenting parental cultural socialization of respect and independence to be associated with general parenting behaviors and styles. Contrary to hypotheses, the current study found that children perceived mothers to be more accepting and less rejecting/harsh when mothers endorsed higher cultural socialization of independence. Prior work with Mexican American parents and children has linked parental socialization of independence with an authoritative parenting style among Mexican American families (Calzada et al., 2012; Kim et al., 2018), marked by high parental demandingness, high parental responsiveness, and high parental acceptance (Baumrind, 1966; Maccoby & Martin, 1983; Lamborn et al., 1991), Aspects of authoritative parenting may be consistent with parental cultural socialization

of independence, such as recognition and encouragement of children's sense of autonomy and self-reliance. Consistent with findings that children in households with an authoritative parenting style report high levels of parental acceptance (Lamborn et al., 1991), children of mothers who endorse higher levels of cultural socialization of independence may perceive their mothers to be more accepting.

Contrary to hypotheses but consistent with a growing body of empirical work, children perceived mothers to be more rejecting/harsh when mothers endorsed higher cultural socialization of respect. Among Mexican American families, cultural socialization of respect has been associated with higher levels of authoritarian parenting (Calzada et al., 2012; Calzada et al., 2017), marked by low levels of warmth and acceptance, and high levels of rejection and harshness (Baumrind, 1966), or high parental demandingness and low levels of parental responsiveness (Maccoby & Martin, 1983). Aspects of authoritarian parenting, which emphasize respect for authority, may be consistent with parental cultural socialization of respect (Calzada et al., 2012; Varela et al., 2004; Knight et al., 1994), although other studies have documented non-significant relations between socialization of respect and dimensional parenting styles (Kim et al., 2018). Given mixed findings in existing empirical work, hypotheses regarding the relations between maternal cultural socialization and child-perceived parenting were conceptualized within an immigrant paradox framework, considering more traditional parental cultural socialization to be promotive of child health via more positive perceptions of parenting. Findings regarding the association between maternal cultural socialization of respect and independence and child-perceived parenting may be

reflective of the bicultural nature of the current sample of Mexican American children, who are reported on average to align strongly with both Mexican and Anglo orientations.

Existing empirical work among younger children has tended to document the relation between parent-reported parental cultural socialization practices, parent-reported parenting behaviors/styles, and parent-reported child adjustment. Evaluation of child perceptions of parenting was hypothesized to contribute to our understanding of parental cultural socialization messages as conferring risk or promotion in pathways of child biobehavioral health, given mixed findings in existing literature. Although socialization of respect has been consistently associated with higher authoritarian parenting and socialization of independence has been consistently associated with higher authoritative parenting, subsequent effects on child adjustment are mixed, warranting further evaluation of cultural socialization practices as promotive, harmful, or both, dependent on contextual factors. Among Mexican American families, greater maternal socialization of independence has been directly associated with higher motor, conceptual, and language development and higher levels of externalizing behaviors (Calzada et al., 2012), and indirectly via authoritative parenting associated with higher levels of adaptive behaviors and higher academic readiness (Kim et al., 2018). Greater cultural socialization of respect has been indirectly associated with higher levels of internalizing and externalizing symptoms via authoritarian parenting (Calzada et al., 2012; Calzada et al., 2017), and directly associated with higher levels of somatic symptoms (Calzada et al., 2017).

Although maternal cultural socialization predicted child-perceived parenting, child-perceived parenting did not explain effects of maternal cultural socialization

messages on child biobehavioral health, contrary to hypotheses. Higher child-perceived maternal acceptance was not associated with fewer mental health symptoms or lower allostatic load. Similarly, higher child-perceived maternal rejection/harshness was not associated with poorer mental health or higher allostatic load. The lack of association between child-perceived parenting and mental health is particularly surprising, given a large body of research highlights the effects of maternal warmth and maternal rejection/harshness on children's mental health (Khaleque, 2013; Yap et al., 2014). Among youth broadly, maternal warmth has been linked with various mental health outcomes, including fewer depressive and anxiety symptoms, and more externalizing symptoms (Boeldt et al., 2012; Kingsbury et al., 2020; Pinquart, 2017). Higher levels of maternal rejection/harshness are consistently linked with poorer mental health, including higher levels of depressive and anxiety symptoms, social aggression, physical aggression, and suicidal ideation (Kingsbury et al., 2020). Importantly, these studies evaluate self-reported or observer-rated parenting, not child-reported parenting. Fewer studies have evaluated child-reported parenting, particularly among younger children, and this may explain inconsistent effects. Future work may directly compare and evaluate discrepancies in parent- and child-reported parenting, given discordance between these ratings has been found to predict youth internalizing and externalizing symptoms and parent-child relationship quality over and above child and parent independent ratings of parenting (Maurizi, Gershoff, & Aber, 2012).

Another potential explanation for the lack of effect of child-perceived maternal parenting on mental health may be the overall rates of internalizing and externalizing

symptoms among the current sample of children at age 7.5 years. The current study is a community sample, which may not represent the full spectrum of child internalizing and externalizing symptoms or maternal warmth or rejection/harshness. Although the current sample faces a variety of transcultural and culture-specific stressors (Kim et al., 2018), 14.5% and 7.2% of children in the current study were reported to meet clinically significant levels of internalizing and externalizing symptoms respectively, relatively consistent with documented prevalence rates among this age group broadly (Danielson et al., 2022), but slightly lower than documented prevalence rates among other samples of young Mexican American children specifically (Calzada et al., 2017).

Alternatively, it is worth noting that child-perceived maternal warmth and child-perceived maternal rejection/harshness were not significantly negatively correlated as would be expected (see Table 7), suggesting that some of the children perceiving mothers to be rejecting or harsh may also see their mothers to be simultaneously accepting. Mahrer et al. (2019) discuss the high prevalence of "no-nonsense" parenting style, marked by high levels of parental acceptance *and* harsh discipline/rejection, among Mexican American families. Other studies corroborate support for a "no-nonsense" parenting style among Mexican-origin parents (Kim et al, 2019; White et al., 2013), even failing to document an authoritarian parenting profile (low in acceptance, high in rejection/harshness) in their samples (Kim et al., 2019). Maternal warmth and maternal rejection/harshness may not be orthogonally predictive of mental health. Indeed, among Mexican American families, high maternal warmth and support may buffer the effect of harsh discipline on youth externalizing behaviors (Germán et al., 2013; McLoyd &

Smith, 2002). Future work should evaluate the interaction of child-perceived acceptance and child-perceived rejection/harshness as a mechanism underlying the effect of parental cultural socialization on subsequent child biobehavioral health.

Interpretation of the lack of association between child-perceived parenting and child mental health also requires consideration of contextual factors impacting child interpretation of specific parenting behaviors. Parenting behaviors and practices may hold culture-specific meaning, such that not all parenting behaviors may be perceived similarly across various groups, parent-child relationships, and cultural contexts (Deater-Deckard & Dodge, 1997; Stewart & Bond, 2002), in ways that positively or negatively impact children's mental health. For example, Mahrer et al. (2019) found that parental familism values moderated the effect of parenting on youth outcomes, such that an authoritative parenting style predicted lower youth internalizing and externalizing symptoms when compared to the no-nonsense parenting style, but authoritative and no-nonsense parenting styles functioned similarly among families highly oriented to familism values. Historically, much empirical work linking parenting behavior, styles, and dimensions with children's emerging mental health has been conducted with relatively homogenous samples of families, often White or European American, English-speaking, or higher SES (Breland-Noble, 2014). Among Mexican American families, parenting dimensions and behaviors (e.g., acceptance, harshness, rejection) have been more inconsistently linked with mental health, warranting ongoing consideration of multi-level contextual buffers.

Importantly, the relation between parenting and children's mental health is bidirectional (Paschall & Mastergeorge, 2016), such that parenting behaviors and practices (such as cultural socialization) and child perceptions of parenting not only affect children's mental health, but children's emotional and behavioral functioning also affects how parents interact with children (Belsky, 1984) and how children interpret parenting (Sfärlea et al., 2019). Mothers may actively and intentionally socialize particular children towards particular values in response to children's emotional and behavioral qualities or other characteristics. Focus groups with Mexican American women revealed cultural socialization of respect to be largely driven by expectations about children's public behavior, decorum, deference, and obedience, delineating appropriate from inappropriate child behavior (Calzada et al., 2010). Perhaps, mothers of children with externalizing problems may be more likely to endorse socialization of respect. The current study addresses only unidirectional effects of maternal cultural socialization on children's mental health, but ancillary findings preliminarily suggest that perhaps mothers may be more likely to endorse cultural socializations of respect with particular children.

For example, in the current sample, mothers of male children reported higher socialization of respect. Findings are mixed with regard to gender differences in parental cultural socialization among other studies. Among a sample of Black and Latino preschoolers, parents of male children were more likely to endorse cultural socialization practices generally (Caughy et al., 2016). In that study, cultural socialization was assessed by inquiring more broadly about parents' messages to children about their ethnic/racial identity and group. Authors suggest that socialization of behavior among

male children may be particularly important to parents navigating childrearing in the context of societal stereotypes and biases that interpret behavior as threatening (Caughy et al., 2016). Additionally, male children were reported by mothers to have higher levels of acculturation than female children in the current study. It is also plausible that parents who report their children to be more acculturated may be more likely to socialize children with more traditional Mexican socialization messages (e.g., respect) to maintain children's traditional cultural orientation.

Compared to mental health, less empirical work has evaluated the effect of child-perceived parenting on child allostatic load. Preliminary work links aspects of the early caregiving environment to indicators of child physiological stress, which accumulate over time and provide support for principles of allostatic load (Blair et al., 2011). Similarly, harsh parenting, lower family support, and negative family interactions during childhood and adolescence have been linked with elevated allostatic load in adulthood (Brody et al., 2017; Brody et al., 2013, Priest et al., 2015; Slopen et al., 2016). Among young adolescents, greater cumulative risk exposure was associated with higher levels of allostatic load years later. However, this effect was evident only among adolescents who reported their mothers to be low in instrumental (e.g., help with homework) and emotional (e.g., willing to talk to me when needed) responsiveness (Evans et al., 2007), similar to the current study's measure of child reported maternal acceptance. The effects of parenting on allostatic load may only emerge when children are experiencing high levels of stress. Direct measurement of contextual and chronic stress exposures and perceptions may be important when aiming to untangle the relation between parenting

and allostatic load early in development. Importantly, these studies highlight the longitudinal, cumulative nature of environmental exposures on allostatic load across the lifespan. Perhaps, the lack of relation between child-perceived parenting and allostatic load in the current study is unsurprising given the age of the children. In the current study, both child-perceived parenting and allostatic load and were assessed cross-sectionally at child age 7.5 years. Parenting effects on allostatic load may be more likely to unfold and emerge longitudinally over time as children age through older childhood, adolescence, and adulthood.

The Role of Child Cultural Orientation

Interestingly, although cultural socialization of respect and independence were strongly positively correlated with one another and both strongly endorsed by grandmothers and mothers, cultural socialization strategies demonstrated distinct and opposite effects on child perceptions of parenting, warranting further consideration of contextual factors impacting child perceptions of parenting behavior. As introduced previously, transmission of culturally based factors may confer protection or risk dependent on the broader cultural context (e.g., familial values, child cultural orientation, community norms; Bhugra & Ayra, 2005; Calzada et al., 2013; Calzada & Sales, 2019). The current study aimed to contribute to this nuanced literature by examining child cultural orientation as a potential moderator of the effect of cultural socialization on child-perceived parenting in Aim 3. The degree to which children view cultural socialization of respect and independence to be accepting/warm or harsh/rejecting was hypothesized to be impacted by their own level of acculturation.

Contrary to hypotheses, child acculturation did not moderate the effect of cultural socialization of respect and independence on child-perceived parenting or biobehavioral health. Even when the interaction of child acculturation and maternal cultural socialization of respect and the interaction of child acculturation and maternal cultural socialization of independence were included in the model, the primary pattern of effects of cultural socialization on child-perceived parenting remained identical. Regardless of child acculturation level, children perceived higher maternal acceptance and lower maternal rejection/harshness among mothers who endorsed higher levels of socialization of independence. Children perceived higher maternal rejection/harshness among mothers who endorsed higher levels of socialization of respect. Interpretation of this finding warrants further discussion of the methodological approach to measuring acculturation and consideration of alternative moderating factors.

Child acculturation in Aim 3 was originally calculated using the unidimensional difference score approach (Cuellar et al., 1995; subtracting mean Mexican orientation from mean Anglo orientation), given the current study was underpowered to evaluate interactive effects of child Mexican orientation *and* child Anglo orientation with parental cultural socialization simultaneously in one model. In this unidimensional approach, Mexican and Anglo orientation are conflated and collapsed into one variable, and children with or near a difference score of 0 are reported to have equal orientation to Mexican and Anglo items. However, equal orientation to Mexican and Anglo items may indicate an integrated bicultural orientation (high Anglo and high Mexican) or a marginalized orientation (low Anglo and low Mexican), which are theorized to be two

vastly different acculturative experiences (Berry, 2005; Jones & Mortimer, 2014) and documented to have contrasting effects on psychological adjustment (Kim et al., 2019; Nguyen & Benet-Martínez, 2013). More recent reviews highlight the utility of bidimensional approaches to measuring acculturation (Jones & Mortimer, 2014), which simultaneously assess Mexican and Anglo orientations and their interaction, with the potential to promote better theoretical understanding of the role of acculturation (and associated mechanisms) in pathways of parent-child processes and biobehavioral health.

Therefore, post-hoc exploratory analyses evaluated child Mexican orientation and child Anglo orientation as separate unique moderators of the effect of cultural socialization of respect and independence on child-perceived parenting and biobehavioral health. Again, findings did not support moderation hypotheses; neither child Anglo orientation nor child Mexican orientation moderated the effects of cultural socialization of independence and respect on child-perceived maternal acceptance and rejection/harshness. Taken together, findings suggest that children are not interpreting cultural socialization messages regarding respect and independence differently across cultural orientation in ways that affect perceptions of parenting. Future studies may consider alternative contextual factors, across child, parent, and family levels, that may moderate the effect of maternal cultural socialization on child-perceived parenting and biobehavioral health. Of note, child cultural orientation was assessed via maternal report. As children age and become able to report on their own alignment to Mexican and Anglo culture, it may be interesting to reassess child-reported cultural orientation as a moderator. Mothers may be biased in their report of children's Mexican and Anglo

orientations. Particularly among the current sample, in which mothers report high Mexican orientation and low Anglo orientation and are primarily Spanish-speaking, bicultural and bilingual children may be more likely to speak Spanish or present congruently with traditional Mexican orientation in line with mothers' cultural orientation.

Additionally, comparison of child reported alignment to specific values (e.g., respect, independence) to parental alignment may be particularly salient, given discordance between parental and child values may play a moderating role in pathways of parental cultural socialization, children's perceptions of parenting, and children's mental health (Camras et al., 2012; Stein & Polo, 2014). Other work with Mexican American adolescent-parent dyads suggests that child and parental perceptions in parental autonomy promotion may be discrepant (Sher-Censor, Parke, & Coltrane, 2011), highlighting the value in multiple reports within parent-child dyads. Among bicultural children, individual cultural orientations may be less predictive of parent-child relationships and health than individual value mismatch or congruence within their familial context (e.g., parental cultural orientation). Parent-child acculturation value gaps have been associated with greater familial conflict (Bámaca-Colbert et al., 2013), with implications for youth mental health (for review see Stein & Polo, 2014).

Ancillary Findings: Immigrant Generational Status, Acculturation, and Child Biobehavioral Health

The Hispanic paradox or immigrant paradox framework suggests that more recently immigrated individuals experience surprisingly adaptive health despite exposure

to high levels of transcultural (e.g., family economic hardship, neighborhood disadvantage) and culture-specific (e.g., discrimination, cultural conflict) stressors (Callister & Birkhead, 2002; de la Rosa, 2002; Kim et al., 2018). However, empirical findings are mixed in support of an immigrant health advantage for psychological and physical health outcomes across the lifespan, and few empirical studies examine this phenomenon among younger children. Findings from the current study support the notion that the relation between immigrant generational status, acculturation, and health is complex and nuanced, necessitating further consideration of potential mechanisms, contextual moderators, and within-group multigenerational study design.

Ancillary findings from Aims 2 and 3 highlight maternal country of birth in Mexico to be associated with more positive child mental health (fewer internalizing and externalizing symptoms). Importantly, cautious interpretation of this finding is warranted given mothers reported on child mental health symptoms, and other studies support the notion that less acculturated Mexican American women may be less likely to endorse mental health symptoms in their children due to difficulty identifying mental health symptoms or stigma associated with mental health and help-seeking (Cook et al., 2014). However, exploratory moderation analyses in the current study, which examined child Anglo orientation as a potential moderator in isolation, similarly found that higher Anglo orientation trended toward positive directional association with child mental health. Taken together, these findings provide preliminary support for a paradoxical effect on mental health among the current sample of Mexican American children, consistent with existing support for an immigrant health advantage across mental health outcomes

spanning internalizing symptoms, externalizing symptoms, and suicidal behavior (for review see Kim et al., 2018).

Findings from Aim 3 support a direct effect of child acculturation on child allostatic load, such that less acculturated children (higher Mexican orientation, lower Anglo orientation) had higher allostatic load, even when controlling for maternal country of birth. Exploratory moderation analyses, which included child Mexican orientation and child Anglo orientation in separate models rather than the use of a single cultural orientation difference score, did not find significant direct effects of child cultural orientation on child allostatic load. Directional associations, however, align with Aim 3 findings and suggest that child Anglo orientation trended toward negative association with child allostatic load, such that higher Anglo orientation was associated with lower allostatic load. Findings contribute to limited, mixed empirical studies on child cultural orientation and physical health among Mexican American youth. Using NHANES data, Kamal et al. (2005) found Mexican-born children to have lower rates of chronic health problems than U.S.-born peers. Similarly, other work has documented a generational effect on health among U.S.-born Hispanic children, documenting that children of immigrants have lower rates of chronic health problems than children in subsequent generational statuses (Avila & Blumberg, 2008). Among 5-year-old children, Padilla et al. (2009) found that children of U.S.-born Mexican American mothers had significantly higher odds of chronic health conditions compared to non-Hispanic White children, but the same was not true among children of Mexican-born mothers. Among Mexican American youth, higher acculturation has also been documented as a risk factor for

asthma (Eldeirawi & Persky, 2009), dietary behaviors (Liu et al., 2012), weight and adiposity (Liu et al., 2012; Luecken et al., 2017; Perez et al., 2022). Contrastingly, other work has documented non-significant associations between acculturation and physical health outcomes, and the relation between acculturation and health is argued to be complex and nuanced (Horevitz & Organista, 2012).

Additionally, although elevated allostatic load is theoretically and empirically linked with such health outcomes across the lifespan (Beckie, 2012), it is important to note that limited empirical work has specifically examined the relation between immigrant generational status, acculturation, and allostatic load among Mexican American youth. A recent between-group examination of racial/ethnic differences in allostatic load risk score (measured across metabolic, cardiovascular, and inflammatory markers) among Hispanic, Black, and non-Hispanic White youth (aged 7-12 years) revealed that Hispanic children demonstrated the highest level of allostatic load risk (Cedillo, Murillo, & Fernández, 2018). Authors hypothesize this finding to reflect that Hispanic youth in their sample were the most recent migrant group, and thus perhaps exposed to the highest levels of contextual and culture-specific stressors. However, neither birthplace (U.S.-born vs. Foreign-born) nor length of residence in the U.S. were associated with elevated allostatic load among Hispanic youth specifically (Cedillo et al., 2018).

Limited work among Mexican American adults similarly provides mixed support for further investigation of protective culturally based effects on allostatic load. Mexican-born individuals and those with shorter residency in the U.S. demonstrated lower

allostatic load than White individuals or Mexican-born individuals with longer residency (Peek et al., 2010). Among Mexican-origin women in the United States, greater acculturative stress was not associated with overall allostatic load, but was related to increased waist-to-hip ratio (D'Alonzo et al., 2019); U.S.-born Mexican women demonstrated higher blood pressure and triglycerides than Mexican-born women, an effect that was partially explained by length of time in the United States. Similar effects demonstrated in a sample of 45-60-year-old Mexican American individuals, finding duration of residence in the United States to attenuate an immigrant health advantage on allostatic load score (Kaestner et al., 2009).

Inconsistent empirical effects of country of birth/generational status and acculturation on mental and physical health outcomes may be the result of proxy measures of acculturation, inconsistent use of child vs. parental acculturation level, between-group design (e.g., comparison across ethnic/racial identities), and limited longitudinal studies following individuals and multigenerational families throughout acculturative processes. A recent systematic review suggested there exists mounting evidence linking acculturative stress and negative physical health outcomes (including sleep, self-reported physical health, asthma, stress hormones) among Latinx individuals (Gonzalez-Guarda et al., 2021), supporting future studies evaluating theoretically supported mechanisms underlying the effect of generational status/acculturation on health. Individual maintenance of specific traditional Mexican cultural values over time (e.g., familism) has been associated with more optimal longitudinal trajectories of depressive and anxiety symptoms across childhood and adolescence (Cruz et al., 2021).

Across primary aims, the current study considered parental cultural socialization and child perceived parenting as potential culturally-based constructs underlying intergenerational transmission of cultural orientation in pathways of health. Direct effects of maternal country of birth on child mental health remained even when accounting for maternal cultural socialization practices, child perceived parenting, and child's own cultural orientation. Maternal cultural socialization and child perceived parenting did not clarify or cancel direct effects of maternal or child acculturation/generational status on child biobehavioral health, warranting evaluation of alternative child-, parent-, and family-based mechanisms and moderators in our understanding of how culturally relevant resilience factors may impact children's emerging biobehavioral health.

Limitations, Strengths, and Conclusions

The current study should be interpreted considering several limitations. First, common to most longitudinal studies, the current study navigated management of missing data and attrition across grandmother, mother, and child participants. Child biological health data was not collected on the full sample given shutdown of in-person research activities due to the COVID-19 pandemic. Across biological indicators, only 48 children had valid IL-6 from assays due to interviewer difficulty obtaining samples from fingerstick blood spots and the biological laboratory assaying CRP first. Across preliminary and primary aims, FIML methodology was used to handle missing data, which is considered the superior approach to listwise or pairwise deletion (Enders & Bandalos, 2001). Despite a smaller sample size than other studies evaluating the factor structure of allostatic load (King et al., 2019; McCaffery et al., 2012), the final proposed

measure of allostatic children in the current study demonstrated adequate model fit consistent with prior empirical work and allostatic load theory.

Similarly, data was collected from 80 grandmothers of 263 active participants at the time of grandmother data collection (of the original 322 families). Concern was noted that perhaps grandmothers who participated in data collected differed from grandmothers who did not. Given mothers were first contacted for permission to contact grandmother, it is possible that certain grandmother-mother characteristics may be associated with grandmother participation in the data collection presented here. For example, mothers may have been less likely to provide permission for grandmother contact among grandmother-mother dyads marked by poor relationship quality. More acculturated, U.S. residing grandmothers may also have been more comfortable with data collection. Most common reasons for grandmother nonparticipation included having passed away, not able to be contacted, and mother not interested in having grandmother participate or mother not thinking grandmother would be interested in participation. As described in the methods, maternal report of family conflict (when growing up) was included as an auxiliary variable in Aim 1 (the only primary aim which included grandmother data), to aid imputation of missing grandmother data with variables that may be associated with participation. Other variables considered for inclusion as an auxiliary variable but excluded due to lack of significant association with grandmother participation included maternal report of female of head of household when growing up, family income, maternal country of birth, and primary study variables for Aim 1. The lack of association between grandmother participation and various maternal and familial sociodemographic

characteristics suggests that the subsample of grandmothers who participated in data collection is not overtly misrepresentative of the overall sample of grandmothers. However, it is plausible that other unmeasured grandmother factors may predict non-participation. Grandmother death was the most common reason for grandmother non-participation. Mothers were not required to report the cause of death (e.g., from physical or mental health complications). Therefore, grandmother health may be one unmeasured confounding factor affecting non-participation, and particularly relevant to studies evaluating maternal and child health.

Identification of factors promoting child biobehavioral health is particularly important among samples of low-income, Mexican-origin families in the United States who may face high rates of transcultural and culture-specific stressors. The current study aimed to evaluate culturally based mechanisms of resilience (e.g., cultural orientation, parental cultural socialization, child-perceived parenting) in pathways of child biobehavioral health, within the context of multi-level stressors. Although the current sample of Mexican-origin families faces socioeconomic disadvantage at the family and neighborhood levels ($10,000-15,000 modal family income at study enrollment; 92.8% residing in low- or very-low opportunity neighborhoods, using Child Opportunity Index 2.0 National Norms), primary models do not directly assess exposure to specific stressors. Direct assessment of specific stress exposures, such as economic or acculturative stressors, may be important to incorporate into models evaluating resilience or promotive factors in pathways of child and family adjustment (Masten, 2014; Masten et al., 2021).

Lastly, the current study focuses on intergenerational transmission of culturally based processes among biologically related maternal grandmothers, mothers, and children. Across primary models evaluated, effects of grandmother on child are hypothesized to occur indirectly via mother. However, more than one-fifth of grandmothers reported living in the same household as children, suggesting that evaluation of direct grandmother influence on child adjustment may be warranted. Additionally, other family members (e.g., grandfathers, fathers) may play important roles in intergenerational transmission of cultural values and practices and child biobehavioral health (Cabrera & Bradley, 2012; Roubinov et al., 2016).

The present study also benefited from several strengths. Current mechanistic understanding of paradoxical health effects among Mexican immigrant families in the United States is limited by cross-sectional design and limited research with multiple generations of the same families. Instead of solely investigating country of birth or generational status, the current study evaluated specific mechanisms (e.g., grandmaternal and maternal cultural socialization, maternal cultural orientation, and child-perceived parenting) and moderators (child cultural orientation) underlying culturally based effects on child biobehavioral health. The longitudinal nature of the current study's primary aims allowed for evaluation of intergenerational processes across three generations of the same families. Data for the current study incorporated grandmother, mother, and child report with objective health data, reducing the potential for same source bias effects (Larelere & Kuhn, 2005). Additionally, intergenerational effects on child biobehavioral health were evaluated early in life, within a life course approach to health disparities framework. The

current study is the first to support use of an allostatic load factor among children as young as age 7.5 years, and simultaneously incorporated biological and psychological health outcomes in models as recommended to capture a more holistic understanding of child functioning (Bush & Roubinov, 2021; Masten et al., 2021).

Racial and ethnic health disparities emergent in adulthood, across domains of cardiometabolic risk, immune function, and mental health, are believed to stem from differential early-life contextual exposures (Doane et al., 2018). Evaluation of intergenerational and early-life influences on biobehavioral health during early childhood among low-income, Mexican-origin youth is particularly important, given this population may face elevated exposure to chronic stressors during childhood and is at elevated risk for a variety of chronic health conditions in adulthood (Rodriguez et al., 2014). Lastly, the current study is strengthened by its consideration of culturally based factors promoting biobehavioral health, even among families facing contextual risks, extending beyond solely a deficit perspective.

Across three generations of Mexican-origin families in the United States – maternal grandmothers, mothers, children – the current study aimed to (1) identify a multidimensional measure of child biobehavioral health across psychological and biological indicators, (2) evaluate the intergenerational transmission of grandmother-mother cultural socialization, (3) evaluate the effect of maternal cultural socialization on child-perceived parenting and child biobehavioral health, and (4) evaluate child cultural orientation as a moderator of the effect of maternal cultural socialization on child-perceived parenting and child biobehavioral health. Findings provide support for use of

an allostatic load factor structure among young children (age 7.5 years), although the hypothesized positive association between allostatic load and mental health symptoms was not supported. As hypothesized, grandmaternal cultural socialization of respect (of mother) predicted maternal cultural socialization of respect (of child) via maternal Mexican orientation, providing partial support for the grandmother-mother transmission of cultural socialization via maternal cultural orientation, however future work is needed to identify predictors of parental cultural socialization of independence. Unexpectedly, findings suggest that both independence and respect may be culturally congruent socialization messages among Mexican-origin grandmothers and mothers. Although maternal cultural socialization (of child) was predictive of child-perceived parenting, child-perceived parenting was not associated with children's mental health or allostatic load as hypothesized. Contrary to hypotheses, child cultural orientation did not moderate the effect of maternal cultural socialization on child-perceived parenting and biobehavioral health, warranting future consideration of alternative child-, parent-, and family-based factors that may interact with culturally specific and general parenting to predict health. In sum, the current project highlights complex and nuanced relations among parental cultural socialization, individual cultural orientation, child perceptions of parenting, and child biobehavioral health among low-income, Mexican-origin families in the United States.

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APPENDIX A

TABLES

Table 1

Sample Demographics at Prenatal Visit (G2, G3)

Maternal age; range, M (SD)	18-42; 27.8 (6.5)
Maternal country of birth; N (%)	
Mexico	278 (86%)
United States	44 (14%)
Grandmaternal country of birth; N (%)	
Mexico	302 (93.8%)
United States	18 (5.6%)
Other	2 (0.6%)
Marital Status N (%)	
Married/living together	249 (77%)
Single, never married	49 (15%)
Separated/divorced	24 (7%)
Maternal education; N (%)	
Less than high school	190 (59%)
High school diploma/GED	86 (27%)
Some college/technical school/college degree	45 (14%)
Annual family income; N (%)	
< $5,000	44 (14%)
$5,000 - $10,000	61 (19%)
$10,000 - $15,000	87 (28%)
$15,000 - $20,000	37 (12%)
$20,000 - $25,000	40 (13%)
$25,000 and above	45 (14%)
Missing/did not answer (n = 8)	
Number of other children; range, M (SD)	0-9; 1.98 (1.7)

Table 2

Grandmother Sample Demographics (G1)

Grandmaternal age; range (M)	45-77 years (59.62)
Grandmaternal country of birth; N (%)	
Mexico	77 (96.3%)
United States	2 (2.5%)
Other	1 (1.3%)
Grandmaternal country of residence; N (%)	
Mexico	26 (32.5%)
United States	53 (66.2%)
Other	1 (1.3%)
Grandmaternal education; N (%)	
Did not attend school	9 (11.3%)
Elementary education	50 (62.6%)
Completed part of high school, but did not finish	9 (11.3%)
High school diploma/GED	6 (7.5%)
At least some college/technical school/college degree	6 (7.5%)
Preferred language; N (%)	
Spanish	78 (97.5%)
English	2 (2.5%)
Grandmother-Grandchild Proximity, N (%)	
In the same household	18 (22.5%)
0-10 miles	20 (25.0%)
11-25 miles	10 (12.5%)
26-50 miles	3 (3.8%)
51-100 miles	0 (0%)
101-250 miles	4 (5.0%)
More than 250 miles	21 (26.3%)
Refusal	3 (3.9%)

Table 3

List of Measures

Measure	Respondent		
	G1 Grandmother	**G2 Mother**	**G3 Child**
Demographic questionnaire	X	X	
Cultural Socialization of Latino Children	X	X	
Acculturation Rating Scale for Mexican Americans – II	X	X	
Child Report of Parenting Behavior Inventory – Mother			X
Child Behavior Checklist		X	
Blood pressure			X
Glycated hemoglobin			X
Glucose			X
Plasma triglycerides			X
High density lipoprotein			X
C-reactive protein			X
Resting heart rate			X
Heart rate variability			X
Body mass index			X
Waist circumference			X

Table 4

Correlations among child biobehavioral health indicators (age 7.5 years)

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. Body mass index (BMI)	1	.880**	.684**	.428**	-.288**	.335**	.102	.227	.078	.442**	-.206*	.176*	.015	.036	.017
2. Waist circumference	.880**	1	.628**	.370**	-.268**	.315**	.096	.170	.077	.419**	-.125	.163	.022	.017	.085
3. Systolic blood pressure	.684**	.628**	1	.702**	-.203*	.133	-.008	.095	.021	.363**	-.326**	.287**	.021	-.028	-.034
4. Diastolic blood pressure	.428**	.370**	.702**	1	-.121	.010	.147	.212	.147	.294**	-.363**	.358**	-.045	-.061	-.045
5. HDL Cholesterol (HDL-C)	-.288**	-.268**	-.203*	-.121	1	-.311**	.204	.090	.037	-.109	.197*	-.114	.000	.145	.041
6. Triglycerides	.335**	.315**	.133	.010	-.311**	1	-.063	-.072	-.079	.040	-.101	.134	-.091	.141	.129
7. Interleukin-6 (IL-6)	.102	.096	-.008	.147	.204	-.063	1	.919**	.940**	.602**	-.232	.411*	-.217	-.086	.193
8. Log-transformed IL-6	.227	.170	.095	.212	.090	-.072	.919**	1	.788**	.692**	-.189	.359*	-.162	-.077	.084
9. C-reactive protein (CRP)	0.078	.077	.021	.147	.037	-.079	.940**	.788**	1	.604**	-.293**	.386**	-.113	.106	.053
10. Log-transformed CRP	.442**	.419**	.363**	.294**	-.109	0.040	.602**	.692**	.604**	1	-.196	.253*	.002	.105	.052
11. Heart rate variability	-.206*	-.125	-.326**	-.363**	.197*	-.101	-.232	-.189	-.293**	-.196	1	-.784**	-.005	-.140	.071
12. Mean resting heart rate	.176*	.163	.287**	.358**	-.114	.134	.411*	.359*	.386**	.253*	-.784**	1	-.042	.043	-.049
13. Glycated hemoglobin (HbA1c)	.015	.022	.021	-.045	.000	-.091	-.217	-.162	-.113	.002	-.005	-.042	1	-.013	-.032
14. Glucose	.036	.017	-.028	-.061	.145	.141	-.086	-.077	.106	.105	-.140	.043	-.013	1	-.031
15. Internalizing symptoms	.017	.085	-.034	-.045	.041	.129	.193	.084	.053	.052	.071	-.049	-.032	-.031	1
16. Externalizing symptoms	-.058	-.008	-.080	-.068	.040	.037	.057	-.051	.067	.121	-.106	.034	0.010	-.089	.499**

Note. *Correlation is statistically significant at the $p < .05$ level. **Correlation is statistically significant at the $p < .01$ level.

Table 5

Descriptive statistics for child biobehavioral health indicators at age 7.5 years

Variable (Units)	N	Mean (SD)	Range	Skewness	Kurtosis
Body mass index (kg/m^2)	175	18.10 (3.75)	12.00, 31.20	1.111	.817
Waist circumference (cm.)	181	66.64 (10.22)	48.00, 107.7	.973	.985
Systolic blood pressure (mmHg)	180	103.38 (9.44)	81.00, 136.00	.578	.783
Diastolic blood pressure (mmHg)	180	59.69 (7.38)	41.00, 88.50	.587	1.241
HDL Cholesterol (mg/dL)	157	52.97 (13.89)	17.00, 85.00	-.181	-.521
Triglycerides (mmol/L)	162	148.00 (77.74)	44.00, 482.00	1.568	3.474
Interleukin-6 (pg/ml)	48	.44 (.28)	.260, 2.20	5.380	33.445
C-reactive protein (mg/L)	133	1.89 (5.41)	.006, 48.54	6.581	49.169
Heart rate variability	142	6.18 (1.09)	2.77, 9.04	-.356	.604
Resting heart rate (bpm)	142	91.22 (10.75)	64.98, 123.61	.373	.246
Glycated hemoglobin (mmols/mol)	164	5.23 (.31)	4.30, 7.10	1.093	7.937
Glucose (mmol/L)	134	98.37 (11.81)	65.00, 145.00	.500	1.525
Internalizing symptoms	235	7.03 (5.73)	0.00, 36.00	1.283	2.466
Externalizing symptoms	235	6.23 (6.59)	0.00, 44.00	2.224	7.190

Table 6

Correlations among primary variables and covariates for Aim 1

Variable	M (SD)	Range	1.	2.	3.	4.	5.	6.	7.
1. G1 cultural socialization of respect	4.40 (.59)	2.67, 5.00	1	.534**	-.175	.277*	.014	.139	.246*
2. G1 cultural socialization of independence	4.32 (.59)	2.71, 5.00	.534**	1	-.129	.114	.020	.186	.109
3. G2 Anglo orientation	2.65 (.99)	1.00, 5.00	-.175	-.129	1	-.411**	-.129	.096	-.361**
4. G2 Mexican orientation	4.33 (.63)	1.00, 5.00	.277*	.114	-.411**	1	.162*	.026	.474**
5. G2 cultural socialization of respect	4.22 (.62)	2.17, 5.00	.014	.020	-.129	.162*	1	.566**	-.020
6. G2 cultural socialization of independence	4.35 (.58)	2.29, 5.00	.139	.186	.096	.026	.566**	1	-.040
7. G2 country of birth[1]	.86 (.34)	0, 1	.246*	.109	-.361**	.474**	-.020	-.040	1
8. G1 country of birth[2]	.94 (.23)	0, 1	.084	.011	-.550**	.329**	.022	-.001	.620**

Note. *Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).
[1]G2 country of birth coded 0 = United States, 1 = Mexico. [2]G1 country of birth coded 0 = United States, 1 = Mexico.

Table 7

Correlations among primary variables and covariates for Aims 2 and 3

Variable	M (SD)	Range	1	2	3	4	5	6	7	8	9
1. G2 cultural socialization of respect	4.22 (.62)	2.17, 5.00	1	.566**	.048	.082	.058	.043	.044	-.008	-.146*
2. G2 cultural socialization of independence	4.35 (.58)	2.29, 5.00	.566**	1	.194*	-.122	.158*	.066	-.008	-.086	-.077
3. G3 perceived maternal acceptance	3.96 (.73)	1.25, 5.00	.048	.194*	1	-.117	.068	-.003	.024	-.032	.030
4. G3 perceived maternal rejection/harshness	2.34 (.74)	1.00, 4.67	.082	-.122	-.117	1	-.048	-.029	.014	.111	-.062
5. G3 Mexican orientation	3.31 (.58)	1.93, 5.00	.058	.158*	.068	-.048	1	-.094	.118	-.043	.204**
6. G3 Anglo orientation	3.68 (.59)	1.25, 5.00	.043	.066	-.003	-.029	-.094	1	-.099	.111	-.068
7. G3 allostatic load (factor score)	0.00 (.88)	-1.76, 3.17	.044	-.008	.024	.014	.118	-.099	1	.009	.001
8. G3 mental health (factor score)	0.00 (.82)	-1.03, 3.12	-.008	-.086	-.032	.111	-.043	.111	.009	1	-.116
9. G3 biological sex[1]	.54 (.50)	0, 1	-.146*	-.077	.030	-.062	.204**	-.068	.001	-.116	1
10. G2 country of birth[2]	.86 (.34)	0, 1	.022	-.001	-.006	-.007	.200**	-.009	-.049	-.155*	.083

Note. *Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). [1]G3 biological sex coded 0 = male, 1 = female. [2]G2 country of birth coded 0 = United States, 1 = Mexico.

Table 8

Model Fit Statistics for Preliminary Biobehavioral Health CFA Models

	Physical Health Models (without Mental Health and Glycemic Indicators)				
Model Fit Statistic	a. Unidimensional Model	b. Unidimensional Model (Correlated Residuals)	c. Multi-Factor Model	d. Second-Order Factor	g. Two Second-Order Factor (with Metabolic Syndrome Factor)*
AIC	3824.248	3585.072	3598.292	3617.291	---
BIC	3921.181	3698.161	3711.381	3714.224	---
Chi-Square (*df*)	344.035 (35)	71.613 (30)	75.033 (30)	104.032 (35)	---
RMSEA	0.217	0.086	0.090	0.103	---
90% CI	0.197, 0.238	0.061, 0.112	0.064, 0.115	0.080, 0.126	---
CFI	0.537	0.938	0.941	0.909	---
SRMR	0.159	0.097	0.078	0.108	---
	Biobehavioral Health Models (with Mental Health Indicators)				
		Model Fit Statistic	e. Multi-Factor Model (including Mental Health)	f. Second-Order Allostatic Load Factor, correlated with Mental Health Factor	
AIC		AIC	4881.187	4895.777	
BIC		BIC	5038.560	5021.675	
Chi-Square		Chi-Square (*df*)	94.122 (45)	126.712 (54)	
RMSEA		RMSEA	0.067	0.074	
90% CI		90% CI	0.048, 0.086	0.058, 0.091	
CFI		CFI	0.941	0.912	
SRMR		SRMR	0.066	0.094	

Note. *Model would not converge.

Table 9

Aim 1 Model Results

		Est.	S.E. Est.	*p*	R^2
G2 respect					.039
	G1 respect	-0.127	0.146	0.385	
	G1 independence	0.066	0.146	0.650	
	G2 Anglo orient.	-0.088	0.055	0.110	
	G2 Mex. orient.	**0.182**	**0.086**	**0.036**	
	G2 country of birth	-0.191	0.154	0.215	
G2 independence					.044
	G1 respect	0.022	0.141	0.877	
	G1 independence	0.159	0.140	0.255	
	G2 Anglo orient.	0.094	0.053	0.075	
	G2 Mex. orient.	0.050	0.083	0.547	
	G2 country of birth	0.074	0.149	0.618	
G2 Anglo orient.					.383**
	G1 respect	**-0.410**	**0.154**	**0.008**	
	G1 independence	0.041	0.190	0.829	
	G2 country of birth	**-1.502**	**0.187**	**0.000**	
G2 Mex orient.					.272*
	G1 respect	**0.457**	**0.113**	**0.000**	
	G1 independence	-0.127	0.145	0.383	
	G2 country of birth	**0.471**	**0.147**	**0.001**	

Note. Unstandardized estimates shown. Bolded p-values indicate statistically significant at $p < .05$; **Indicates statistical significance at level $p < .001$; *Indicates statistical significance at level $p = .001$. G1 = grandmother report, G2 = maternal report. "Respect" = cultural socialization of respect; "independence" = cultural socialization of independence; "orient." = orientation; "Mex." = Mexican. G2 country of birth coded 0 = United States, 1 = Mexico.

Table 10

Aim 2 Model Results

		Est.	S.E. Est.	*p*	R^2
G3 mental health					.085
	G2 rejection/harshness	0.118	0.091	0.194	
	G2 acceptance	-0.010	0.088	0.908	
	G2 respect	0.031	0.104	0.762	
	G2 independence	-0.108	0.106	0.308	
	G2 country of birth	**-0.194**	**0.083**	**0.019**	
	G3 biological sex	-0.118	0.079	0.137	
G3 allostatic load					.011
	G2 rejection/harshness	0.018	0.099	0.852	
	G2 acceptance	0.034	0.087	0.694	
	G2 respect	0.092	0.119	0.440	
	G2 independence	-0.063	0.115	0.580	
	G2 country of birth	-0.065	0.092	0.481	
	G3 biological sex	0.009	0.084	0.918	
G2 rejection/harshness					.065
	G1 respect	**0.237**	**0.094**	**0.012**	
	G1 independence	**-0.278**	**0.095**	**0.003**	
	G2 country of birth	-0.003	0.084	0.968	
	G3 biological sex	-0.067	0.075	0.372	
G2 acceptance					.045
	G1 respect	-0.096	0.093	0.305	
	G1 independence	**0.247**	**0.093**	**0.008**	
	G2 country of birth	-0.010	0.082	0.905	
	G3 biological sex	0.051	0.074	0.489	

Note. Standardized estimates shown. Bolded p-values indicate statistically significant at $p < .05$; **Indicates statistical significance at level $p < .001$; *Indicates statistical significance at level $p = .001$. G1 = grandmother, G2 = mother, and G3 = child. "Respect" = cultural socialization of respect; "independence" = cultural socialization of independence; "orient." = orientation; "Mex." = Mexican. G2 country of birth coded 0 = United States, 1 = Mexico. G3 biological sex coded 0 = male, 1 = female.

Table 11

Aim 3 Model Results

		Est.	S.E. Est.	*p*	R^2
G3 mental health					.086
	G2 rejection/harshness	0.112	0.093	0.225	
	G2 acceptance	-0.003	0.090	0.977	
	G2 respect	0.025	0.107	0.811	
	G2 independence	-0.098	0.108	0.367	
	G3 acculturation	0.064	0.090	0.472	
	Accult. X respect	0.002	0.120	0.989	
	Accult. X independence	0.005	0.121	0.970	
	G2 country of birth	**-0.186**	**0.084**	**0.027**	
	G3 biological sex	-0.109	0.081	0.176	
G3 allostatic load					.076
	G2 rejection/harshness	0.046	0.098	0.637	
	G2 acceptance	0.016	0.088	0.854	
	G2 respect	0.066	0.118	0.575	
	G2 independence	-0.062	0.114	0.587	
	G3 acculturation	**-0.259**	**0.115**	**0.024**	
	Accult. X respect	0.040	0.181	0.824	
	Accult. X independence	0.021	0.157	0.896	
	G2 country of birth	-0.099	0.093	0.285	
	G3 biological sex	-0.023	0.085	0.787	
G2 rejection/harshness					.080
	G2 respect	**0.249**	**0.095**	**0.008**	
	G2 independence	**-0.273**	**0.096**	**0.004**	
	G3 acculturation	0.043	0.103	0.673	
	Accult. X respect	0.015	0.164	0.929	
	Accult. X independence	-0.138	0.139	0.320	
	G2 country of birth	-0.005	0.085	0.953	
	G3 biological sex	-0.074	0.077	0.332	
G2 acceptance					.074
	G2 respect	-0.100	0.092	0.278	
	G2 independence	**0.237**	**0.093**	**0.010**	
	G3 acculturation	-0.086	0.098	0.380	
	Accult. X respect	0.138	0.145	0.343	

Accult. X independence	-0.075	0.127	0.555
G2 country of birth	-0.025	0.083	0.766
G3 biological sex	0.040	0.075	0.598

Note. Standardized estimates shown. Bolded p-values indicate statistically significant at $p < .05$; **Indicates statistical significance at level $p < .001$; *Indicates statistical significance at level $p = .001$. G1 = grandmother, G2 = mother, and G3 = child. "Respect" = cultural socialization of respect; "independence" = cultural socialization of independence; "orient." = orientation; "Accult." = G3 acculturation. G2 country of birth coded 0 = United States, 1 = Mexico. G3 biological sex coded 0 = male, 1 = female.

APPENDIX B

FIGURES

Figure 1

McCaffery et al. (2012) Factor Structure of Allostatic Load among Adults

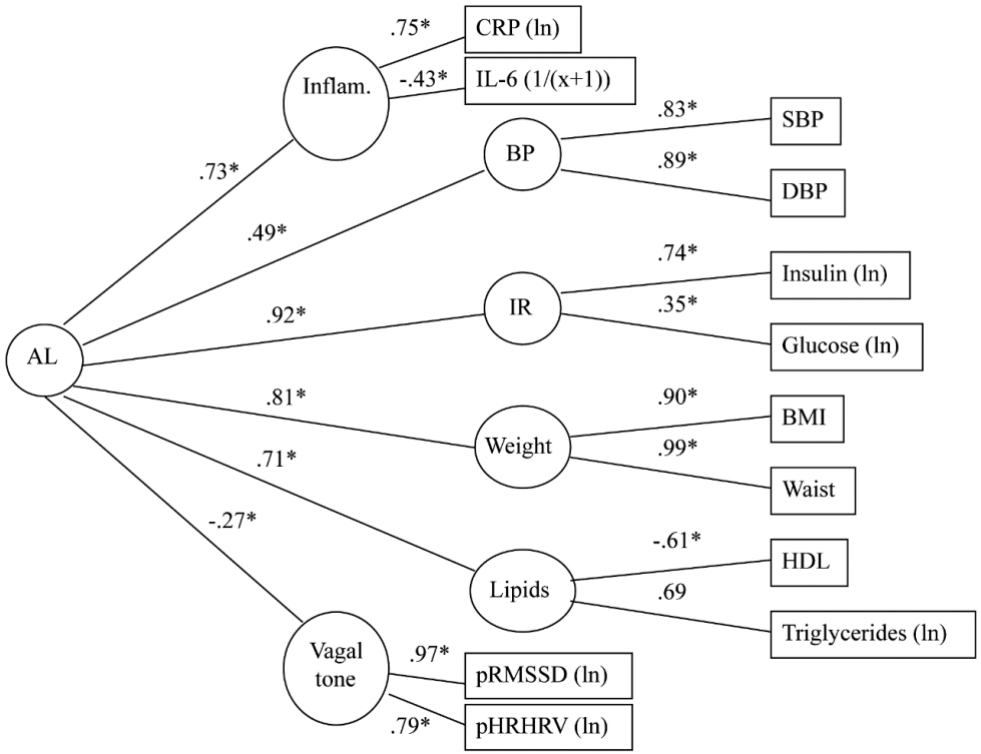


Figure 2

King et al. (2019) Factor Structure among Adolescents

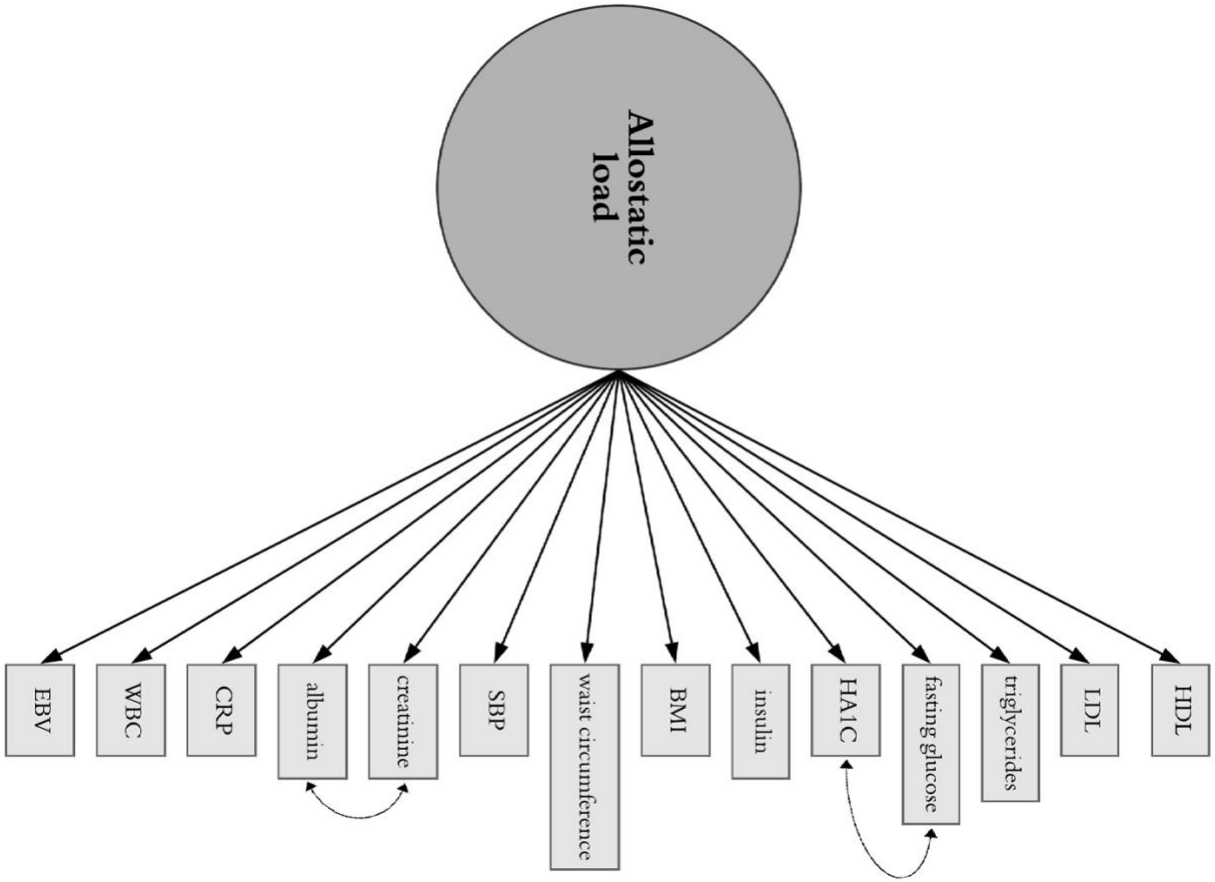


Figure 3

Conceptual Model for Aim 1

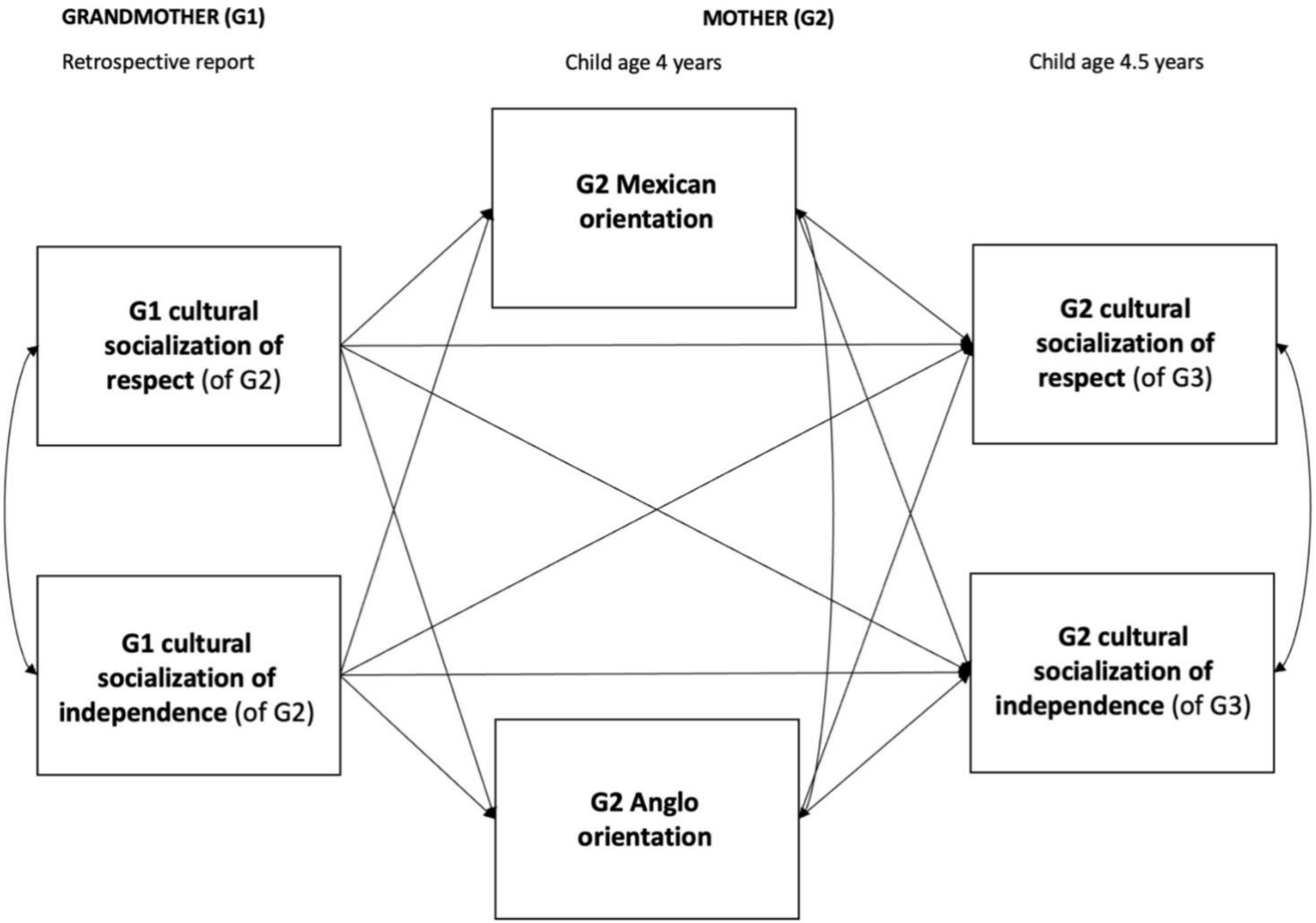


Figure 4

Conceptual Model for Aim 2

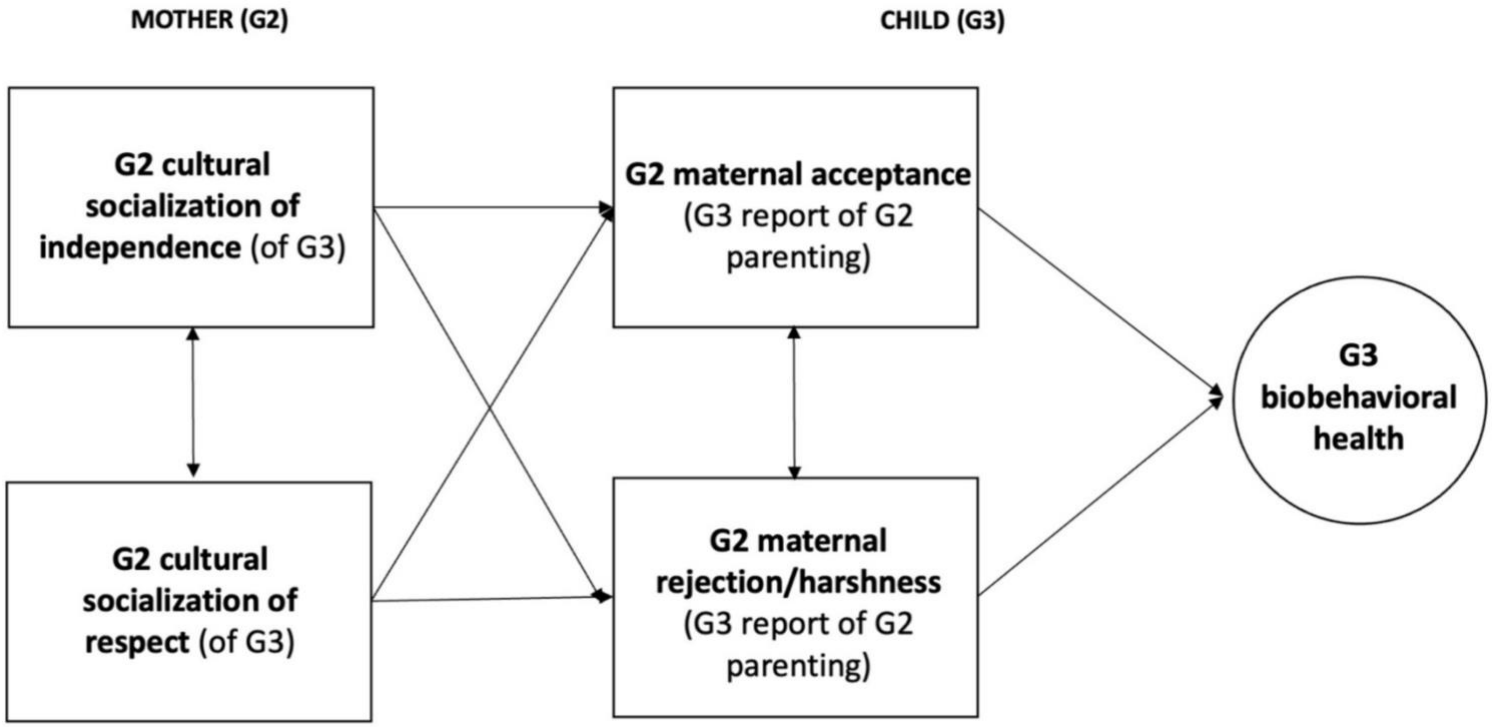


Figure 5

Conceptual Model for Aim 3

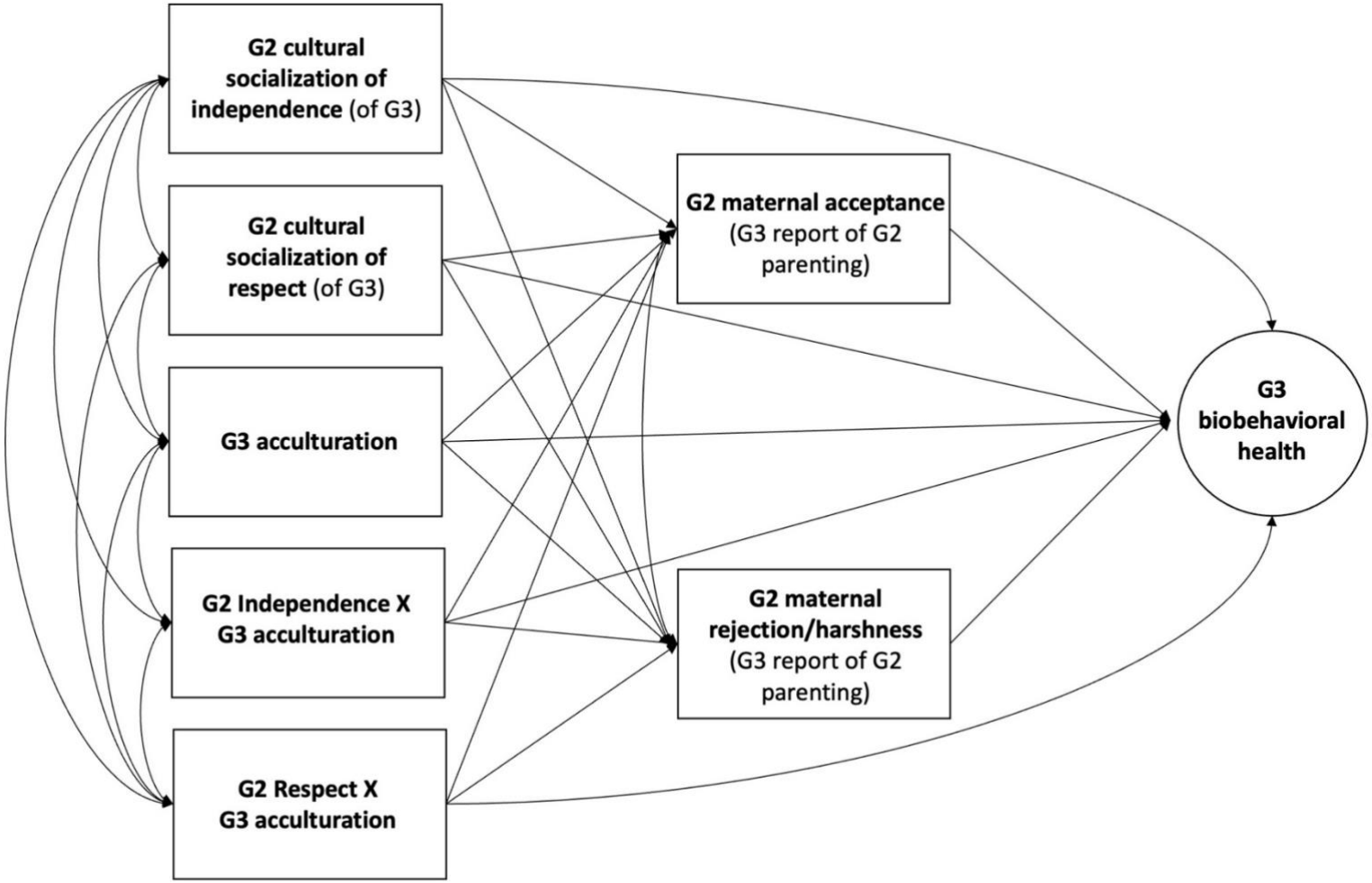


Figure 6a

Unidimensional Model of Biobehavioral Health

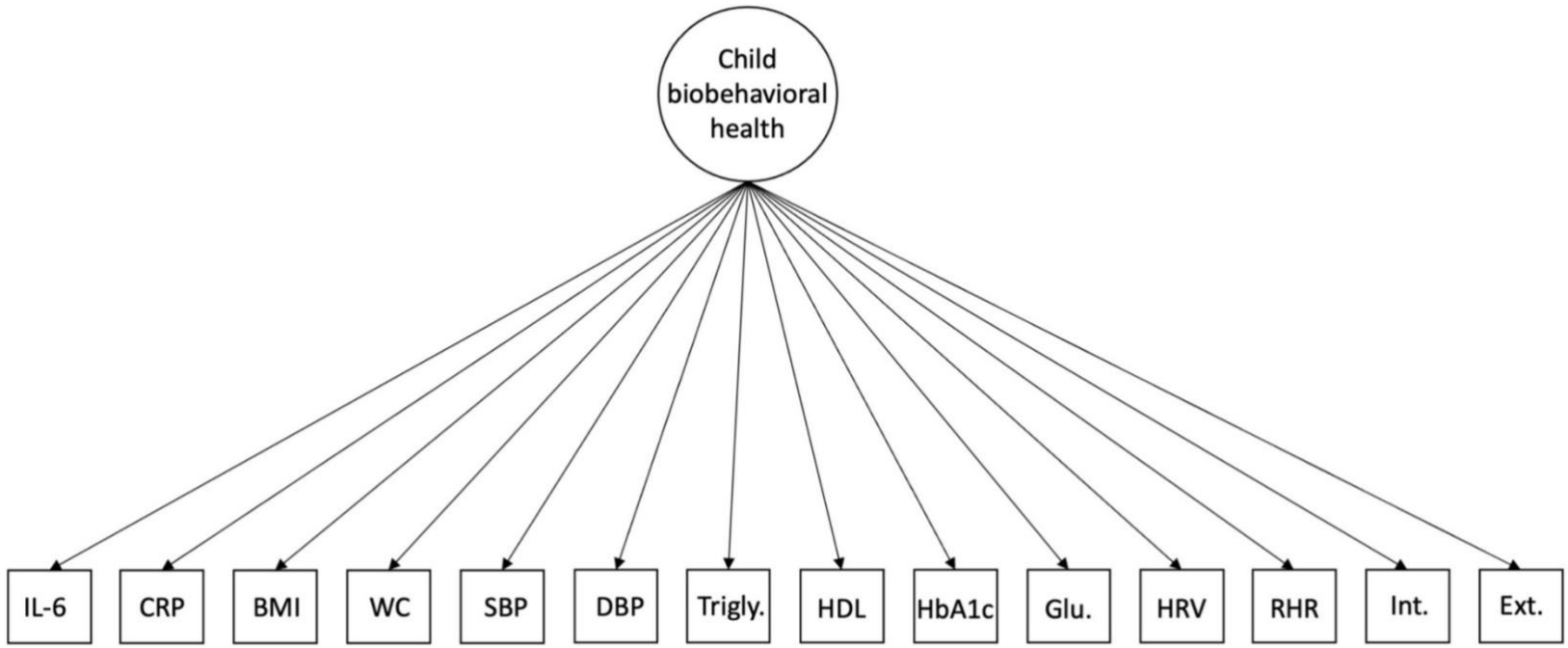


Figure 6b

Multi-Factor Model of Biobehavioral Health

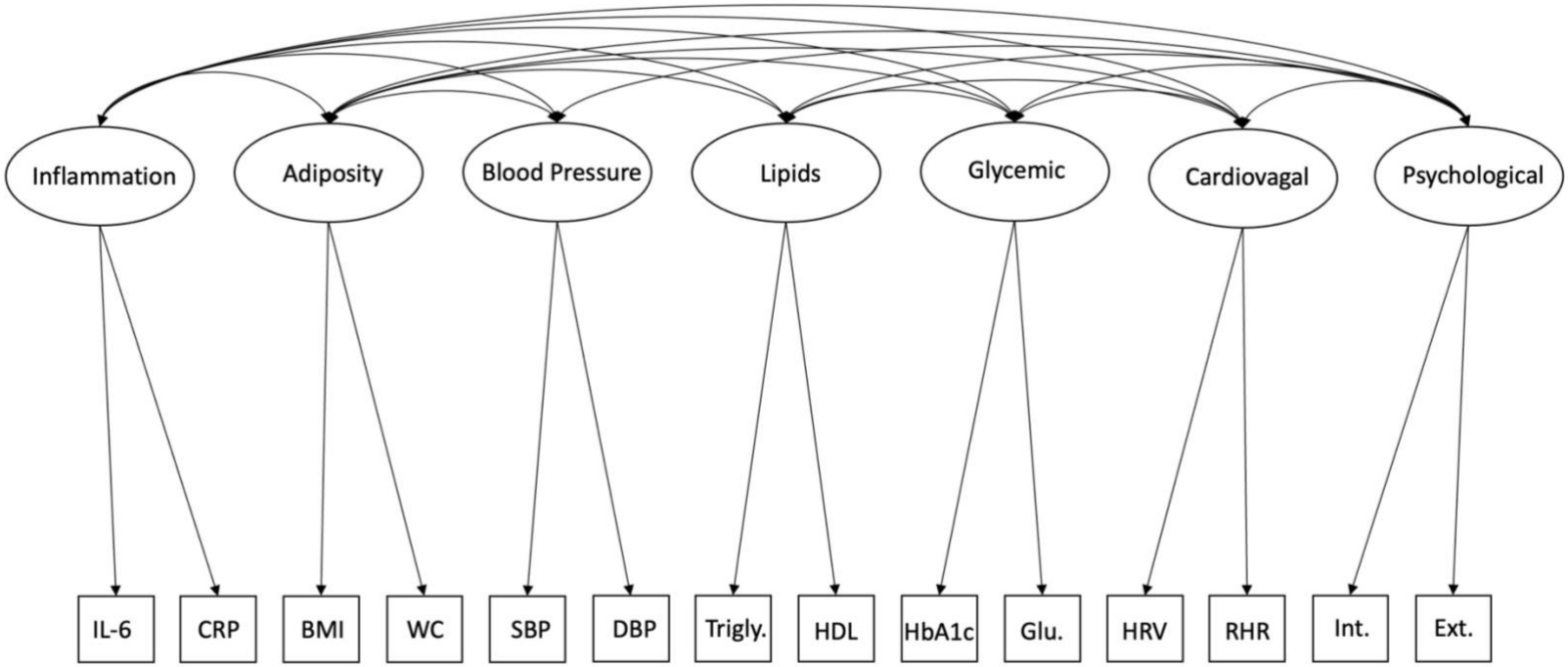


Figure 6c

Multi-Factor Model of Allostatic Load (No Psychological Factor)

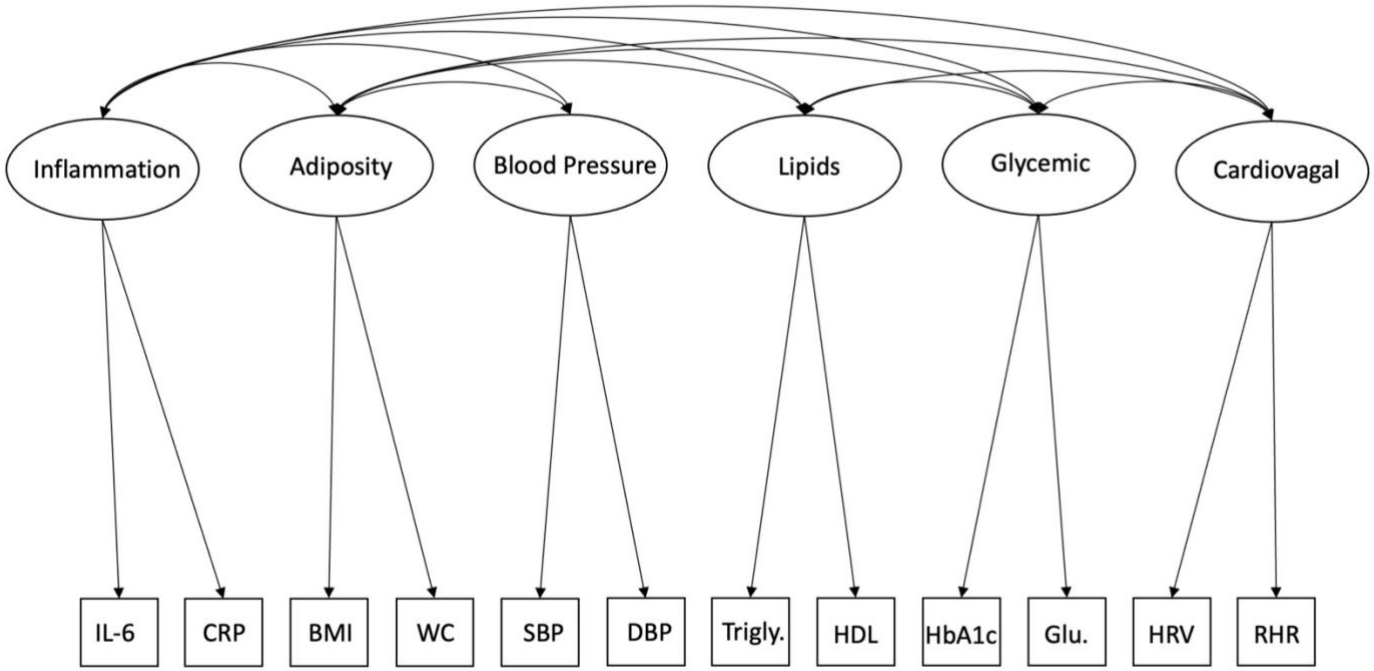


Figure 6d

Second-Order Biobehavioral Health Factor (with Psychological Indicators)

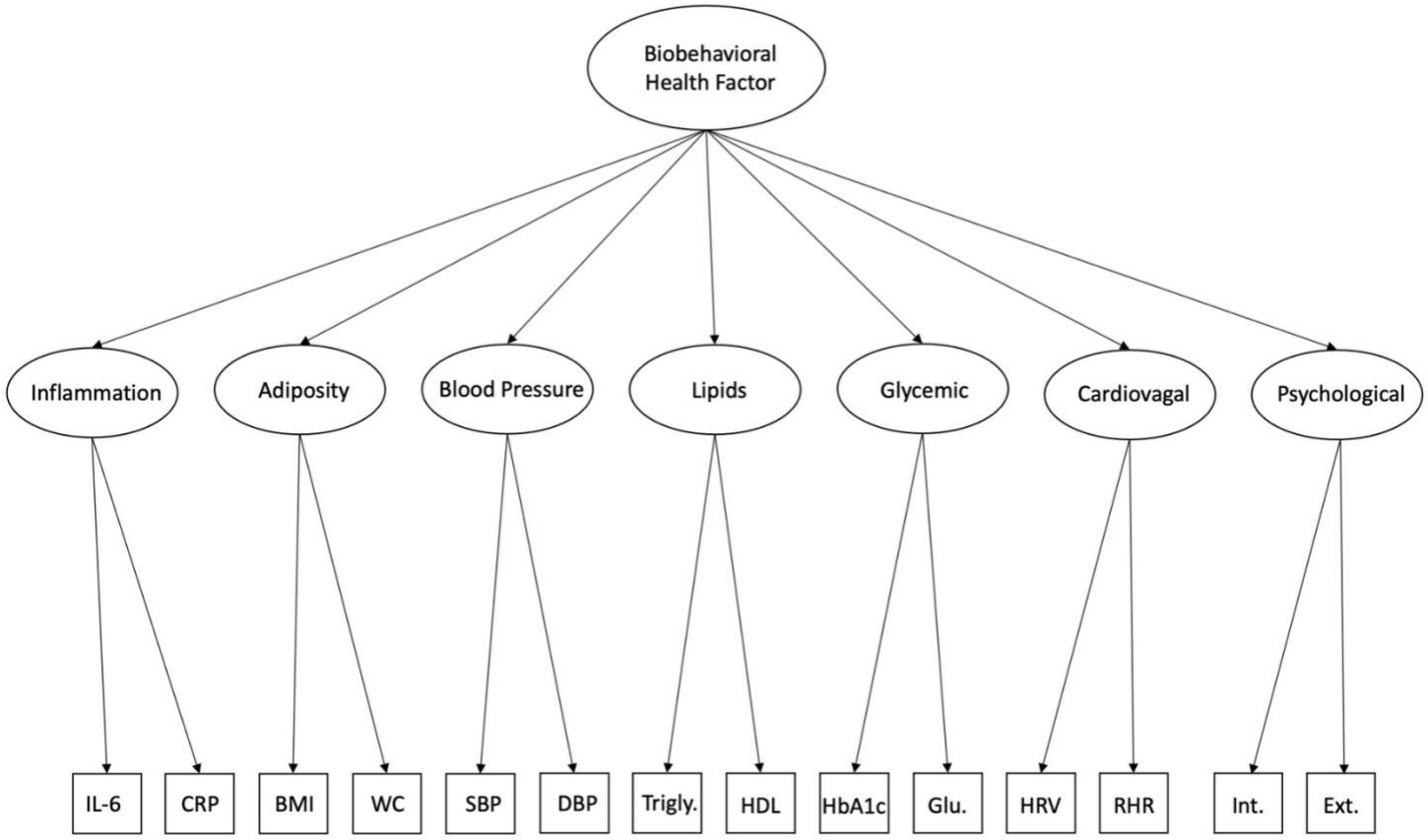


Figure 6e

Higher-Order Allostatic Load Health Factor (without Psychological Indicators)

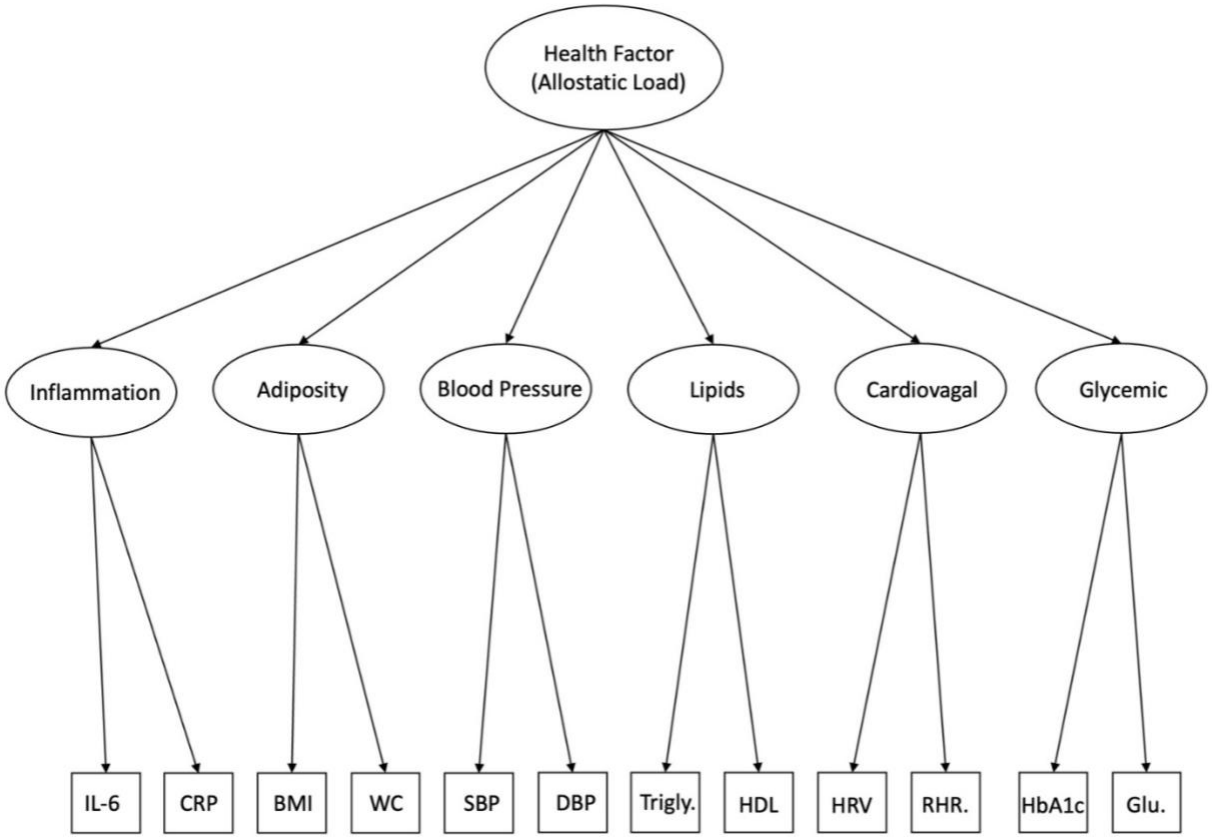


Figure 6f

Higher-Order Allostatic Load Health Factor, with Metabolic Syndrome Residual Modeled after McCaffery et al. (2012)

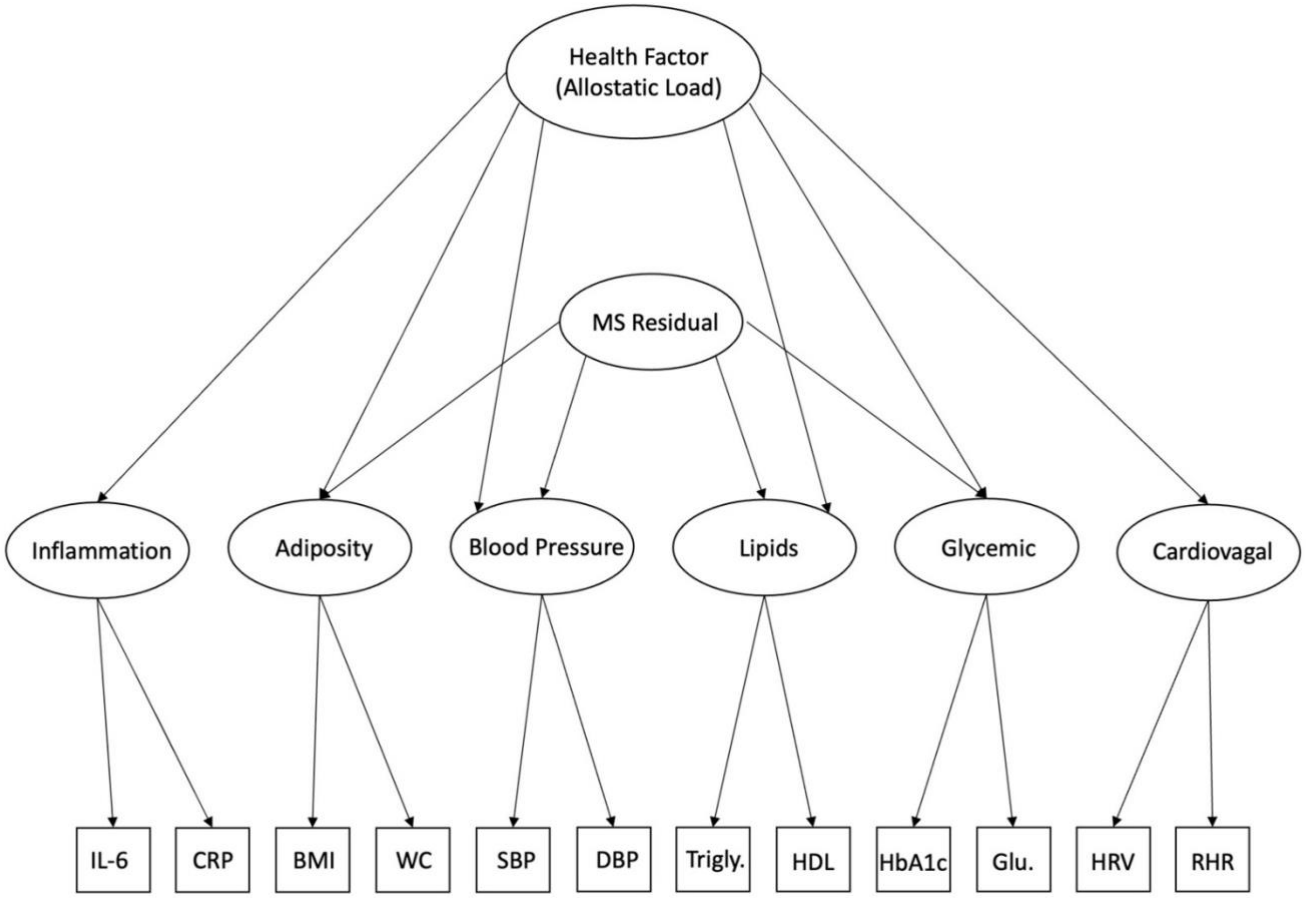
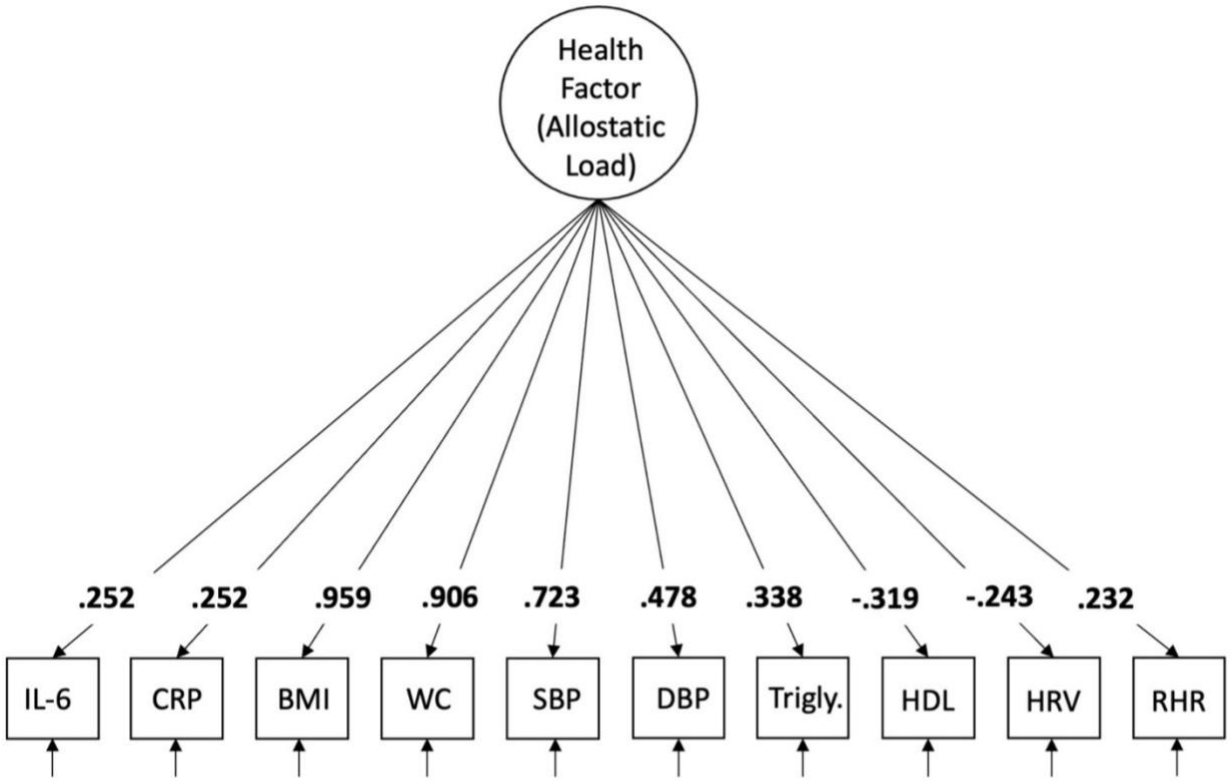


Figure 7

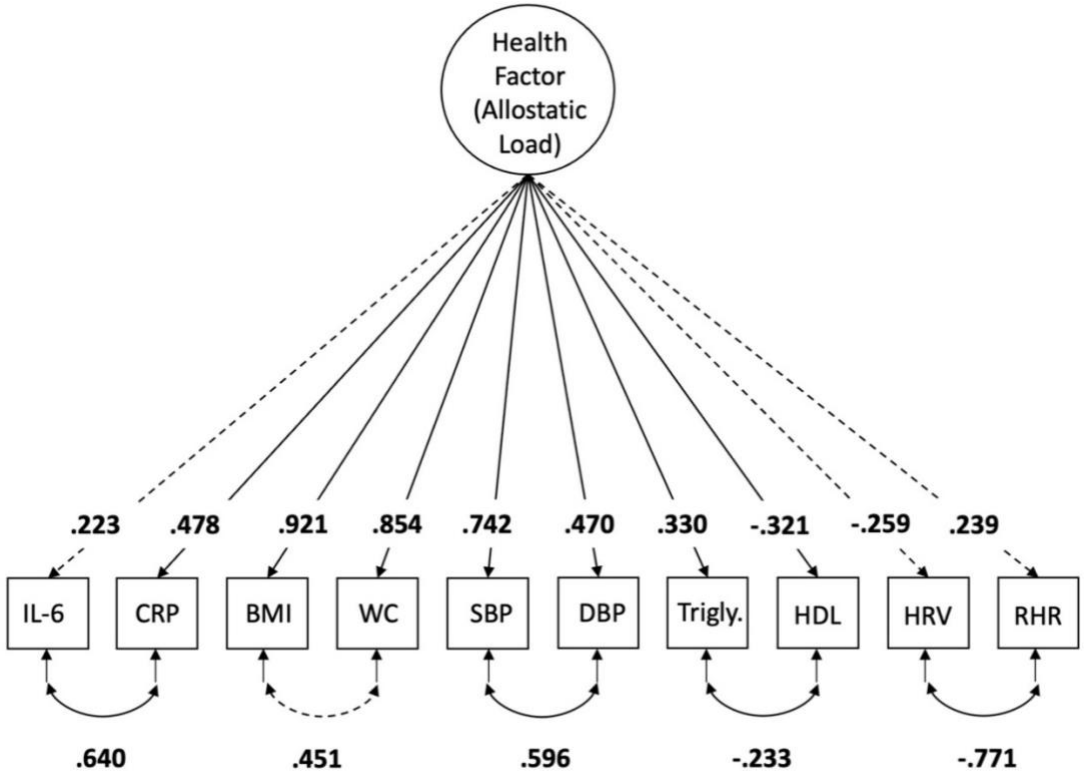
Unidimensional Model of Physical Health



Note. Standardized estimates shown. Solid lines indicate statistical significance at $p < .05$; dashed lines indicate non-statistical significance. See Table 8 Model A for fit statistics.

Figure 8

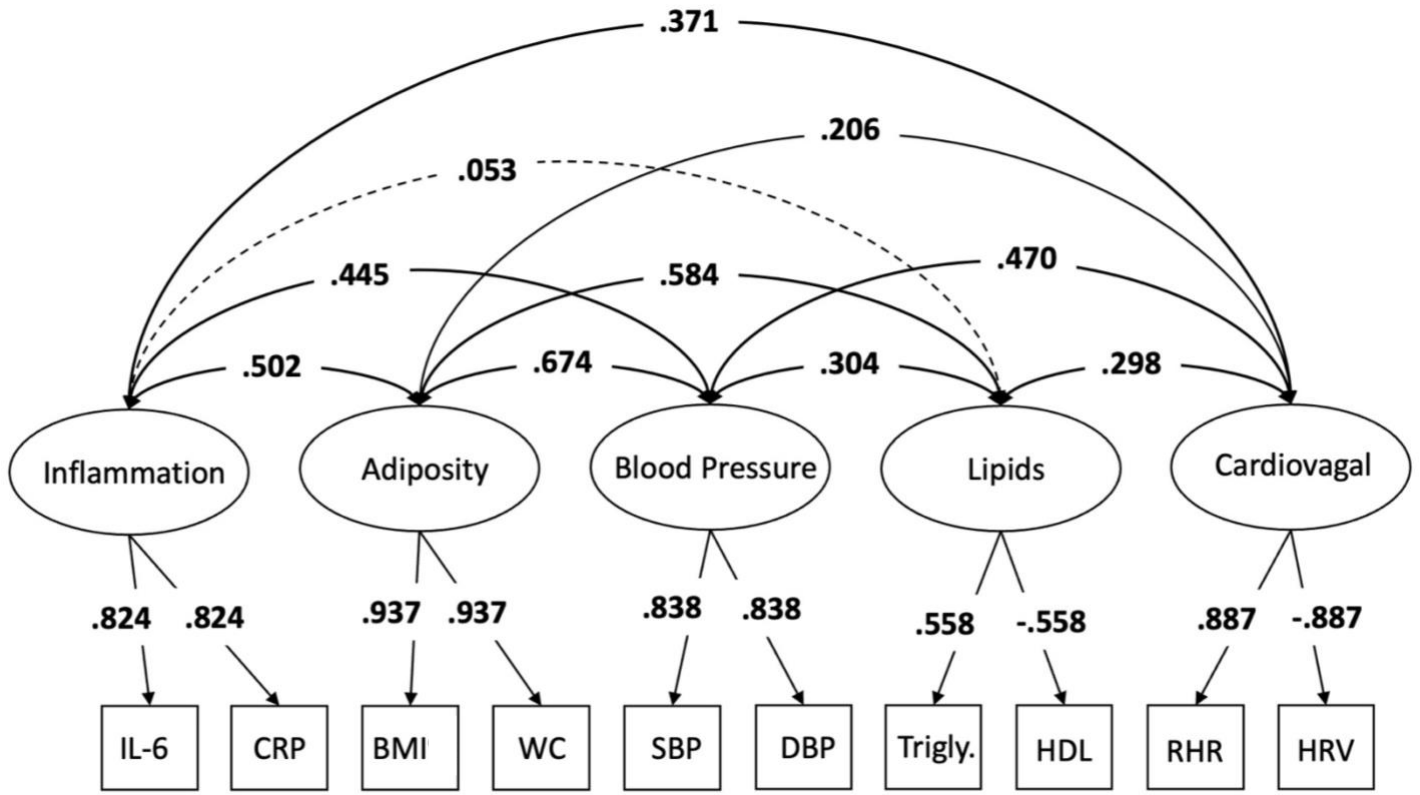
Unidimensional Model of Physical Health with Correlated Metabolic Residuals



Note. Standardized estimates shown. Solid lines indicate statistical significance at $p < .05$; dashed lines indicate non-statistical significance. See Table 8 Model B for fit statistics.

Figure 9

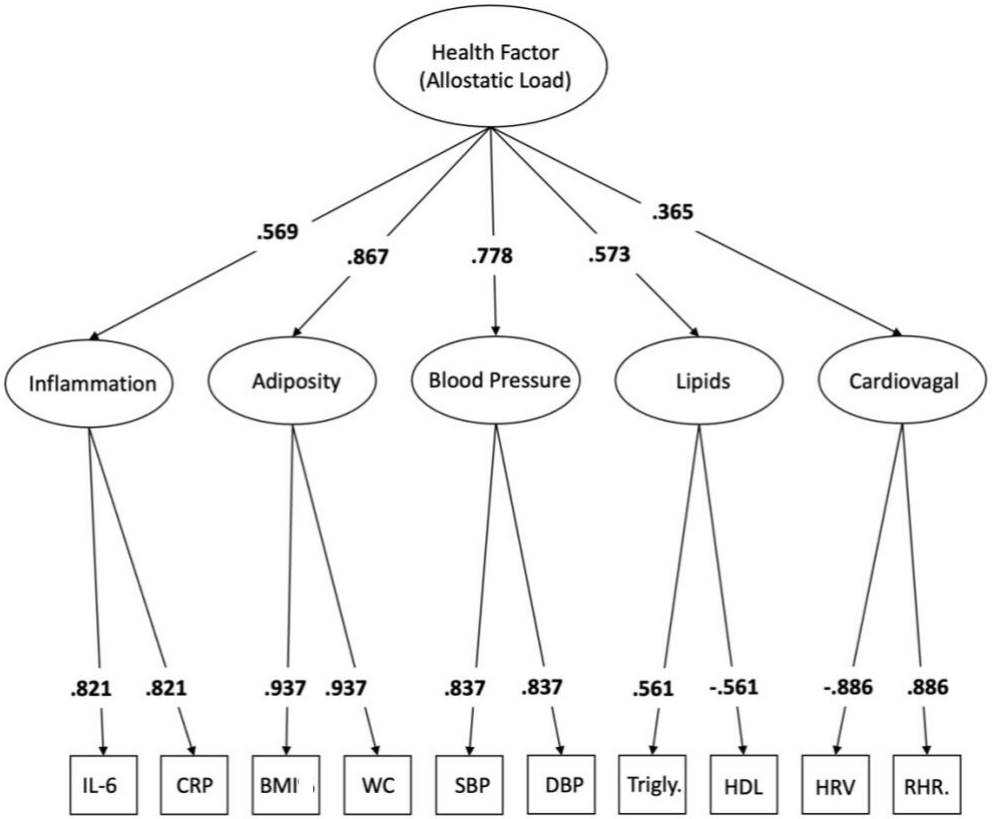
Multi-Factor Model of Physical Health Indicators (Allostatic Load) Results



Note. Standardized estimates shown. Solid lines indicate statistical significance at $p < .05$; dashed lines indicate non-statistical significance. Error terms not shown. See Table 8 Model C for fit statistics.

Figure 10

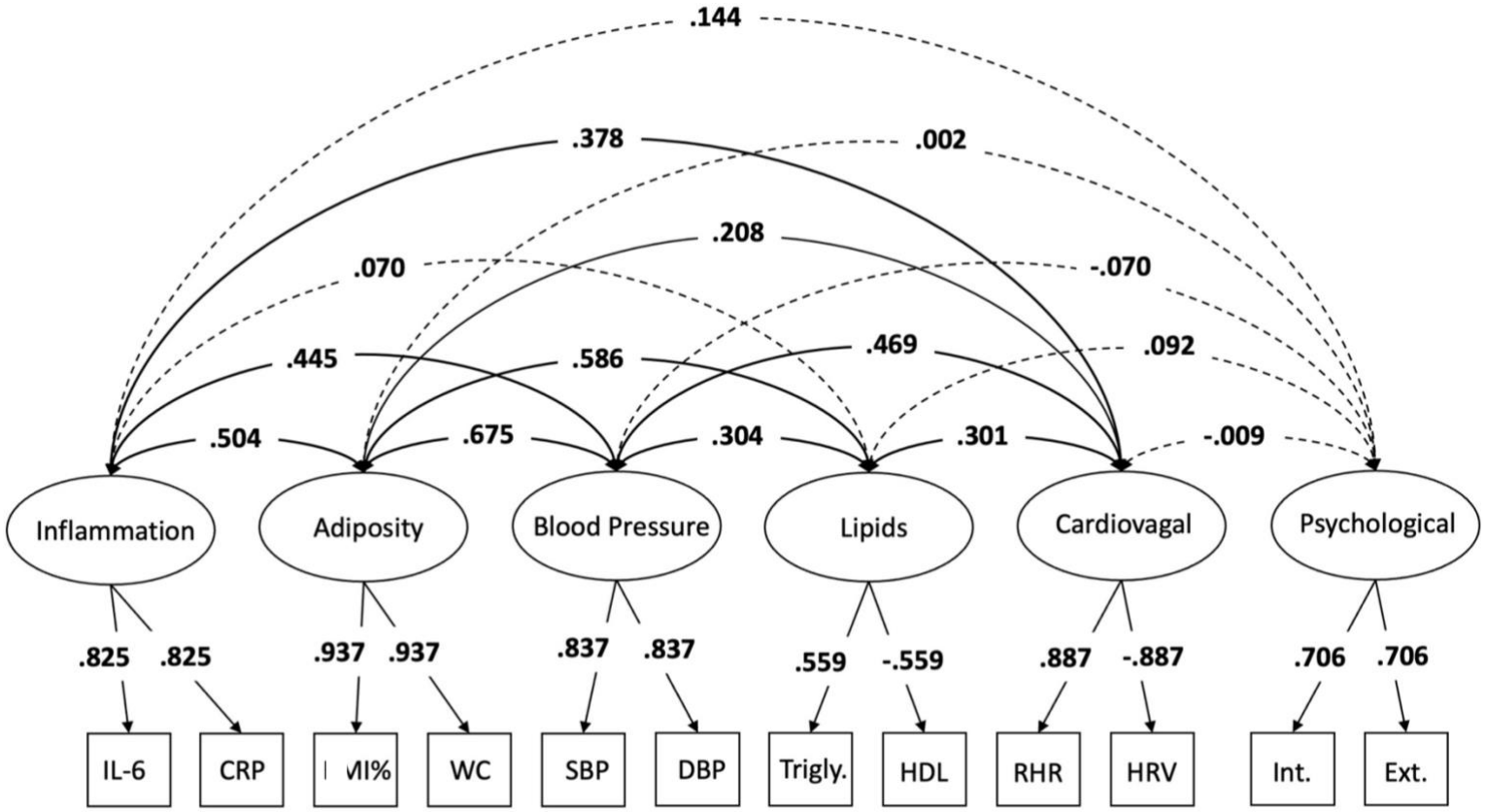
Second-Order Allostatic Load Model Results



Note. Standardized estimates shown. Solid lines indicate statistical significance at $p < .05$; dashed lines indicate non-statistical significance. Error terms not shown. See Table 8 Model D for fit statistics.

Figure 11

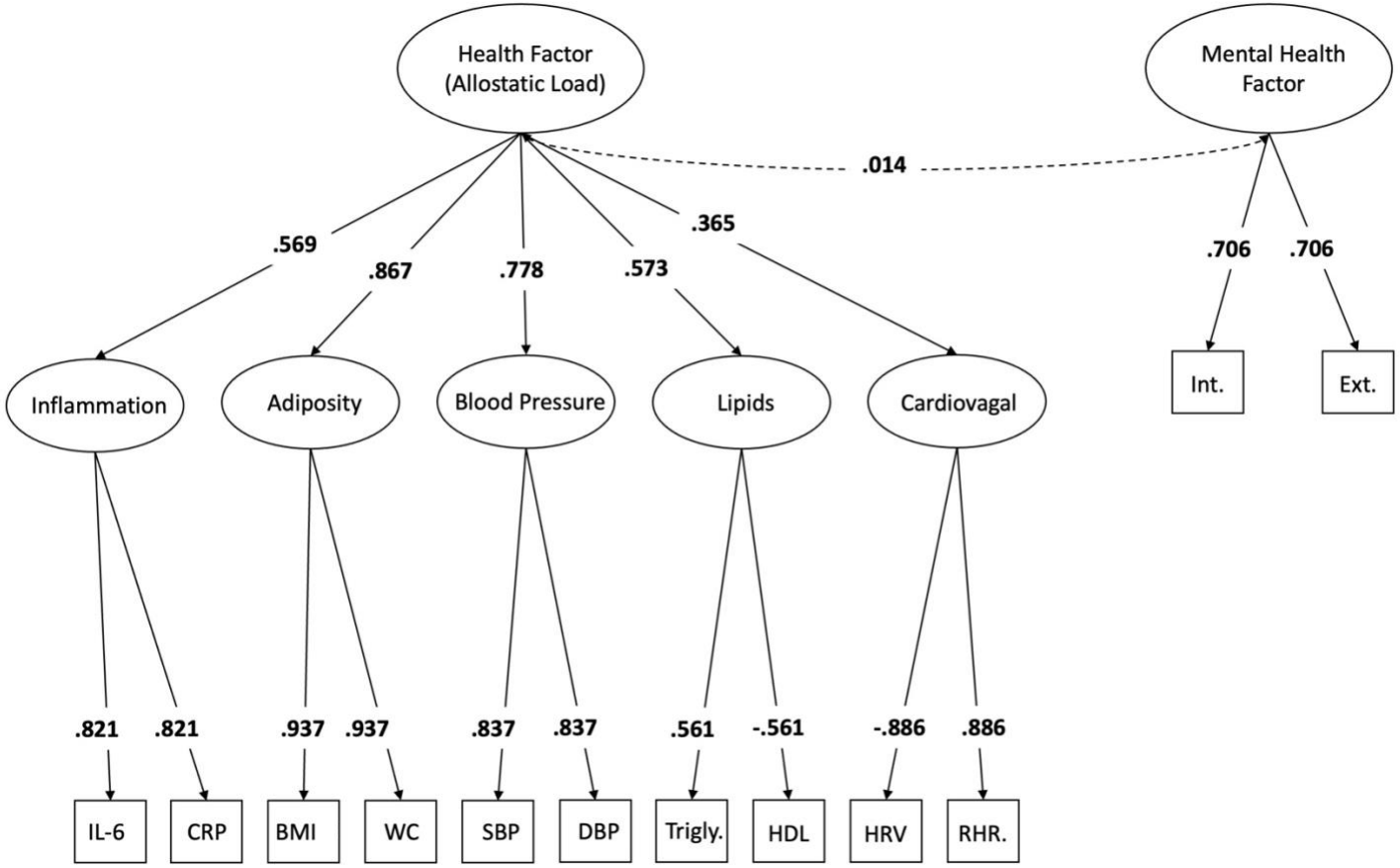
Multi-Factor Model of Biobehavioral Health (including Psychological Indicators)



Note. Standardized estimates shown. Solid lines indicate statistical significance at $p < .05$; dashed lines indicate non-statistical significance. Error terms not shown. See Table 8 Model E for fit statistics.

Figure 12

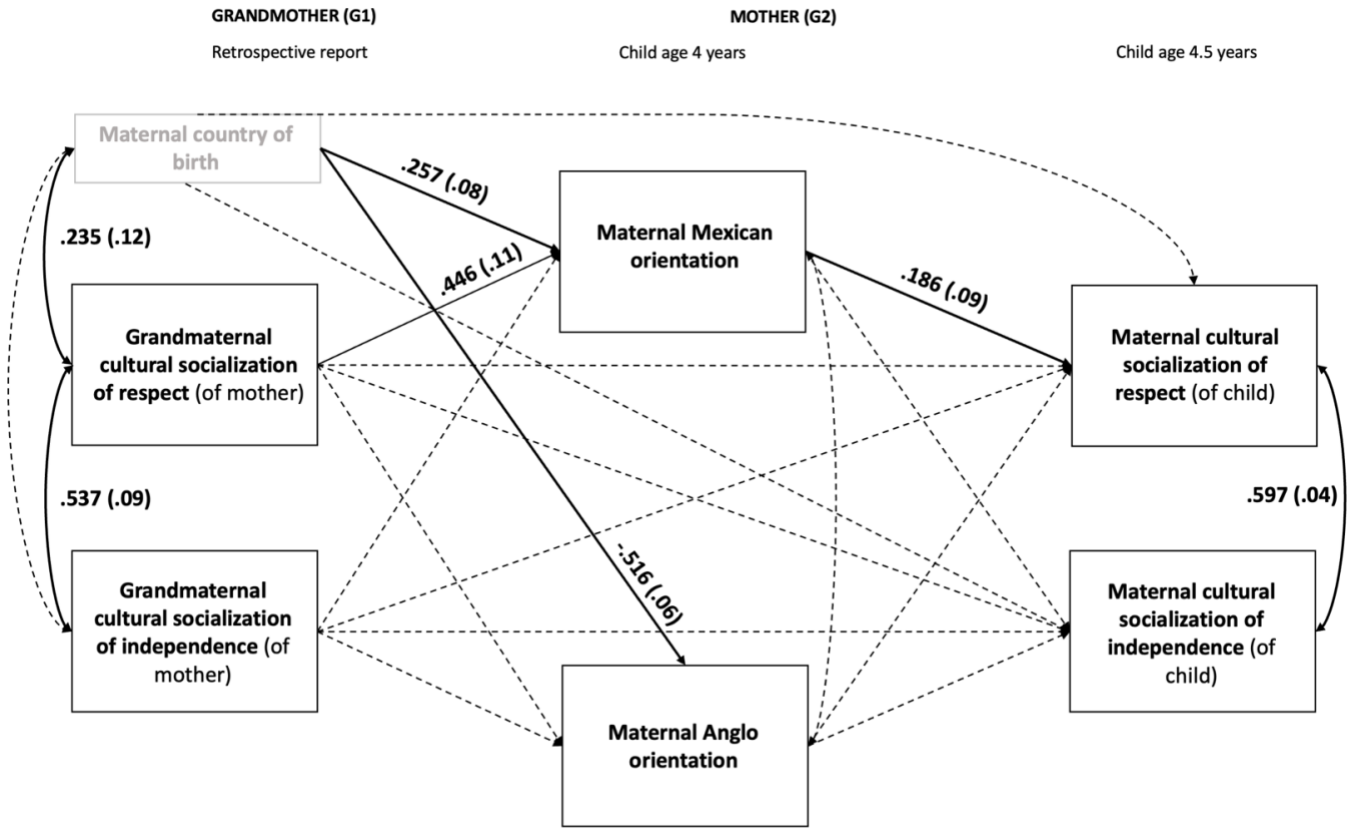
Second-Order Allostatic Load Factor Correlated with Psychological Factor



Note. Standardized estimates shown. Solid lines indicate statistical significance at $p < .05$; dashed lines indicate non-statistical significance. Error terms not shown. See Table 8 Model F for fit statistics.

Figure 13

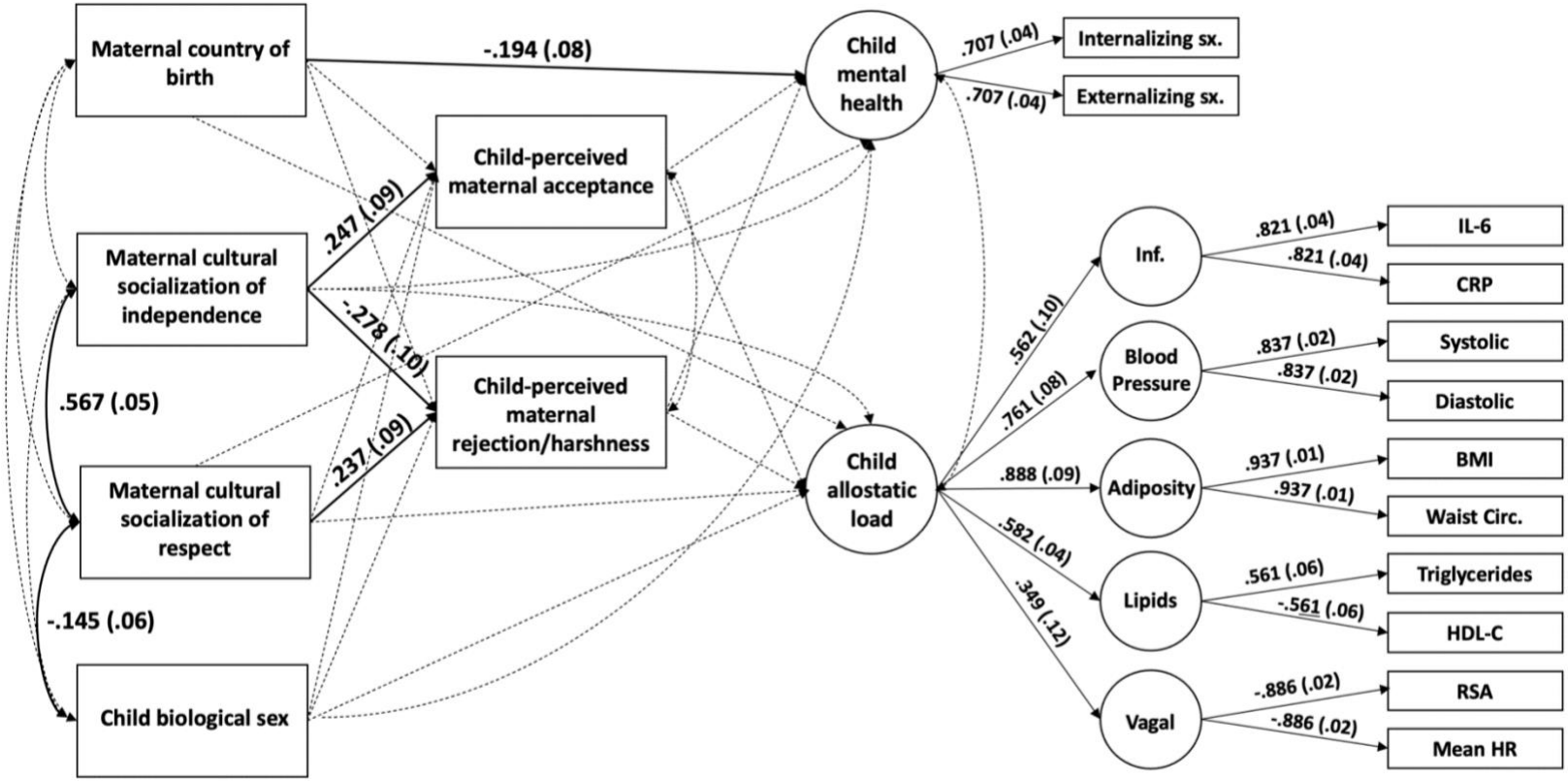
Aim 1 Model Results



Note. Standardized estimates shown. Bolded, solid lines indicate statistical significance at $p < .05$; dashed lines indicate non-significant paths. Maternal country of birth coded 0 = United States, 1 = Mexico. Maternal retrospective report of family conflict included as auxiliary variable.

Figure 14

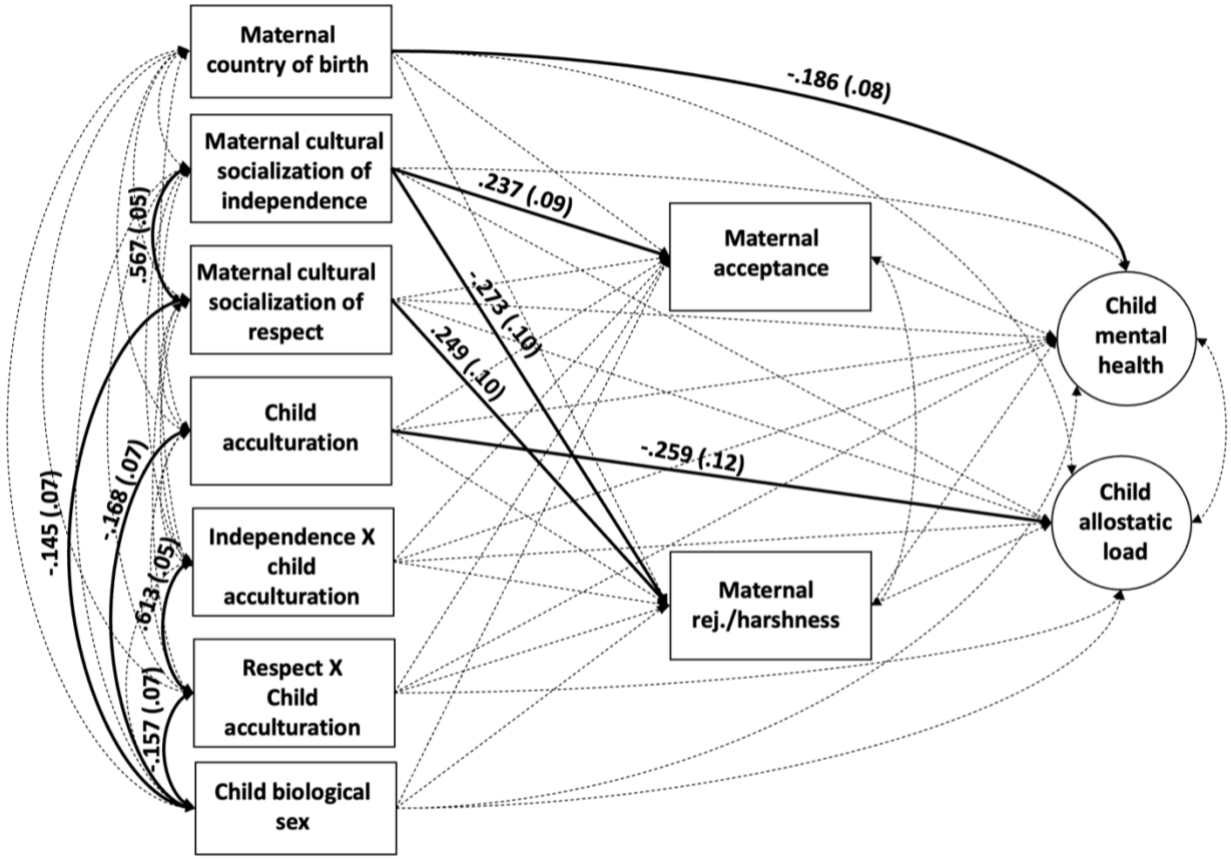
Aim 2 Model Results



Note. Standardized estimates shown; only significant predictor covariances shown. Bolded, solid lines indicate statistical significance at $p < .05$; dashed lines indicate non-significant paths. Error terms not shown. "Inf" = inflammation. Maternal country of birth coded coded 0=United States, 1 = Mexico. Child biological sex coded 0 = male, 1 = female.

Figure 15

Aim 3 Model Results



Note. Standardized estimates shown; only significant predictor covariances shown in figure. Bolded, solid lines indicate statistical significance at $p < .05$; dashed lines indicate non-significant paths. "Rej." = rejection; "Independence" = maternal cultural socialization of independence; "Respect" = maternal cultural socialization of respect. Error terms and factor loadings not shown in figure.