Paternal and Maternal Relationship and C-Reactive Protein and Glucose Levels: Effects and Moderating Factors

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Abstract

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The biomarkers of C-reactive protein and glucose are indicative of chronic stress, and consistently high levels of these biomarkers can relate to adverse health outcomes, including increased risk for cancer, diabetes, cardiovascular disease, and other conditions (Ansar & Ghosh, 2016; Collier, Dossett, May, & Diaz, 2008; Logan & Barksdale, 2008). These biomarkers can be influenced by environmental stressors and quality of interpersonal relationships. Previous research has indicated a negative relationship between parental warmth and the presence of pro-inflammatory biomarkers such as C-reactive protein and glucose levels (Baumeister, Akhtar, Ciufolini, Pariante, & Mondelli, 2015; Carrol et al., 2013; Chen, Miller, Kobor, & Cole, 2010). However, much of this research has focused on the maternal relationship, as mothers have traditionally played a larger role in childrearing. With shifts in childrearing responsibilities over recent decades, there is need for a closer examination of the importance of the paternal relationship for youth's health outcomes, and how the effects of this relationship compare to those of the maternal relationship. This study compares the influence of paternal and maternal involvement and warmth as related to adolescent C-reactive protein and glucose levels. The study uses parental education as a proxy for socioeconomic status to determine how SES is linked to the relationship between parental care and C-reactive protein and glucose, and also

examines the roles of race/ethnicity, religious involvement, and community engagement as potential moderators between paternal/maternal warmth and adolescent CRP and glucose levels. Data from Wave I of The National Longitudinal Study of Adolescent to Adult Health (Add Health) was used to determine relative socioeconomic status, and data from Wave IV of Add Health was used to determine the paternal and maternal overall relationship and biomarker data for C-reactive protein and glucose levels. Analysis shows that neither paternal nor maternal warmth, closeness, nor contact were significant predictors for CRP/glucose levels for the full sample. However, several moderation effects were found. It was observed that higher level of contact with the opposite gender parent was associated with higher youth CRP levels, and that higher levels of parental education tended to relate to lower youth glucose levels. For participants low in civic engagement, higher levels of paternal closeness were related to higher glucose levels, but for those high in civic engagement, paternal closeness was unrelated to glucose levels. The implications of this study indicate there is a need for further research on opposite-gender parent-child relationships, as well as an examination into the impact of civic engagement on the relationship between the parental relationship and stress levels.

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Table of Contents

Page

Introduction

Scientific studies have revealed a dramatic rise in rates of diabetes across the world over the past decade, with an estimated 382 million people currently living with the metabolic disease (Guariguota, 2013). The rates of diabetes among youth and adolescents has similarly increased, particularly within socially and economically disadvantaged individuals and communities (Guariguota, 2013). Cardiovascular disease poses a comparable public health concern, and is a leading contributor to morbidity and mortality rates in most countries (Reddy & Yusuf, 1998). Risk factors for cardiovascular disease include genetic, behavioral, and environmental factors (such as low socioeconomic status and living in a disadvantaged neighborhood; Reddy & Yusuf, 1998). Such diseases are linked with stress, which can exert wear and tear on the body, lead to dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, and result in high levels of inflammation that may increase the likelihood of disease risk and adverse health outcomes (Logan & Barksdale, 2008; Martínez & González-Juanatay, 2009).

Within the past decade or so, it has become widely accepted in the academic community that differences in societal and environmental factors, including race/ethnicity, socioeconomic status, and family and community ties, often correlate with disparities in health within the American population (Laveist, 2005). Relatedly, previous research has suggested a link between positive parental relationships and the long-term health and well-being of youth. In fact, parental warmth has been shown to act as a buffer against certain biomarkers indicative of stress, inflammation, and disease risk, including C-reactive protein, glucose, and cortisol levels (Baumeister, Akhtar, Ciufolini, Pariante, & Mondelli, 2015; Carrol et al., 2013; Chen, Miller, Kobor, & Cole, 2010). At the same time, research also suggests that individual factors such as race/ethnicity and socioeconomic status (in this study, represented by parent education) tend to

influence parenting practices and the parent-youth relationship (Cruz et al., 2011; Yunus & Dahlan, 2013). Previous studies have also indicated community-based factors such as religious engagement (Nooney, 2005; King, Mainous, & Pearson, 2002) and civic engagement (Kim & Ferraro, 2013; Kamiya, Whelan, Timonen, & Kenny, 2010) may be protective against stress levels in individuals.

In the context of parental warmth and parent-youth interactions, while prior research has examined the link between the maternal, or overall parental relationship, with biomarkers of health, few studies have separately compared and contrasted the associations between maternal and paternal relationships with these biomarkers (Veneziano, 2003). Yet, this is important to study because of the increasing role that fathers play in their children's lives as family duties become less segregated between mothers and fathers (Cherlin, 2017). At the same time, our understanding of the moderating effects of race/ethnicity, SES, and community ties is relatively limited.

My study seeks to understand how experiences of family in the early life course (adolescence to young adulthood) matter for health, whether negative effects of family are more problematic for certain individuals, and whether these negative effects can be mitigated by strong community ties. Specifically, I will extend previous research by examining both individuals' relationships with their mothers and fathers and the effects of biomarkers on health (i.e., C-reactive protein [CRP], glucose levels), whether there is variation in these relations across race/ethnicity or socioeconomic status, and whether aspects of community ties (i.e., religious adherence, civic engagement) may act as moderators between the parental relationships and biomarkers of health.

Biomarkers of Health: C-Reactive Protein and Glucose

C-reactive protein and glucose are both biomarkers indicative of inflammation levels in the body. Inflammation is closely related with immune system responses and long-term negative health outcomes, and inflammation may be triggered by both physical and psychological stress (Martínez & González-Juanatay, 2009). Abnormally high levels of these biomarkers are thus often indicators of high stress or high chronic stress levels (Ansar & Ghosh, 2016; Collier, Dossett, May, & Diaz, 2008).

More specifically, C-reactive protein (CRP) is a ring-shaped plasma protein which is a key part of the innate immune response (C-Reactive Protein). CRP binds with lipoprotein and activates the complement system, which enhances antibodies and phagocytosis, as well as promotes inflammation (Ansar & Ghosh, 2016). CRP is produced in the liver, and its level is measured by testing the blood. It is classified as an acute phase reactant, which means that its concentration will rise in response to inflammation (Ansar & Ghosh, 2016). CRP has been found to have a consistent relationship with cardiovascular disease, and it is a main biological predictor for the illness due to its localization in the atherosclerotic vessels (Ansar & Ghosh, 2016).

Glucose is a sugar that is an important energy source in living organisms and is a component of many carbohydrates (Collier et al., 2008). Glucose is a metabolic biomarker which is also a proxy for inflammation. Stress and illness can trigger high levels of glucose blood sugar, and such high levels are related to diabetes (Collier et al., 2008). In recent years, the concept of stress diabetes or stress hyperglycemia has gained much attention (Collier et al., 2008). Research has indicated that lower levels of glucose correlate with anti-inflammatory tendencies and

improved health outcomes, while high glucose production increases the pro-inflammatory process and negatively impacts the innate immune system (Collier et al., 2008).

High levels of chronic stress have long term health implications through inflammatory responses, which, as already indicated, can greatly increase risk for cardiovascular disease, diabetes, poor birth outcomes, and many more adverse health implications (Logan & Barksdale, 2008). Thus, it is critical to ascertain what factors may correlate with high levels of these biomarkers, and what could potentially act as buffers, in order to understand and potentially mitigate health issues related to stress. In the current study, I focus specifically on the potential influence of individuals' relationships with their parents.

Parenting Relationship and Biomarkers of Health

Previous research has shown a correlation between the parenting relationship and stress-related biomarkers; providing progeny with a nurturing parental relationship is beneficial for their overall wellbeing (Carroll et al., 2013). Lueken (1998) showed that poor quality of caretaking related to altered attachment relationships in children, which subsequently changed their neurohormonal responses to stress and correlated with increased blood pressure. In a study by Carroll et al. (2013), researchers found that individuals who experienced high levels of abuse and low levels of love and affection in childhood showed increased risk for morbidity and mortality in adulthood across an 18-biomarker measure of multisystem risk; conversely, those who experienced high levels of parental warmth and affection during childhood had a significantly lower score across the 18 biomarkers. Neural circuitry is postulated to occur in early childhood in response to factors such as stress and environment, and this process influences physiological responses in the future to further stress, which may create wear and tear across multiple regulatory systems (Carroll et al., 2013). Thus, a loving relationship may prevent the

rise in biomarkers indicative of disease risk across numerous physiological systems, impacting adverse health outcomes decades later.

According to a study by Chen et al. (2010), individuals who were raised in low socioeconomic status environments but who had mothers who expressed high warmth toward them, exhibited less production of interleukin 6 (IL-6), reduced indications of pro-inflammatory transcription factor activity (NF-kB), and lower levels of immune activating transcription factor activity (AP-1) compared to those who were low in socioeconomic status early in life but experienced low maternal warmth. All of these biomarkers are also closely related to the stress pathway and HPA-axis, and thus they can be closely associated with CRP and glucose, as well. In fact, IL-6, a major pro-inflammatory cytokine produced in tissues, is actually what synthesizes CRP (Pradhan, 2001). This indicates that maternal warmth can act as a buffer against other adverse conditions.

The research into the relationship between parental behaviors and offspring development has tended to be rather focused on maternal behaviors or overall parental behaviors on offspring well-being but has not focused as much attention on isolating the effect of paternal behaviors on offspring development (and comparing this with the size of maternal behavioral effects). Even when paternal effects are considered, these are usually narrowly represented by a single variable reflecting the physical availability of the father in the relationship. One of the few studies that isolated and examined the importance of paternal warmth for youth indicated that paternal warmth is often a more significant predictor of youths' functioning than is maternal warmth (Veneziano, 2003). Additionally, the study found that paternal physical availability is a much less significant factor for predicting paternal influences on offspring functioning than is paternal warmth, and that paternal physical availability is not an accurate substitute for paternal warmth

and affection (which indicates a need for future studies to expand the constructs used to represent the paternal relationship). Another study indicated that adolescents who report a more positive relationship with their fathers are less likely to engage in delinquent acts than were adolescents with less positive paternal relationships, even after accounting for the strength of the maternal relationship (Bronte-Tinkew, Moore, & Carrano, 2006).

One of the studies that did compare the maternal versus paternal relationship with regards to youth (8^{th} graders) mental health found that paternal and maternal attachment contribute almost equally to youth depressive symptoms (Liu, 2006). This indicates that the paternal relationship may be equally as influential on stress for youth as is the maternal relationship. A more recent study by Kaczynski, Lindahl, Malik, and Laurenceau (2016) indicated that father's parenting was more related to internalizing youth behavior, whereas mother's parenting was more related to externalizing youth behavior.

This study will look at several different factors in the maternal and paternal relationship, including measures of closeness with youth, amount of contact with youth, and levels of warmth towards youth, and evaluate how each of these relates with the biomarkers C-reactive protein and glucose levels in youth. The study will thus compare the effects of the maternal and paternal relationship on CRP and glucose levels, in order to better understand how mothers and fathers affect their adolescent's levels of stress and, potentially, future health outcomes.

Effects of Race/Ethnicity and Socioeconomic Status on CRP and Glucose Levels

Previous research has indicated that racial and ethnic health disparities exist because discrimination and stress can get "under the skin" and disrupt biological processes—members of minority racial groups tend to be affected by this to a greater extent, partly due to both overt and internalized discrimination (Williams, 1999). These health disparities (including increased rates

of cardiovascular disease, obesity, diabetes, and preterm births) for minorities, particularly affecting the black and Latino population, exist even after accounting for socioeconomic status (Sparks, 2009; Williams, 1999). A study by Khera, McGuire, and Murphy (2005) found that black participants had significantly higher C-reactive protein levels than did white participants. It has also been found that glucose levels tend to be significantly higher among U.S. ethnic minorities (Latinos, Asians, Native Americans, and African Americans) than whites (Herman et al., 2007). The harmful effects of discrimination have also been studied specifically in the context of adolescence, indicating that discrimination can correspond with dysregulation of the HPA axis and increased allostatic load at even such a relatively young age (Benner, 2017).

These mean differences in health outcomes between minorities and whites may be extended to moderate the parental relationship with CRP and glucose levels. It is likely that even with highly positive maternal and paternal relationships, minority status may relate to higher CRP and glucose levels due to the internalization of stress related to institutionalized racism and discrimination, relative to individuals who have highly positive parental relationships but are white (who will likely have, on average, lower CRP and glucose levels). In regards to potential variation between parenting practices related to race/ethnicity, it is important to keep in mind differences in culturally salient parenting practices and how such variation may relate to CRP and glucose differences in adolescents (Barber, Maughan, & Olsen, 2005; Vazsonyi & Belliston, 2006). Examples of culturally salient parenting styles include *guan*, or training or governance, in Chinese families (Chao, 1994) or *familismo* in Latino families (Ceballo, Kennedy, Bregman, & Epstein-Ngo, 2012; Halgunseth, Ispa, & Rudy, 2006). These culturally relevant parenting styles can correlate with different academic and health outcomes for youth (Kim, Wang, Orozco-Laprey, Shen, & Murtuza, 2013; Calzada, Barajas-Gonzalez, Huang, & Brotman, 2015; Lim &

Lim, 2003). While this study does not specifically examine different parenting practices across cultures and ethnicities, these are likely a factor that could influence variation in CRP and glucose levels across different racial groups in the study.

With the income gap increasing, it is also important to understand how inequalities in standard of living may affect health outcomes (Adler & Ostrove, 1999). Socioeconomic status (SES) (Winkleby, Jatulis, Frank, & Fortmann, 1992) is usually measured by determining education, income, occupation, or a composite of these dimensions. SES is a fairly reliable indicator of conditions such as standard of living, access to education and economic opportunities, and even proximity to crime (Winkleby et al., 1992). Considerable previous research has identified SES as an important factor for stress levels; lower SES tends to correlate with higher levels of social and environmental stressors, while higher SES provides protective benefits and tends to correlate with lower levels of such stressors (Baum, Garofalo, & Yali, 1999; Winkleby et al., 1992; Adler & Ostrove, 1999). The chronic stress associated with low SES conditions may contribute to much of the variance in health outcomes (including risk for mental distress, coronary heart disease and immune disorders) between the groups of high and low SES individuals; thus, stress is a pathway linking SES and health (Baum & Grunberg, 1991). A study by Owen, Poulton, Hay, Mohamed-Ali, and Steptoe (2003) supported these theories; the result of the study indicated that lower SES increased disease risk through pathways of inflammation to the immune system. Such studies have also found that SES is inversely related to CRP levels (Owen et al., 2003; Nazmi & Victoria, 2007) and risk for cardiovascular disease (Winkelby et al., 1992). In relation to glucose levels, Connolly (2000) similarly indicated increased glucose levels in economically deprived communities, which also correlated with higher rates of diabetes.

These mean differences related to SES and health can likely be extended to moderate the relationship between parenting and biomarkers of health; in spite of positive parenting, the stress associated with low SES environments and lifestyles may lead to elevated CRP and glucose levels in youth. In relation to variation in parenting behavior related to SES, higher SES parents often engage in "concerted cultivation" (teaching critical thinking skills and enabling children to engage in a variety of activities) and lower punishment behaviors towards their children as compared to lower SES parents, who often stress "accomplishment of natural growth" (emphasizing self-growth and taking a more hands-off approach in child development) and tend to use harsher discipline practices due to stress and need for youth to assist the family (Bornstein, 1995; Carolan & Wasserman, 2014). Therefore, it is likely that lower SES parents will exhibit lower levels of warmth towards youth in this study (which may in turn correlate with higher CRP and glucose). However, as this trend has already been well-documented in previous literature, this study will focus rather on the moderating effect of SES on the parental relationship and stress biomarkers.

Effects of Gender on CRP and Glucose Levels

Gender has similarly been examined more recently in relation to stress levels and health outcomes. While women tend to have a longer life-expectancy than men, they have marked disadvantages in terms of morbidity (Baum & Grunberg, 1991); this phenomenon is known as the female-male health-survival paradox (Mayor, 2015). In fact, women experience higher rates of physical and mental illness than men at all ages and across almost every region of the world; 90% of the most common illnesses are more prevalent among women than men (Mayor, 2015). In certain studies, women have been found to have higher CRP levels than men (Khera et al., 2005). It is critical to understand the pathways behind these significant gender-health disparities.

Gender roles may explain part of the gender differences in stress, which in turn activate the HPA-axis, leading to the release of stress hormones such as cortisol and catecholamines, which may induce pro-inflammatory cytokines (such as IL-6), and eventually lead to greater risk of depression, cardiovascular disease, diabetes, and inflammatory or autoimmune diseases (Mayor, 2015). Traditional socialization tends to be more advantageous for men in terms of health (Mayor, 2015). Family caretaking is a significant predictor that negatively impacts mental and physical health through pathways of stress, and because women are more often primary caretakers than are men, females tend to be more influenced by the negative health impacts related to caretaking (Mayor, 2015). Additionally, femininity has been shown to correlate with higher levels of depression as opposed to masculinity (Mayor, 2015).

These concepts can likely be expanded when examining the overarching parental relationship with biomarkers of health. In spite of positive parental relationships, it is likely that female participants will experience elevated CRP and glucose levels than males who have positive parental relationships, due to the significant gender-related stressors females experience. In terms of variation between parenting and adolescent gender on CRP/glucose, this study predicts that lower levels of warmth, closeness, and contact from the same-gender parent will relate to significantly elevated CRP and glucose levels in the same-gender youth. This outcome is likely because prior research has indicated the same-gender parent is often a role model and source of aspiration for same-gender youth (Harris & Morgan, 1991; Russell & Saebel, 1997).

Community Connections and CRP and Glucose Levels

According to prior research, community engagement can predict health outcomes. Youth civic engagement and activism have been shown to increase positive feelings of empowerment among participants (Watts & Flanagan, 2007). Higher levels of social capital and community ties

have also been found to confer better message recall about health issues such as cardiovascular disease (meaning increased engagement in a community correlates with increased awareness and proactivity related to potential illnesses) even after controlling for gender, education, and other variables (Viswanath, Steele, & Finnegan, 2006). High levels of helping behaviors such as volunteering in the community can similarly buffer the effects of stress on health in individuals by protecting against inflammation that is associated with increased risk of hypertension and cardiovascular disease (Poulin, 2014; Kim & Ferraro, 2013; Kamiya et al., 2010), perhaps through the psychological benefits of having positive views of others (Poulin, 2014; Borgonovi, 2008). Additionally, volunteering activities have been shown to correlate with lower levels of CRP and cardiovascular risk among adolescents who experienced increased levels of empathy and altruistic behaviors through the course of a volunteering program (Schreier, Schonert-Reichl, & Chen, 2013). Conversely, social isolation has been found to confer an increased risk for coronary heart disease events and mortality (Heffner, Waring, Roberts, Eaton, & Gramling, 2011). In the study, low levels of social integration among adults were related to higher levels of C-reactive protein, suggesting a possible biological link between social isolation and coronary heart disease.

Previous studies have indicated that religiosity may be another buffering factor against stress. Religious involvement has been found to have a positive relationship on self-reported happiness, and a negative relationship with stress and depression in adolescents (Borgonovi, 2008; Nooney, 2005; Greenfield & Marks, 2007; Hackney & Sanders, 2003). This association between attendance at religious services and health may generally extend to lower blood pressure and immune system regulation, lower cardiovascular morbidity and mortality, and decreased CRP levels (Seeman,

Dubin, & Seeman, 2003; King et al., 2002). According to Lawler (2010), forgiveness taught through religion may be a critical pathway in mediating the effects of religion on health.

The positive effects of community and religious engagement on lowering stress can likely be extended to the relationship between parental warmth, contact, and closeness with youth CRP and glucose levels. The adverse health effects of a poor maternal/paternal relationship, for example, may be buffered if the individual in question receives social support through community and religious involvement.

The Present Study and Hypotheses

In sum, while there is some literature on the parental relationship and youth health outcomes, there is little research that compares the effects of the maternal and paternal relationship on offspring health outcomes. In addition to comparing the effects of maternal and paternal relationships on youth health, I will also examine how these relationships differ by race, socioeconomic status, and gender; and whether community engagement may play a buffering role in these relationships. The study sample population comes from the National Longitudinal Study of Adolescent to Adult Health (Add Health), a longitudinal study of a nationally representative sample of adolescents in grades 7-12 in the United States.

The present study will focus primarily on four research questions:

1) Do young adults' relationships with their parents influence their physical health, as measured by C-reactive protein or glucose levels?
2) Does the maternal or paternal relationship more strongly influence young adults' physical health?
3) Do individual characteristics (i.e., race/ethnicity, SES, gender) moderate the association between relationships with parents and young adults' physical health?

4) Do young adults' community connections (i.e., civic engagement, religiosity) moderate the association between relationships with parents and young adults' physical health?

I hypothesize that parental relationships, including amount of contact, levels of closeness, and amount of warmth towards youth, will influence youth's stress levels as measured by CRP and glucose—with lower contact, lower closeness, and lower warmth predicting higher levels of CRP and glucose. For my second research question, I hypothesize that variations in the maternal relationship (contact, closeness, and warmth) will more strongly predict variations in CRP and glucose levels than variations in the paternal relationship; this is because mothers tend to have a larger early childhood rearing role (Belsky, Spritz, & Crnic, 1996), and this has been shown to be an incredibly influential time period in terms of long-term attachment (Belsky, Spritz, & Crnic, 1996). My third research question investigates the moderating effect of community connections on the effect examined in my first question: whether parental relationships affect offspring's CRP and glucose levels. Regarding this question, I predict that higher levels of community engagement, such as volunteering and religious involvement, will act as moderators in the relationship between parental relationship and CRP and glucose levels. I also hypothesize that the negative effects of lower parental warmth, contact, and closeness on biomarkers of health will be buffered for individuals who engage in high levels of community involvement. Lastly, I predict that race, SES, and gender will all act as moderators in the relationship between parental relationship and CRP and glucose levels. I predict that the negative effects of lower parental warmth on biomarkers of health will be exacerbated for minority status individuals, for individuals from low SES backgrounds, and for girls.

Method

Data and Participants

The data were drawn from the National Longitudinal Study of Adolescent to Adult Health (Add Health), a longitudinal, nationally representative sample of adolescents in grades 7 through 12 during the 1994-1995 school year. The Add Health study follows the original cohort into young adulthood with four waves of in-home interviews. Add Health combines longitudinal survey data on participants' social, economic, psychological, and physical well-being with contextual data on the family, neighborhood, community, school, friendships, peer groups, and romantic relationships in order to study how social environments and behaviors in adolescence are linked to health and achievement outcomes in young adulthood. Add Health used a multistage, stratified, school-based cluster design. The 132 schools in the sample were diverse in regard to sector (public and private), grade span, geographic location, and urban location. Almost all students (N = 90,118) in the selected schools responded to an in-school survey, and a nationally representative sample was selected for in-home interviews at Wave I (N = 20,745). For the current study, participants were selected based upon the completeness of their answers regarding parental, gender, ethnic, community, religious, and health-based data. This study utilizes data from Wave I and Wave IV of Add Health, with Wave IV significantly expanding the collection of biological data in the Add Health study.

The final analysis sample was diverse in terms of gender (49.5% male, 50.5% female) and race/ethnicity (17% Latino, 22.5% African American, 7.1 % Asian American, 50.4% White, 2.9% Other). Demographic information for students is displayed in Table 1.

Procedures

After getting parental consent and student assent to participate in Add Health Wave I, the survey was administered (using a paper-and-pencil instrument) to adolescents in grades 7 through 12 at school during school hours. Add Health Waves II, III, and IV followed these original participants through adolescence and young adulthood through in-home interviews. Add Health data protects the confidentiality and anonymity of participants by assigning identification numbers for each participants which are not linked to any identifiers.

Measures

Descriptive statistics and bivariate correlations for study constructs are displayed in Table 2. Parental closeness, parental contact, and parental warmth were predictor variables; C-reactive protein and glucose levels were outcome variables; and race, gender, parent education, civic engagement, religious frequency, and religious importance were mediator variables.

Parental closeness. In Wave IV, individuals' closeness to their parents was measured by asking: "How close do you feel to your mother figure?" and "How close do you feel to your father figure?" Ratings for each question ranged from "not at all close" (1) to "very close" (5).

Parental contact. In Wave IV, parental contact was measured by asking participants how often they saw and communicated with their mother and their father (four questions total). Ratings for each question ranged from "never" (0) to "almost every day" (5). Responses were averaged for contact with each parent separately, with higher scores denoting greater contact with mothers and fathers, respectively.

Parental warmth. In Wave I, parental warmth was measured by asking participants to rate their agreement or disagreement to the statement "Most of the time, your mother is warm and loving toward you" and "Most of the time, your father is warm and loving toward you".

Ratings for these two separate questions ranged from “strongly agree” (1) to “strongly disagree” (5). The variables for maternal and paternal warmth were then individually reverse coded so that higher scores denoted higher levels of maternal or paternal warmth, and lower scores denoted lower levels of maternal or paternal warmth.

C-reactive protein levels. In Wave IV, this biomarker was measured by drawing participants’ blood into order for classification of C-reactive protein sensitivity. Ratings for this question ranged from undetectable, low (<1 mg/L), average (1-3 mg/L), and high (>3 mg/L). The mean level of CRP across participants was found to be 2.14 mg/L, with a standard deviation of 0.965.

Glucose levels. In Wave IV, this biomarker was measured by glucose levels in participants’ blood in units of mg/dL. Values range from 36 mg/dL to 777 mg/dL, with a mean level of 107.40 mg/dL across participants, and a standard deviation of 33.075.

Race. In Wave I, respondents were asked to indicate their race/ethnicity. We created dummy variables capturing Hispanic, Black, Asian, and Other, with White as the omitted reference group**.**

Gender. To account for demographic variability, the models in this study included gender. Data on the students’ gender was collected from the school district in Wave I. The gender of the student was introduced through a dummy variable indicating female gender, with the make gender serving as the base category. 49.5% of participants were male, 50.5% female

Parent Education. To account for demographic variability, the models in this study included parents’ highest educational level, which was used as a proxy for family socioeconomic status. Parents’ highest educational level was assessed in Wave I by asking the students via survey for their parents’ highest educational attainment by the time participants were in high

school, ranging from “Did not graduate high school” to “4-year college degree or higher”. These responses were then translated and compiled into two discrete variables—“high school or less” or “college or more” educational attainment. 40.5% of parents fell in the “high school or less category”, and 53.2% of parents fell into the “college or more” category.

Civic Engagement. In Wave IV, participants were asked to report an answer to the question “In the past 12 months, how many hours did you spend on volunteer or community service work?” Ratings for this question ranged from 0 hours (1) to 160 hours or more (6).

Religious Frequency. In Wave IV, participants were asked “In the past 12 months, how often did you attend religious services?” Ratings for this question ranged from “never” (0) to “more than once a week” (5).

Religious Importance. In Wave IV, participants were asked “How important is religion to you?” Ratings for this question ranged from “not important” (1) to “more important than anything else” (4).

Control Variables. In Wave IV, to account for potential influence on C-reactive protein levels, use of corticosteroid medication within four weeks of the recording (0 = *not used,* 1 = *used*) and the presence of infectious or inflammatory diseases were used as controls (0 = *absence,* 1 = *presence*). In Wave IV, to account for glucose levels, the hours since the participant last ate and classification as a diabetic were used as controls. From Wave I, living status (currently living with (1) or without biological parents (0)) was also controlled for, as was nativity status (with measures ranging from born outside US, born in US with at least one parent as immigrant, all parents born in US).

Planned Analyses

The first and second research questions investigate whether young adults' relationships with their parents influence their physical health (as measured by C-reactive protein or glucose levels), and whether there were significant differences between the maternal and paternal relationship effects on young adult's stress levels. In order to answer these questions, I conducted structural regression analyses. These analyses examined the effects of the predictors (i.e., maternal warmth, paternal warmth, maternal closeness, paternal closeness, maternal contact, paternal contact) on each of the outcome variables (i.e., C-reactive protein and glucose). Analyses also controlled for the effects of all moderators and covariates on the outcomes.

To answer research question 3, which asked whether individual characteristics affect young adults' health, I conducted moderation analyses. For the categorical moderators (i.e., race, socioeconomic status, gender), I conducted multiple group analyses. Using multiple group analyses, I estimated a baseline model, with all paths freely estimated across groups, followed by a fully constrained model (i.e., all paths constrained to be equal across groups). If the fully constrained model fit the data significantly worse than the baseline model (as determined by Chi-square difference tests), I introduced constraints on individual paths. For racial/ethnic differences, I omitted "Other" students because of sample size issues.

Research question 4 investigated the role of community factors in moderating the parental relationship effect on young adult stress levels. For the continuous moderators for research question 4 (i.e., civic engagement, religious importance, religious frequency), I conducted hierarchical structural regressions. I first tested main effects of these three variables in an initial Model 1 (separate models for each moderator), and I then added the interaction effect (parental relationship x community factor) in Model 2. When significant interactions emerged, I

conducted simple slope analyses to examine the extent to which participants' relationships with parents were linked to C-reactive protein and/or glucose levels when they had high civic engagement/religiosity versus low civic engagement/religiosity. All analyses were conducted in Mplus.

Results

Parenting Relationship and CRP and Glucose Levels

The first research question investigated whether young adults' relationships with their parents has a significant effect on their physical health, as measured in this study by C-reactive protein and glucose levels. Across the sample, maternal closeness (M = 4.49; SD = .844) and paternal closeness (M = 4.10; SD = 1.100) were quite high. Maternal contact (M = 3.7609; SD = .93982) and paternal contact (M = 3.2479; SD = 1.14820) were relatively high. CRP levels (M = 2.14; SD = .965) and glucose levels (M = 107.40; SD = 33.075) were both fairly average relative to the general population.

All regression models included living status and immigrant status as covariates, and controlled for use of corticosteroid medication, presence of infectious diseases, time since the participant last ate, and participant diabetes classification in the analyses. The results of the analyses are presented in Table 2. Neither paternal or maternal warmth, paternal or maternal closeness, nor maternal contact were found to be significant predictors of C-reactive protein or glucose levels. Paternal contact was found to be marginally associated with elevated C-reactive protein levels (b = .02, p < .10).

Moderating Effects of Individual Characteristics on the Link between Parenting Relationships and CRP and Glucose Levels

The next research question examines the moderating effect of individual characteristics (gender, socioeconomic status, and race/ethnicity) on the relationship between parental relationships and young adults' stress levels. All three models include living status, immigrant status, use of corticosteroid medication, presence of infectious diseases, time since the participant last ate, and participant diabetes classification as covariates.

Gender. In the sample, gender of participants was split fairly evenly, with 49.5% male and 50.5% female. The results of the moderation analyses for gender are found in Table 3a. Three significant moderating effects were observed. The first was the association between maternal warmth and young adults' CRP levels (X^2_{diff} (1) = 7.07, $p < .01$). Specifically, greater levels of maternal warmth were related to higher CRP levels for girls ($b = .03$, $p < .05$), but these were not related for boys ($b = -.03$, *ns*). The second significant effect was the association between maternal contact and young adults' CRP levels (X^2_{diff} (1) = 2.62, $p < .10$). Specifically, greater levels of maternal contact were related to higher CRP levels for boys ($b = .05$, $p < .05$), but these were not related for girls ($b = .00$, *ns*). The third significant effect was the association between paternal contact and young adults' CRP levels (X^2_{diff} (1) = 7.45, $p < .01$). Specifically, greater levels of paternal contact were related to higher CRP levels for girls ($b = .05$, $p < .01$), but these were not related for boys ($b = -.02$, *ns*).

Parent Education. Parent education, which was also used as a categorical proxy variable to estimate socioeconomic status (with two categories—high school or less versus some college or more), was found to be a significant moderator in the parent relationship—stress biomarker relationship. Results for these analyses are found in Table 3b. One significant moderating effect

was observed. This was the association between maternal contact and young adults' glucose levels (X^2_{diff} (1) = 3.96, $p < .05$). Specifically, greater levels of maternal contact were related to higher glucose levels when parents had obtained only a high school or less education (b = 1.74, $p < .01$), but these were not related when parents had pursued some college or more education (b = -.27, *ns*).

Race/Ethnicity. Race/ethnicity was not found to be a significant moderator in the relationship between parental relationships and young adult stress biomarkers.

Community Connections and CRP and Glucose Levels

The final research question examines whether community connections affect the relationship between parental relationships and young adult stress levels. To assess the moderation effects of community engagement variables (civic engagement, religious personal importance, and religious service frequency), hierarchical regression models were run for each moderator and outcome. All models included living status, immigrant status, use of corticosteroid medication, presence of infectious diseases, time since the participant last ate, and participant diabetes classification as covariates. Model 1 included the main effects, while Model 2 integrated the interaction terms.

Civic Engagement. Civic engagement, which assessed how many times participants had partaken in volunteering or community service activities over the past twelve months, was found to be a significant moderator. In the sample, civic engagement ranged from "0 hours" (1) to "160 hours or more" (6), with a mean of less than 1 hour (M = 1.63) in the past year (SD = 1.12). The results of the moderation analyses for young adult civic engagement are found in Table 4a and 4b. The effects of maternal warmth, paternal warmth, maternal closeness, paternal closeness, maternal contact, and paternal contact on CRP were similar for those who were low and high in

civic engagement—meaning civic engagement was not found to be a significant buffer for CRP levels. However, there was one significant interaction effect found for glucose levels. For those low in civic engagement, higher levels of paternal closeness were related to higher glucose levels (b = -.69; SE = .33; $p < .05$). In contrast, for those high in civic engagement, paternal closeness was unrelated to glucose levels.

Religious Frequency. The religious frequency variable was determined by asking participants how many times they had attended religious services in the past twelve months. In the sample, religious frequency ranged from "never" (0) to "more than once a week" (5), with a mean between "a few times" and "once a month" (M = 1.64) in the past year (SD = 1.61). The results of the analyses examining the interaction effects between parental relationships and young adult religious frequency on stress biomarkers CRP and glucose are found in Table 4c and 4d, respectively. While religious frequency was found to have a significant direct effect on glucose levels (b = -.44; SE = .17), no evidence of interaction effects was observed.

Religious Importance. Religious personal importance was determined by asking participants how important religion was in their life. In the sample, religious importance ranged from "not important" (1) to "more important than anything else" (4), with the mean lying between "somewhat important" and "very important" (M = 2.54; SD = .88). The results of the analyses examining the interaction effects between parental relationships and young adult religious importance on stress biomarkers CRP and glucose are found in Table 4e and 4f, respectively. Religious importance was not found to be a significant moderator in the parent-young adult relationship with biomarkers of health.

Discussion

This study examined the relationship between young adults' relationships with their parents and biomarkers of stress and whether personal characteristics and community engagement might moderate these associations. While there were no significant results for the overall relationship between parental relationships (maternal warmth, paternal warmth, maternal closeness, paternal closeness, maternal contact, paternal contact) and stress biomarkers, there were some significant moderation effects. Results showed that the interaction between maternal warmth and gender was significant for C-reactive protein levels, and the interaction between maternal and paternal contact and child gender was significant for C-reactive protein levels. In addition, the interaction between maternal contact and parental education level was significant for glucose levels. Civic engagement also proved to have a significant interaction with paternal closeness on glucose levels.

Interestingly, and surprisingly, I did not observe any statistically significant parent-young adult relationships and stress markers, which is quite different from many earlier studies that have found such direct links (e.g., Carroll et al., 2013; Leuken, 1998; Chen et al., 2010). While this is an issue that deserves more attention in future studies, I should note that earlier studies have not adequately considered (if at all) moderation effects due to other variables on this parent-young adult relationship, which was an important part of my thesis. When moderation effects are actually present, but ignored, it can corrupt the main effects and inappropriately show up as statistically significant main effects. The extent of the corruption will be data-specific. As a simple example, assume that low levels of parental education, when combined with high levels of maternal contact, increase glucose levels (as I found in my analysis and discuss later). Now, consider a particular data set in which the proportion of families with low levels of parental

education is high. Then, in such a data set, if the moderating effect of education is ignored, the regression will tend to "transmit" this moderating effect as a positive and statistically significant main effect of maternal contact on glucose levels. Essentially, the composition of the data set will determine the direction and significance of the main effect, when a true interaction effect is ignored (Preacher, Curren, & Bauer, 2006). To summarize, my thesis suggests caution in interpreting main effects when moderation effects are not considered, and recommends that future studies on parent-young adult relationships investigate moderation effects more rigorously.

Although I observed no direct relations between parent-young adult relationships and stress markers, I did find evidence of moderation by gender, SES, and civic engagement. First, gender was found to have a significant moderating effect on the maternal warmth-CRP relationship. Specifically, higher levels of maternal warmth and maternal closeness were found to be positively associated with increased levels of CRP for girls but not boys. This was an unexpected finding, but it is possible that this result is due to daughters feeling pressured by mothers as they look up to their mothers as role models (Hoffman & Hoffman, 1964). Future studies should examine this effect in further detail to obtain more insights into the nature of this relationship.

The moderation models suggested that higher contact with the opposite-gender parent may actually have a detrimental effect upon young adult stress levels. For males, higher levels of maternal contact were associated with elevated CRP levels. For females, higher levels of paternal contact were associated with elevated CRP levels. Although I did not necessarily expect to find these significant results, there are many possibilities that may explain this moderation effect. It is likely that young adults may view their same-gender parent as a role model or mentor, and feel

more comfortable in connecting with their same-gender parents because there is a feeling of shared experience and solidarity. As young adults gain autonomy and begin pursuing their own professional career, the same-gender parent may be a helpful resource as a confidant or advisor to guide their young adult in navigating the workforce as a young man or woman. A young adult experiences the often patriarchal workforce through a lens of gender (Alksnis, Desmarais, & Curtis, 2008), and thus perhaps the same-gender parent is easier to identify with during this time. Conversely, the relationship between the opposite-gender parent and adolescent may be strained during this period, as this parent may be less understanding or disconnected about the issues and considerations individuals of the opposite gender may face in the workplace. Another study by Moon and Hoffman (2008) found, in examining parent x child gender interactions, that the lowest personal-interaction parenting scores (hugging their child, etc.) were for fathers with daughters, which could explain that, even when daughters have high levels of contact with fathers, this may not be necessarily warm contact, which can relate to increased stress levels. However, prior research, which looked at the implications of same-gender parent households has indicated that "successful parenting is not gender specific" (Biblarz & Stacey, 2010, p. 1). Different from the current study, earlier studies have found that while the gender of parents correlates in novel ways with parent-child relationships, this has minor significance for youth's psychological adjustment, social success, and overall wellbeing (Biblarz & Stacey, 2010). Based on the results of the current study, there would seem a need to revisit the issue of same-gender and cross-gender interactions of parental contact levels on young adults' stress biomarkers.

For SES, I observed that higher levels of maternal contact are linked to higher glucose levels for young adults whose parents have lower (but not higher) levels of education. The findings of this study support previous research (Baum, Garofalo, & Yali, 1999; Winkleby et al.,

1992; Adler & Ostrove, 1999) which postulates that socioeconomic status (indicated in this study by the categorical proxy variable "highest parent education") is a factor in levels of stress biomarkers—lower parental education/socioeconomic status was found to associate with higher glucose levels for those experiencing higher levels of maternal contact. This result needs to be viewed in the context of multiple considerations simultaneously. First, this result is in line with the family stress model (Conger, Rueter, & Conger, 2000). The family stress model postulates the pathways through which financial pressure can affect young adult wellbeing. The model pathway moves from economic pressure, to parent psychological stress, to interparental conflict, to parenting problems, and finally to young adult difficulties (Conger et al., 2000). Parents who have attained higher education are likely to have better employment prospects and opportunities, which may afford greater long-term stability and income for the family (Davis-Kean, 2005). Conversely, parents who have attained a high school degree or less will possibly have fewer job opportunities, and these limited possibilities can lead to unstable jobs and/or pay a lower salary, and even limit the economic and educational opportunities of the young adult. Thus, this financial stress can exacerbate interfamily conflict and poor parenting practices which eventually negatively impacts the young adult.

Second, it is important to keep in mind that family studies have consistently found that, in most families, the mother continues to be the primary caregiver of children (Deding & Lausten, 2010; Ekert-Jaffé, 2010; Bernardo, Paleti, Hoklas, & Bhat, 2015). While the current analysis is in the context of young adults who may not need the kind of care-giving that they needed when younger, one can expect that a good part of the maternal contact for these young adults is associated with a continuation of the support and comfort role the mother played when younger.

Third, relative to their earlier cohorts, there is a higher educational expectation of today's young adults if they are to be gainfully employed in the work force, as compared to previous generations (Arnett, 2000). In fact, many professional organizations have been actively working to raise educational requirements to require a Master's degree for the licensure of future professionals, with the notion that the traditional four-year undergraduate program will no more be sufficient to prepare the future professionals in an increasingly complex, competitive and global market place (Côté & Bynner, 2008). This has actually led to the delay of traditional markers of adulthood (including marriage and having children) and a new stage of development termed "emerging adulthood" (Arnett, 2000); as young adults instead focus through their twenties on education and job opportunities in order to gain financial stability that allows them to provide for themselves and, eventually, a family.

Fourth, parents with a higher education can provide a better educational environment for their children (when the children are faced with educational challenges), not only in terms of the knowledge wherewithal to directly assist their children, but also by harnessing their network of professional contacts as a supplementary scaffold (Kins, Beyers, W., Soenens, & Vansteenkiste, 2009). The confluence of the four considerations above implies that the ability of parents to support their young adults can be substantially limited and ineffective if the parents are not well educated, especially in an increasingly demanding environment of educational qualifications. Further, given that maternal contact continues to be the main comfort and caretaker "voice", it is not inconceivable that the frustration and inability to assist the young adult due to barriers related to the low education prevalent in the parents gets overtly expressed and specifically channeled as increased stress levels due to higher levels of maternal contact.

Civic engagement was found to significantly moderate the relationship between paternal closeness and glucose levels. For those low in civic engagement, higher levels of paternal closeness were related to higher glucose levels; in contrast, for those participants high in civic engagement, paternal closeness was unrelated to glucose levels. Men tend to use more direct communication than women due to socialization processes (Eagly & Wood, 1991). In fact, "men and masculine people [are] expected to be more likely to respond to a [person] in a way that reduces interpersonal intimacy; women and feminine people [are] expected to respond in a way that enhances interpersonal intimacy" (Basow & Rubenfeld, 2003). Thus fathers likely may be more vocally critical of the performance of their child and voice high expectations for their child, without considering a less direct or more empathetic approach that a woman or mother might take. Another study by Moon and Hoffman (2008) found that mothers were rated higher for physical care and emotional support than were fathers. Therefore, in youth who do not have the community supports and scaffolds offered by civic involvement, a close relationship with a more critical father figure could actually correspond with higher stress. Higher levels of civic engagement can then perhaps act as a buffer against glucose levels, with increasing levels of paternal closeness being associated with decreasing glucose levels when also combined with high young adult civic engagement participation. Equivalently, when civic engagement levels are low, as paternal closeness increased, there was an associated increase in glucose levels. This indicates that civic engagement could potentially be a very crucial factor in buffering stress and inflammation levels.

Strengths and Limitations

My study has several strengths. Add Health provided a large sample size that was nationally representative. Because the data I used was from a longitudinal study, I was able to

estimate long-term effects of parenting relationships on the participants, rather than having the data isolated to simply one collection point. Another benefit of using the Add Health data was that it provides information on a rich set of data: from collecting participants' reflections on the self and parental, sibling, peer, and community relationships data, to its recent expansion into the addition of biomarkers of health, Add Health provides a wealth of social, environmental, behavioral, and biological data, which I was able to utilize in my study.

However, there are also several limitations to this study, so the findings on the relationships between parenting relationships, individual and community factors, and stress biomarkers should be interpreted with caution. First, although Add Health is advantageous in its breadth of measurement, it does not go into great depth on many of its measures. My civic engagement and religiosity variables were compiled from only one question because there were few measures that looked into these factors. Second, quality of parental relationships was self-reported by the adolescent, which could be a biased measure. Future studies should also ask parents to rate the quality of their relationship with their child so that more comprehensive and accurate variables related to parenting quality can be compiled. Additionally, future studies could potentially look at the impacts of various religions on stress levels to determine whether specific religious faiths differ in affecting stress levels.

Conclusions and Implications

Overall, this study contributes significant findings to the literature over parental relationships and their impact on young adult stress levels and health outcomes. Several variables were found to moderate the parental relationship effects on stress. Civic engagement, parental education levels, and gender were all significant moderating factors which have various implications for young adult health. These results indicate that parents should recognize that

attaining higher education levels may benefit their child's long-term wellbeing (as the alternative, attaining lower education levels, was associated with higher young adult stress when paired with high maternal contact). If these results are replicated, in the interest of public health, it would also be beneficial for the United States government to expand resources and funding towards educating individuals, particularly women and mothers, and create further flexible educational programs (such as affordable online programs) through which parents can complete a college degree while also maintaining childcare responsibilities. Another implication of this study is the benefit of civic engagement being promoted in young adult's schools, perhaps through expansion of volunteering programs that offer course credit, in order to incentivize young adults to partake in community involvement. Generally, this study also points to the importance of positive parent-child relationships. Although there were not significant results found when looking at overall maternal and paternal relationships against C-reactive protein and glucose levels, this lack of significance indicates that there is not a great difference between the effects of maternal or paternal relationships on child health outcomes. This is supported by research by Barnett, Brennan, and Marshall, 1994, whose research found that "parent role quality is significantly negatively associated with psychological distress for men as well as for women", with primary parent gender having little effect on this. This signifies that there is no substantial benefit to one parent taking more responsibility in childrearing over another, and this supports the efforts of working mothers who are now splitting childcare responsibilities more evenly with husbands or male partners in dual-earning families (Pleck, 2007). This indicates that it would be beneficial for both mothers and fathers to be granted paid maternity and paternity leave by employers, to support this effort towards equal childcare responsibility. Another possible implication of this study is urging employers to make an effort to reduce the pay gap between

genders so that men and women, and mothers and fathers, are paid equally (Alksnis et al., 2008), while also making a concerted effort to provide equal opportunities and a safe, harassment-free environment for all employees, regardless of gender. This could benefit health outcomes in the next generation of children, by taking away a factor of possible disconnect or misunderstanding between parents and their opposite-gender children.

Future studies should further examine the interaction between opposite gender parents and adolescent stress levels, as well as the same-gender interaction between maternal warmth and daughter's elevated stress levels. Additionally, studies should further investigate the possible moderating role of civic engagement on the relationship between parental relationships and youth health outcomes. Finally, researchers should explore the efficacy of community service programs directed towards young adult involvement that are already in place in schools, and determine whether these are sustainable models which could have a positive impact on young adult stress levels, and, ultimately, long-term health outcomes, by buffering the potential negative effects of parental relationships. Researchers should also investigate whether these programs might have a different effect upon youth stress levels in neighborhoods that vary along racial, cultural, or income lines. While there is still a long way to go before researchers fully understand the impact of parental relationships on young adult health outcomes (and the effect of various moderating factors upon this overall relationship), this study brings us one step closer to grasping these interactions.

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Table 1. Descriptive statistics and correlations of study variables

	1	2	3	4	5	6	7	8	9	10	11
1. Maternal warmth (W1)											
2. Paternal warmth (W1)	.03***										
3. Maternal close (W4)	.08***	.02									
4. Paternal close (W4)	-.00	.16***	.35***								
5. Maternal contact (W4)	.09***	-.02	.42***	.17***							
6. Paternal contact (W4)	.02*	.22***	.19***	.60***	.50***						
7. C-reactive protein (W4)	.01	-.02*	.02**	.01	.07***	.04***					
8. Glucose (W4)	.00	.02*	.00	.01	.00	.02	.05***				
9. Civic engagement (W4)	.04***	.05***	-.00	.01	.05***	.07***	.00	.00			
10. Relig importance(W4)	.04***	.04***	.02	.01	.01	.01	.00	.00	.98***		
11. Relig frequency (W4)	.04***	.04***	.01	.01	.01	.02	.01	-.00	.99***	.99***	
M	4.35	4.11	4.49	4.10	3.76	3.25	2.14	107.40	1.63	2.54	1.64
SD	.81	.93	.84	1.10	.94	1.15	.97	33.08	1.12	0.88	1.61
N	19444	14424	14740	12802	12115	11142	14061	13956	15595	15657	15693

Note. W1 = wave 1 of Add Health; W4 = wave 4 of Add Health. Relig = religious. *p < .05. **p < .01. ***p < .001.

Table 2. Primary effects of parental relationships on C-reactive protein and glucose levels

Central Predictors	C-reactive Protein *b* (SE)	Glucose *b* (SE)
Maternal Warmth	0.01 (0.01)	-0.40 (0.37)
Paternal Warmth	-0.00 (0.01)	0.44 (0.37)
Maternal Closeness	0.01 (0.01)	-0.21 (0.40)
Paternal Closeness	0.00 (0.01)	0.15 (0.39)
Maternal Contact	0.02 (0.01)	0.77 (0.48)
Paternal Contact	0.02 (0.01)ŧ	0.01 (0.45)
Covariates		
Female	0.27 (0.02)***	-6.75 (0.52)***
Latino	0.14 (0.03)***	-0.75 (0.93)
Black	0.06 (0.02)**	-6.31 (0.68)***
Asian	-0.11 (0.04)**	0.93 (1.30)
Other Race	0.07 (0.05)	3.65 (1.61)*
Born Outside US	-0.10 (0.04)**	-0.41 (1.20)
Born In US, 1+ Parent is Immigrant	-0.03 (0.03)	0.57 (0.96)
Grade Level	0.01 (0.01)*	0.13 (0.16)
Parent Education Level	-0.04 (0.01)***	-0.27 (0.23)
Lives with Biological Parents	0.02 (0.02)	0.27 (0.54)
Inhaled Corticosteroid Medication Use in Past 4 Weeks	0.15 (0.13)	
Count of Common Infectious or Inflammatory Diseases	0.05 (0.01) ***	
Hours Since Last Ate		-0.58 (0.05)***
Joint Classification of Evidence of Diabetes		48.09 (0.99)***

ŧ = significant for p ≤.10; * = significant for p ≤.05; ** = significant for p ≤.01; *** = significant for p ≤.001.

Table 3a. Moderation by gender for C-reactive protein and glucose levels

Moderator	Path	Group Differences		Unstandardized Coefficients by Group	
		X^2	*df*	Boys	Girls
Gender					
	Maternal warmth → C-reactive protein	7.07**	1	-.03	.03*
	Paternal warmth → C-reactive protein	0.80	1	.01	-.01
	Maternal closeness → C-reactive protein	5.01*	1	-.03	.03†
	Paternal closeness → C-reactive protein	3.61†	1	.03	-.02
	Maternal contact → C-reactive protein	2.62 †	1	.05*	.00
	Paternal contact → C-reactive protein	7.45**	1	-.02	.05**
	Maternal warmth → glucose	0.56	1	-.72	-.15
	Paternal warmth → glucose	1.72	1	.96†	-.01
	Maternal closeness → glucose	0.37	1	-.53	-.03
	Paternal closeness → glucose	0.11	1	.02	.27
	Maternal contact → glucose	0.01	1	.73	.81
	Paternal contact → glucose	0.10	1	-.16	.14

Note. † $p < .10$; * $p < .05$; ** $p < .01$.

Table 3b. Moderation by parent education for C-reactive protein and glucose levels

Moderator	Path	Group Differences		Unstandardized Coefficients by Group	
		X^2	*df*	High school or less	College or more
Gender					
	Maternal warmth → C-reactive protein	0.32	1	.01	.00
	Paternal warmth → C-reactive protein	0.00	1	-.00	-.00
	Maternal closeness → C-reactive protein	2.13	1	.02	-.01
	Paternal closeness → C-reactive protein	0.13	1	-.01	.00
	Maternal contact → C-reactive protein	0.03	1	.03	.02
	Paternal contact → C-reactive protein	0.03	1	.02	.02
	Maternal warmth → glucose	1.08	1	-.12	-.93
	Paternal warmth → glucose	1.25	1	-.04	.84
	Maternal closeness → glucose	0.60	1	-.46	.19
	Paternal closeness → glucose	0.29	1	.43	-.01
	Maternal contact → glucose	3.96*	1	1.74**	-.27
	Paternal contact → glucose	1.65	1	-.65	.55

Note. * $p < .05$; ** $p < .01$.

Table 3c. Moderation by race/ethnicity for C-reactive protein and glucose levels

Moderator	Path	Group Differences		Unstandardized Coefficients by Group			
		X^2	*df*	Latino	Black	Asian	White
Race/ethnicity							
	Maternal warmth → C-reactive protein	4.62	3	-.04	-.01	.04	.02
	Paternal warmth → C-reactive protein	2.27	3	.02	.01	-.06	.00
	Maternal closeness → C-reactive protein	0.92	1	-.02	.05	.03	-.00
	Paternal closeness → C-reactive protein	0.79	1	.01	-.00	-.03	.00
	Maternal contact → C-reactive protein	1.83	1	-.01	.00	-.02	.04*
	Paternal contact → C-reactive protein	0.83	1	.04	.03	.03	.02
	Maternal warmth → glucose	1.90	3	-.08	-1.40	-.72	-.05
	Paternal warmth → glucose	3.50	3	.57	2.15†	-.32	.04
	Maternal closeness → glucose	3.72	3	-1.53	.22	2.00	-.15
	Paternal closeness → glucose	2.03	3	.46	.46	-1.59	.43
	Maternal contact → glucose	1.25	3	-.24	1.67	.65	.67
	Paternal contact → glucose	0.49	3	.26	-.55	.73	-.13

Note. † $p < .10$; * $p < .05$.

Table 4a. Coefficient estimates from path analyses for maternal and paternal relationship and civic engagement interactions on C-reactive protein levels

	Model 1		Model 2	
	b (*SE*)	*p*	*b* (*SE*)	*p*
Maternal warmth (W1)	-.00 (.01)		.01 (.01)	
Paternal warmth (W1)	-.00 (.01)		.00 (.01)	
Maternal closeness (W4)	-.01 (.01)		-.01 (.02)	
Paternal closeness (W4)	-.00 (.01)		.00 (.01)	
Maternal contact (W4)	.06 (.01)	***	.07 (.02)	***
Paternal contact (W4)	.01 (.01)		.01 (.01)	
Civic engagement (W4)	-.01 (.01)		-.01 (.01)	
Maternal Warmth (W1) x Civic Engage (W4)			.00 (.01)	
Paternal Warmth (W1) x Civic Engage (W4)			-.00 (.01)	
Maternal Closeness (W4) x Civic Engage (W4)			.02 (.01)	
Paternal Closeness (W4) x Civic Engage			.00 (.01)	
Maternal Contact (W4) x Civic Engage (W4)			.01 (.01)	
Paternal Contact (W4) x Civic Engage (W4)			.00 (.01)	

Note. N = 20,745. W1 = wave 1; W4 = wave 4; Civic Engage = civic engagement.
*** $p < .001$.

Table 4b. Coefficient estimates from path analyses for maternal and paternal relationship and civic engagement interactions on glucose levels

	Model 1		Model 2	
	b (*SE*)	*p*	*b* (*SE*)	*p*
Maternal warmth (W1)	-.30 (.43)		-.30 (.43)	
Paternal warmth (W1)	.44 (.34)		.44 (.36)	
Maternal closeness (W4)	.16 (.40)		.16 (.42)	
Paternal closeness (W4)	.20 (.39)		.42 (.37)	
Maternal contact (W4)	-.36 (.47)		-.29 (.44)	
Paternal contact (W4)	.31 (.45)		.39 (.40)	
Civic engagement (W4)	.02 (.27)		.02 (.27)	
Maternal Warmth (W1) x Civic Engage (W4)			.38 (.37)	
Paternal Warmth (W1) x Civic Engage (W4)			-.18 (.32)	
Maternal Closeness (W4) x Civic Engage (W4)			.59 (.37)	
Paternal Closeness (W4) x Civic Engage			-.69 (.33)	*
Maternal Contact (W4) x Civic Engage (W4)			-.11 (.40)	
Paternal Contact (W4) x Civic Engage (W4)			.44 (.37)	

Note. N = 20,745. W1 = wave 1; W4 = wave 4; Civic Engage = civic engagement.
* $p < .05$.

Table 4c. Coefficient estimates from path analyses for maternal and paternal relationship and religious frequency interactions on C-reactive protein levels

	Model 1		Model 2	
	b (*SE*)	*p*	*b* (*SE*)	*p*
Maternal warmth (W1)	-.00 (.01)		.01 (.01)	
Paternal warmth (W1)	-.00 (.01)		.00 (.01)	
Maternal closeness (W4)	-.01 (.01)		-.01 (.02)	
Paternal closeness (W4)	-.00 (.01)		.00 (.01)	
Maternal contact (W4)	.06 (.01)	***	.07 (.02)	***
Paternal contact (W4)	.01 (.01)		.01 (.01)	
Religious frequency (W4)	.00 (.01)		.00 (.01)	
Maternal Warmth (W1) x Rel Freq (W4)			.00 (.01)	
Paternal Warmth (W1) x Rel Freq (W4)			.01 (.01)	
Maternal Closeness (W4) x Rel Freq (W4)			.01 (.01)	
Paternal Closeness (W4) x Rel Freq			.01 (.01)	
Maternal Contact (W4) x Rel Freq (W4)			.02 (.01)	
Paternal Contact (W4) x Rel Freq (W4)			-.00 (.01)	

Note. N = 20,745. W1 = wave 1; W4 = wave 4; Rel Freq = religious frequency.
*** $p < .001$.

Table 4d. Coefficient estimates from path analyses for maternal and paternal relationship and religious frequency interactions on glucose levels

	Model 1		Model 2	
	b (*SE*)	*p*	*b* (*SE*)	*p*
Maternal warmth (W1)	-.16 (.37)		-.27 (.43)	
Paternal warmth (W1)	.51 (.37)		.50 (.36)	
Maternal closeness (W4)	.19 (.40)		.25 (.42)	
Paternal closeness (W4)	.22 (.39)		.43 (.37)	
Maternal contact (W4)	-.31 (.47)		-.21 (.44)	
Paternal contact (W4)	.34 (.45)		.41 (.40)	
Religious frequency (W4)	-.44 (.17)	**	-.51 (.20)	*
Maternal Warmth (W1) x Rel Freq (W4)			-.21 (.26)	
Paternal Warmth (W1) x Rel Freq (W4)			-.02 (.22)	
Maternal Closeness (W4) x Rel Freq (W4)			.39 (.27)	
Paternal Closeness (W4) x Rel Freq			-.22 (.23)	
Maternal Contact (W4) x Rel Freq (W4)			.08 (.27)	
Paternal Contact (W4) x Rel Freq (W4)			-.03 (.24)	

Note. N = 20,745. W1 = wave 1; W4 = wave 4; Rel Freq = religious frequency.
* $p < .05$. ** $p < .01$.

Table 4e. Coefficient estimates from path analyses for maternal and paternal relationship and religious importance interactions on C-reactive protein levels

	Model 1		Model 2	
	b (*SE*)	*p*	*b* (*SE*)	*p*
Maternal warmth (W1)	-.00 (.01)		.01 (.01)	
Paternal warmth (W1)	-.00 (.01)		.00 (.01)	
Maternal closeness (W4)	-.01 (.02)		-.01 (.02)	
Paternal closeness (W4)	.00 (.01)		.00 (.01)	
Maternal contact (W4)	.07 (.02)	***	.07 (.02)	***
Paternal contact (W4)	.01 (.01)		.01 (.01)	
Religious importance (W4)	.01 (.01)		.01 (.01)	
Maternal Warmth (W1) x Rel Import (W4)			.00 (.02)	
Paternal Warmth (W1) x Rel Import (W4)			.00 (.01)	
Maternal Closeness (W4) x Rel Import (W4)			.02 (.02)	
Paternal Closeness (W4) x Rel Import			-.00 (.01)	
Maternal Contact (W4) x Rel Import (W4)			.03 (.02)	
Paternal Contact (W4) x Rel Import (W4)			.01 (.02)	

Note. N = 20,745. W1 = wave 1; W4 = wave 4; Rel Import = religious importance.
*** $p < .001$.

Table 4f. Coefficient estimates from path analyses for maternal and paternal relationship and religious importance interactions on glucose levels

	Model 1		Model 2	
	b (*SE*)	*p*	*b* (*SE*)	*p*
Maternal warmth (W1)	-.18 (.37)		-.29 (.43)	
Paternal warmth (W1)	.48 (.37)		.48 (.36)	
Maternal closeness (W4)	.17 (.40)		.14 (.42)	
Paternal closeness (W4)	.21 (.39)		.43 (.37)	
Maternal contact (W4)	-.36 (.47)		-.26 (.44)	
Paternal contact (W4)	.31 (.45)		.38 (.40)	
Religious importance (W4)	-.10 (.31)		-.55 (.36)	
Maternal Warmth (W1) x Rel Import (W4)			-.20 (.48)	
Paternal Warmth (W1) x Rel Import (W4)			.13 (.40)	
Maternal Closeness (W4) x Rel Import (W4)			.17 (.45)	
Paternal Closeness (W4) x Rel Import			-.17 (.41)	
Maternal Contact (W4) x Rel Import (W4)			.47 (.48)	
Paternal Contact (W4) x Rel Import (W4)			-.20 (.45)	

Note. N = 20,745. W1 = wave 1; W4 = wave 4; Rel Import = religious importance.

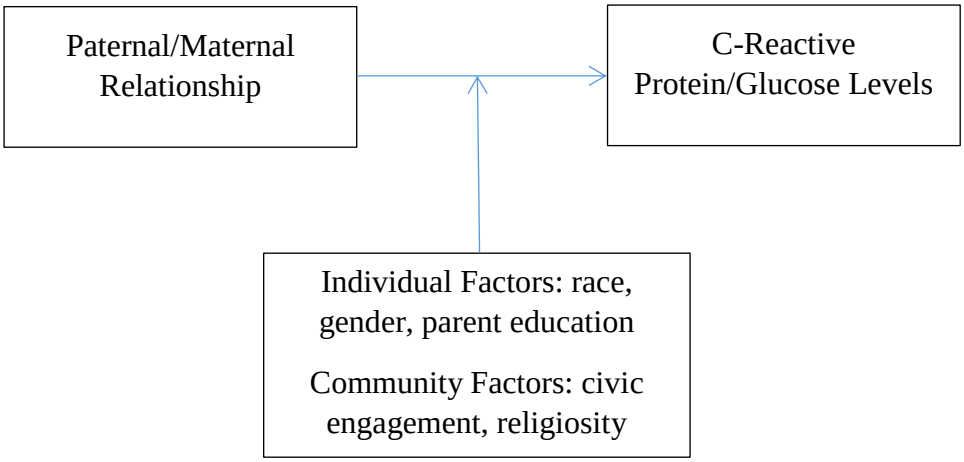

Figure 1. Conceptual model for the association of the parenting relationship and young adults' biological functioning and the moderating role of personal characteristics and community factors.

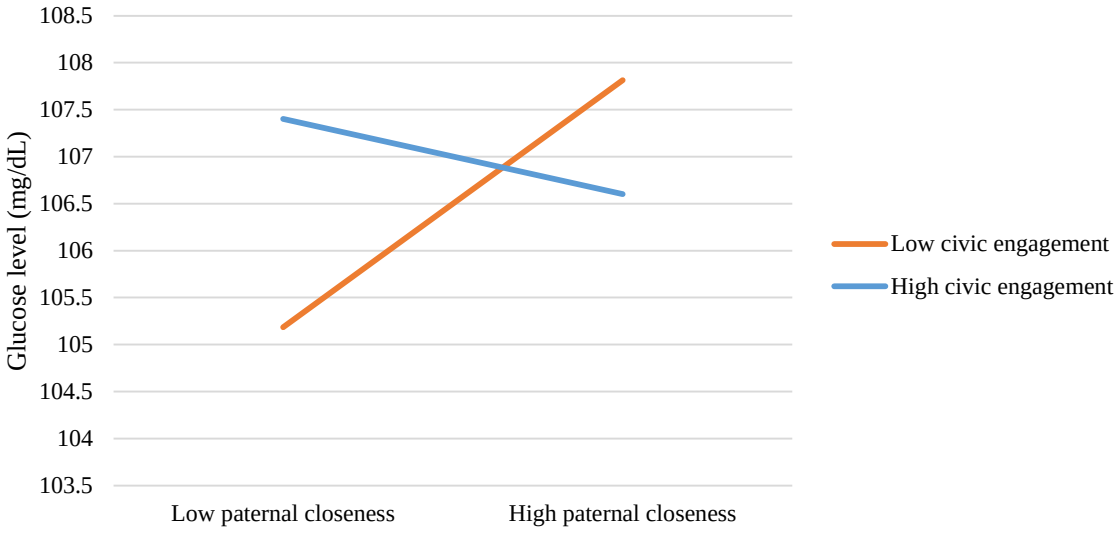

Figure 2. Interaction between paternal closeness and civic engagement on glucose levels.

Biography

Aarti Bhat was born in Northampton, Massachusetts in 1996, and moved to Austin, Texas in 1997. She attended the University of Texas at Austin for her undergraduate studies, majoring in Plan II Honors along with Honors in Advanced Human Development and Family Sciences, while minoring in Sociology and getting certificates in Global Business Foundations as well as Evidence and Inquiry. Aarti will be moving to Oakland, California after graduation to teach secondary biology, while simultaneously pursuing her Master's in Education at Loyola Marymount University. Eventually, Aarti hopes to get a PhD in the field of social determinants of health. Outside of academics, Aarti enjoys playing tennis, watching movies, and spending time with friends and family.