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Sociodemographics and Chronic Stress in Mother-Toddler Dyads Living in Poverty

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Abstract

Experiencing chronic stress early in life is associated with later health disparities, and poverty may be a significant stressor for both mothers and children. With a sample of primarily Black and White mothers ($N = 75$) and toddlers ($N = 71$) living in poverty in the United States, we examined the direct relations between sociodemographic conditions of poverty and chronic physiological stress. Mothers completed questionnaires on sociodemographics, including mother/toddler race, mother's education, father's education, poverty level, economic hardship, marital status, unemployment status, and toddler sex. Physiological chronic stress was measured by assaying the cortisol content of 4cm samples of hair cut from the posterior vertex of mothers and toddlers (20–24 months of age) to represent four months of stress. Mothers' and toddlers' chronic stress was significantly, moderately, and positively associated. Toddlers had a trending relationship of moderately higher chronic stress if they were Black compared to not Black. Mothers had significantly, moderately higher chronic stress if they were Black or had a Black toddler (compared to not Black), not married (compared to married), or were working (compared to not working). The findings suggest that these mothers, simultaneously navigating poverty and parenting a toddler, need resources to reduce chronic stress.

Keywords

hair cortisol; poverty; stress; race; mother-child

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Exposure to chronic stress is a significant public health concern that predicts several adverse health and wellness domains (Anda et al., 2006; Shonkoff, 2012), amounting to costly health disparities of over $750 million per year to the United States alone (Bellis et al., 2019; O'Brien et al., 2017). Experiencing chronic stress before toddlerhood (i.e., before 2 years of age) can be particularly harmful; adverse effects during this sensitive period of development can be long-lasting (McLaughlin et al., 2015; Shonkoff, 2012).

One potential and widespread chronic stressor among families with toddlers is poverty (Fass et al., 2009; Jiang et al., 2017). Families living with poverty face numerous challenges, including inadequate financial and educational resources, relationship instability, and overall unpredictability (Combs-Orme & Cain, 2006; Evans et al., 2005) that may contribute to significant chronic stress for mothers and their children. With over 20% of infants and toddlers living in poverty in the United States (Jiang et al., 2015), there is an urgent need to understand if toddlers younger than 2 years old are experiencing chronic stress associated with poverty. These relationships are also critical to understand because income inequality in the United States, particularly between Black and White Americans, is the highest of G7 nations and has grown steadily over the past 50 years (Schaeffer, 2020). Additionally, because poverty is stressful for families, and young children perceive the world through their primary caregivers - often their mothers - it is essential to consider mothers' chronic stress levels as well. To date, many researchers have estimated chronic stress in young children with hair cortisol (Bates et al., 2017). However, few researchers have examined direct relationships between sociodemographic factors and chronic physiological stress measured with hair cortisol in mother-toddler dyads living in poverty in the United States. Thus, the objective of this study was to examine relationships between sociodemographics and chronic physiological stress, measured with hair cortisol, in a sample of primarily Black and White mothers and their toddlers living in poverty in the United States. With this study, we hope to identify targets for buffering chronic stress in this population and thus reduce health care costs associated with chronic stress-related health disparities.

The Stresses of Poverty

Poverty definitions and associated income guidelines vary by country. In the United States, research suggests that families need an income of at least 200% of the United States Federal Poverty Level to afford basic needs such as food and shelter (Jiang et al., 2017). Despite being one of the richest countries in the world, the United States has the most disproportionate level of wealth equality (Grimm et al., 2020; Menasce Horowitz et al., 2020) with a staggering number of children living in poverty. In the United States, at least 20% of infants and toddlers live in poor homes (families earning below 100% of the Federal Poverty Level) and nearly 50% live in low-income homes (families earning below 200% of the Federal Poverty Level; Jiang et al., 2017). Hence, about one in two infants and toddlers in the United States live in a family that is likely enduring stress to financially survive.

Research shows that mothers in poverty have disproportionately higher levels of perceived stress than mothers with higher income (Baskind et al., 2019; Bates, Salsberry, Justice, et al., 2020; Chung et al., 2004; Gaynes et al., 2005; Roubinov & Boyce, 2017). Besides not having enough income to meet basic needs, these mothers experience stress from

isolation, stigmatization, and unfair distribution. For example, in poverty, employment opportunities are often unstable and wages are low making it difficult to purchase healthy foods (Koury et al., 2020), pay bills to avoid evictions or utility shut-offs (Thompson & Dahling, 2019), afford safe housing (Jensen et al., 2017), or live in safer neighborhoods (Collinson & Ludwig, 2019). In addition to income limitations, poverty can also be isolating. For example, poverty restricts family access to social capital, such as high-quality childcare, with is not universally provided in the United States. Further, licensed center-based childcare costs about $15,000 per year, which may comprise 50% of the income of a U.S. family living in poverty (Workman & Jessen-Howard, 2018). This significant expense often requires mothers to choose between working or working more hours, settling for more affordable but lower-quality childcare (Schochet & Malik, 2017), or leaving the workforce altogether to care for their children. Poverty is also stigmatizing; American culture emphasizes poverty due to an individual's irresponsibility (Fass et al., 2009) from failing to profit from capitalist markets, a victim-blaming belief (Assari, 2017) that particularly fails to account childrens' dependence on their families. Poverty is also unfairly distributed amongst social classes. For example, Black families are more likely to experience poverty (Fass et al., 2009). This is in part due to policies that have limited access to wealth or have stolen wealth from Black families across time, leading to lower overall intergenerational family wealth (Alexander, 2010; Boyd-Swan & Herbst, 2019; Hamilton & Logan, 2020; Schaeffer, 2020) and marginalized Black children from opportunities.

The experiential canalization in the context of adversity theory shows that mothers and their children mobilize stress hormones to survive poverty (Blair & Raver, 2012). Specifically, adapting to adversity may increase physiological stress hormones, which mobilize resources to enable adequate fight or flight actions. This developmental adaptation has short-term advantages of surviving adversity. Over time, however, these adaptations may result in increased wear-and-tear on the body resulting in adverse health, health behaviors, and chronic stress-related health disparities (Blair & Raver, 2012). Indeed, childhood poverty costs the United States at least $800 billion/year in reduced productivity, increased crime, and higher health expenditures (National Academies of Sciences, 2019).

Physiological Chronic Stress Measured with Hair Cortisol

Researchers are able to estimate chronic physiological stress with hair cortisol, which helps overcome the limitations of toddlers' inability to communicate perceptions of chronic stress. In brief, cortisol is a glucocorticoid hormone and an end-product of the hypothalamic-pituitary-adrenal (HPA) axis. The adrenal glands secrete cortisol in pulses, producing a high output shortly after morning awakening, then decreasing amounts until the next awakening period (Chan & Debono, 2010). Cortisol is also secreted in response to perceived stressors (Lightman et al., 2008), helping mobilize energy sources to fight or flee the stressor; it is a frequently used biomarker of stress (Russell et al., 2012). As hair grows about 1cm each month, with minor racial and ethnic variations (Loussouarn et al., 2016), each 1cm of hair reflects average HPA activity over 1 month, including activity in response to acute stressors (Russell et al., 2012). Generally, researchers use 1–6cm of hair to measure 1–6 months of chronic stress, respectively (Dettenborn et al., 2012; Russell et al., 2012). Typically, higher levels of hair cortisol are associated with higher levels of chronic stress, although lower

levels of hair cortisol have also been associated with stress-related disorders (Khoury et al., 2019) due to dampened activity of the HPA axis (Xu et al., 2019) or both high and dampened activity of the HPA axis (Ford et al., 2019) associated with clinical depression. Toddlerhood is a critical period of HPA axis development and this may be reflected in their cortisol response (McLaughlin et al. (2015).

Mother-Child Chronic Stress Measured with Hair Cortisol

As children often perceive the world through their primary caregivers, it is vital to consider the mother when examining early childhood chronic stress. Chronic stress may be related in mothers and a dependent young child due to sharing a similar environment, shared interactions, and a shared genetic response system (Rietschel et al., 2017). However, research on mothers and young children is sparse and has mixed results. For example, in a sample of mothers and infants (9–12 months) living in poverty in Brazilian slums, Liu et al. (2017) found their hair cortisol was significantly positively and highly correlated. In another sample of mostly college-educated mothers and 12-month-old infants living in New England, Flom et al. (2017) found that their hair cortisol was significantly moderately positively related. Among mostly college- or vocationally-educated mothers and preschoolers (4–5 years old) in Germany, Schloß et al. (2019) found that maternal hair cortisol predicted preschooler hair cortisol, especially if the mother had higher maternal sensitivity. Yet, in a second study with mostly college- or graduate-educated mothers and infants (aged 9 and 12 months) in New England, Liu et al. (2016) did not find significant mother and infant hair cortisol associations. Although most of these studies included SES-privileged samples, the findings may also vary due to developmental timing and the nature of the shared environment. That is, consistent with experiential canalization in the context of adversity theory (Blair & Raver, 2012), synchrony of stress reactions (e.g., stronger associations) may occur in higher-risk contexts (e.g., poverty) as compared to lower-risk contexts (e.g., SES privilege) because of exposure to similar stressors (Liu et al., 2017). Hence, our research builds upon this work and theory by investigating shared chronic physiological stress of mothers and toddlers at 20–24 months of age living in poverty.

Sociodemographics and Chronic Stress in Mothers and Toddlers Living in Poverty

While conceptually challenging to classify SES and disadvantage (Simmons et al., 2019), parental education and finances are associated with experience-based and physical resources for child development (Ursache et al., 2017). Hence, parent education and income are often used to classify SES in studies of chronic stress in mothers and young children. For example, Anand et al. (2019) found that racially diverse children (1–4 years old) in the United States whose parents had the lowest income and education had the highest chronic stress. Yet, Flom et al. (2017) found that primarily White infants (12 months old) with highly educated mothers in the United States showed no relationship between a standardized SES composite (parent income, education, and occupational prestige) and their chronic stress. Mixed findings are similarly reported for older children in the United States from diverse backgrounds (Tucker-Drob et al., 2017; Ursache et al., 2017) and in samples from

studies conducted in Australia (Simmons et al., 2019), Canada (Vaghri et al., 2013), and Germany (Schloß et al., 2019).

The reason for these mixed results may be related to the distal effects of parental education and income on a young toddler. More proximal SES markers may show stronger relationships such as maternal employment, economic hardship, and marital status. Maternal employment provides both financial and social resources to raise a child; these added resources may reduce stress within poverty. However, maternal employment may add stressors, as mothers may have to balance low-wage and complicated work schedules with expensive childcare. Economic hardship, defined as not having enough money to pay bills and avoid utility shut-offs or eviction, has been associated with adverse parental mental health, inconsistent parenting practices, and child stress (Yoshikawa et al., 2012; Yoshikawa et al., 2008). Hence, economic hardship may increase the unpredictability associated with navigating poverty, which can be stressful for a child. Marriage, however, may be a protective factor against stress due to increased financial and relationship stability (Wilcox et al., 2011). These SES factors have not been fully examined in prior research.

Race in the United States and Associations with Stress and Poverty

In the U.S., there is considerable evidence of historical and current practices of racial discrimination that may lead to more chronic stress for those who are Black. Racial oppression may also explain why Black individuals report more distress and have signs of higher physiologic stress than those who are White (Bailey et al., 2017; Ford & Stowe, 2013; Ford & Stowe, 2017). However, few studies have examined associations between race and chronic stress measured with hair cortisol in young United States children. Researchers showed that in both younger children (Anand et al., 2019) and older children (Tucker-Drob et al. (2017), Black children had higher levels of hair cortisol compared to White children. However, no known studies have concurrently examined mother-child chronic stress in a diverse sample.

The Current Study

Our study extends the prior research on mother-child chronic stress measured with hair cortisol and SES indicators in several ways. First, we examine these relationships in an understudied sample of mother-toddler dyads living in poverty in the United States. This study also moves beyond examining parent income and education as markers of SES; unique for this sample, we investigate associations of mother-toddler chronic stress with race, maternal employment status, marital status, and economic hardship. With this information, we may better identify more specific targets within poverty that could be addressed to buffer chronic stress and reduce chronic-stress-related disparities for mothers and toddlers living in poverty.

Our aims were threefold. *First*, we addressed whether and to what extent mothers' chronic stress was associated with toddlers' chronic stress. We hypothesized that mothers' and toddlers' chronic stress would be strongly, positively associated. *Second*, we addressed whether and to what extent mothers' and toddlers' chronic stress differed between those

who identified as White or Black. We hypothesized that those are Black would have higher chronic stress compared to those are White. *Third*, we addressed whether and to what extent mothers' and toddlers' chronic stress differed with markers of socioeconomic status. We hypothesized that mothers and toddlers would have higher chronic stress if they had lower socioeconomic status (lower education levels, had lower levels of income, mothers were unemployed, and mother was unmarried).

Methods

Design, Participants, and Procedure

The study used an observational, correlational design occurring over the second year of the child's life using data from the longitudinal birth cohort parent study, the Kids in Columbus Study (KICS). KICS researchers used a robust quota sampling method to enroll 322 mother-child dyads from local Women, Infant, Children (WIC) clinics to represent women living at or below the federal poverty level in Franklin County, Ohio (Salsberry et al., 2016). Mothers were eligible to participate in the parent study if they were 18 years of age or older, planned on living in Franklin County for the study duration, had a child without severe medical diagnoses (e.g., anoxia, epilepsy), and provided consent for themselves and their child to participate. Mothers were given diapers, wipes, a gift card, and a children's book for participating. Data were primarily collected at the child's home. The study was approved by the Institutional Review Board (IRB) of the authors' shared, affiliated university.

When children were between 20–24 months of age, dyads who were still active in the study were invited to participate in an exploratory substudy on better understanding chronic physiological stress in mother-toddler dyads living in low-income homes. Sampling details of this substudy, including comparisons to the larger parent study are described elsewhere (Bates, Salsberry, Ford, et al., 2020). We invited the 142 dyads still active to participate; 94 dyads provided samples of hair. Comparing the mothers who participated in hair sampling ($n = 94$) to those enrolled in the parent study and who did not participate in hair sampling ($n = 228$), the substudy had fewer Black toddlers ($\chi 2 = 6.34$; $p = .01$), yet there were no significant differences in maternal education (Bates, Salsberry, Ford, et al., 2020).

Demographics of the substudy participants for this analysis are shown in Table 1. Of the total sample who provided hair samples, about 54% of the children were female and about 43% were Black/African American (36% of mothers were Black/African American). When these children were 15–19 months of age, nearly 51% of mothers did not have any college education and approximately 78% of the dyads lived with a household income of less than $30,000 USD per year.

Measures

Chronic Stress—Chronic stress was estimated with hair cortisol over four months. Hair was sampled with thinning shears primarily from the posterior vertex of mothers and children's scalp when children were between 20–24 months of age (Bates, Salsberry, Ford, et al., 2020). Samples were stored at room temperature prior to cortisol extraction at The Ohio State University College of Nursing Stress Science Lab. Hair was analyzed with

enzyme-linked immunoassay (ELISA) following established methods (Meyer et al., 2014). In the lab, samples were cut to a four cm length proximal from the scalp to represent the prior four months' average cortisol output from the HPA axis (Wennig, 2000); lengths up to six cm are reliable (Russell et al., 2012). The samples were weighed and washed twice with isopropanol. Samples were dried, minced, and then ground to a powder with a Retsch 400 Mill for 10 minutes. Cortisol was extracted from the hair powder by adding high-performance liquid chromatography methanol, evaporating the methanol over 48 hours, and reconstituting the sample in assay buffer from Salimetrics®. The samples were assayed in duplicate. Cortisol values were calculated in pg/mg (Meyer et al., 2014) and log-transformed to reduce distributional skew.

Valid hair cortisol results were determined by computing results with MyAssays®, which plots values along a four-parameter logistic curve. Values within the curve were used in final analyses as concentrations outside the curve cannot be calculated (personal communication with MyAssays 5/24/19). This resulted in 71 valid child values and 75 valid mother values (total $n = 146$), constituting the final analytic sample. Intra- and inter-assay CVs were acceptable by conventional standards (Salimetrics, n.d.). The average child intra-assay coefficient of variability (CV) for the concentrations was 5.56%. The average mother intra-assay CV of the concentrations was 4.00%. The average concentration inter-assay CV was 5.46%.

We examined hair cortisol differences based on any reported steroid use during the sampling period (using a questionnaire with specific prompts and open-ended answers to listing any medication use), hair washing frequency, and hair chemical use (coloring, bleaching, straightening, perming) by mothers. Of the 71 toddlers with valid hair cortisol values, 13 used a steroid at some time six months before hair collection. A Kruskal-Wallace test for differences in groups with a non-normal distribution showed that there were no differences in hair cortisol levels (pg/mg) by child steroid use ($p = .93$) or child hair washing frequency ($p = .69$). Of the 75 mothers with valid hair cortisol values, eight mothers used a steroid within six months before hair collection. A Kruskal-Wallace test also showed no difference in maternal hair cortisol (pg/mg) by maternal steroid use ($p = .74$). There were no differences in hair cortisol by location of hair sampling, chemical straightening, hair coloring, or hair bleaching (all p's $> .05$). Consequently, we did not exclude mothers or toddlers in the analysis based on steroid use, hair wash frequency, hair sampling location, or use of harsh hair chemicals.

Sociodemographics—Sociodemographics included mother and toddler race, maternal and parental education, household poverty status, maternal employment, economic hardship, and parental marital status. We also examined child sex. All sociodemographic variables, except child race, were measured when children were 15–19 months of age. Child race was measured at enrollment.

Mother and child race were maternal reported and scored *Black/African American* (= 1) and *not Black/African American* (= 0). Maternal education and paternal education were reflected as *not a high school graduate* (= 0) and *high school graduate* (= 1). This scoring decision was made because lower maternal education levels are associated with fewer resources and

training to provide conventional enriching experiences for their child (Zimmerman et al., 2015).

Household poverty status was calculated by an estimated household poverty ratio with household income categories (we did not have data on continuous household income). Mothers selected categories of household income, which were converted to a continuous variable by averaging categories. For example, a yearly household income between $10,001-$20,000 USD was converted to $15,000 USD per year. This income was then divided by the number of people living in the household. This income to needs ratio was then divided by the poverty threshold for the 2016 or 2017, corresponding to when the data were collected (United States Department of Health and Human Services, 2016, 2017).

Mothers reported on their employment according to applicable categories: full-time, part-time, self-employed, out of work and looking for work, unable to work, out of work but not looking for work, homemaker, and retired (mothers could select more than one category). The percentages are reported as demographics in Table 1. Following prior work that analyzed mothers employed versus not employed with child salivary cortisol (Chryssanthopoulou et al., 2005), we dichotomized maternal employment into *not working* (= 1: out of work and looking for work, unable to work, out of work but not looking for work, or homemaker) and *working* (= 0: working full time, part-time, or self-employed).

Economic hardship was measured with the Economic Hardship scale (Yoshikawa, Godfrey, & Rivera, 2008). The measure has four questions scored *no* (= 0) and *yes* (= 1) on not being able to pay bills for utilities, rent, or mortgage payments over the past year. The distribution of dyads who provided hair and reported economic hardship was skewed: no economic hardship = two dyads (2.4%), one economic hardship = four dyads (4.7%), two economic hardships = 12 dyads (14.1%), three economic hardships = 22 dyads (25.9%), and four economic hardships = 45 dyads (52.9%). Due to the characteristics of this low-income sample being heavily skewed with economic hardship, we used the median (four economic hardships) as the cutoff point for meaningful analysis. Hence, those who experienced *severe economic hardship* (the most hardship, or total score of 4) were scored as 1; those with *less economic hardship* (scores of 3 and less) were scored as 0.

Marital status was reflected as parents *married* (= 0) and *not married* (= 1). We also examined associations between mother and toddler chronic stress with child sex, scored *male* (= 0) and *female* (= 1), as some evidence suggests that hair cortisol may be higher in young male children compared to female (Simmons et al., 2019).

Analytic Overview—Data were analyzed in SPSS 24/25. Of the 94 dyads who provided hair, 16 had data missing on at least one of the independent sociodemographic variables (≤ 13.8%/variable; Table 2). Little's Missing Completely at Random (MCAR) test was not significant ($p = .18$), indicating no sufficient evidence against the hypothesis that the data were missing completely at random. Preliminary analyses were analyzed with descriptive statistics. Given that this is one of the first studies to examine relationships between sociodemographics and chronic stress in a sample of mothers and toddlers living in poverty in the United States, we analyzed aims with Pearson correlations between

key variables. We further conducted Welch's independent samples *t*-tests (not assuming equal variances) to compare stress based on dichotomous sociodemographic variables (with Bonferroni adjustments). We primarily interpreted effect sizes (Cohen, 1988), with statistically significant values up to $p = .10$. We also explored relationships between sociodemographics and categories of chronic stress (blunted, average, and high based on the mean and SD of the mothers and toddlers), but no relationship reached significance and the non-linear analyses provided no additional insight. Thus, only linear relationships were reported.

Results

Descriptive statistics are reported in Table 2, correlations in Table 3, and independent samples *t*-tests in Table 4. Descriptively, the sample was primarily living in deep poverty; on average, families were living at 23% ($SD = 20\%$) of the United States Federal Poverty level. About 14% of mothers and nearly 30% of fathers were not high school graduates. About 23% of mothers were not employed and 27% were married. As shown in Table 3, there were no significant associations between mother or child hair cortisol with child sex, child age, or mother age.

Aim 1: Associations between Mother and Toddler Chronic Stress

For this aim, we examined correlations (Table 3). Consistent with our hypothesis, toddler and mother chronic stress as measured by hair cortisol were significantly moderately and positively associated.

Aim 2: Differences in Mother and Toddler Chronic Stress by Race

For this aim, we conducted independent samples *t*-tests, using chronic stress as the dependent variable and race (Black vs. non-Black) as the independent variable (Table 4). We found mixed results for our hypotheses. There was a trending relationship in that toddler chronic stress was moderately higher in those who were Black as compared to not Black ($d = 0.43$). Toddler chronic stress did not differ by maternal race. However, maternal chronic stress was significantly and moderately higher in those who were Black ($d = 0.61$) or who had a Black toddler ($d = 0.64$).

Aim 3: Mother and Toddler Chronic Stress by Sociodemographic Status

For this aim, we examined the correlation between stress and the continuous poverty ratio variable (Table 3) as well as the means of stress measures based on the binary SES variables (Table 4). Here we also found mixed results for our hypotheses. We did not find that toddlers' chronic stress significantly varied by SES; effect sizes ranged from negligible to small. Mothers had more varied findings. Compared to mothers who were working, mothers who were not working had significantly and moderately lower chronic stress ($d = -0.53$). Compared to mothers who were married, mothers who were not married had significantly and moderately higher chronic stress ($d = 0.66$). Yet, after Bonferroni correction for multiple comparisons, the adjusted *p*-values were no longer significant, although the effect sizes were unaffected. Finally, we found negligible effects on mother chronic stress by either mother or father's education level and the extent of economic hardship.

Discussion

This is one of the first studies to investigate relationships among several sociodemographic factors and chronic stress estimated with hair cortisol in mothers and their toddlers living in deep poverty in the United States. For this sample, we found three notable findings regarding chronic stress in the past four months: (1) chronic stress between mothers and toddlers was moderately associated; (2) mothers who were Black or had a Black toddler (compared to those who were not Black) had significantly higher chronic stress; and (3) mothers who were not married (compared to married) or who were employed (compared to not employed) had higher chronic stress. We discuss each of these findings with considerations to prior research in turn.

First, this study was one of the first to examine the relationship between maternal and toddler chronic stress in a sample of dyads living in poverty in the U.S.; the mean poverty level of the sample was approximately 23% of the federal poverty level. The positive association in our findings are similar to those of Flom et al. (2017) and Schloß et al. (2019) in SES-advantaged samples, and the strength the relationship is similar to that reported by Liu et al. (2017) in a sample of mother-infant dyads living in Brazilian slums. Possible mechanisms for this finding include shared heritability and environment, and timing. In most cases, children obtain 50% of their genes from their mother, and this genetic structure could be involved in similar programming of their HPA axis and result in similar stress responses (Rietschel et al., 2017; Tucker-Drob et al., 2017). However, studies with pregnant women or fetuses note that fetal hair cortisol either has no relationship with mother hair cortisol or the relationship is negative (Hoffman et al., 2017; Romero-Gonzalez et al., 2018). This may be related to developmental timing, as suggested from the findings of McLaughlin et al. (2015) that toddlerhood may be a sensitive period of time where the HPA axis is primed for long-term regulation. Additionally, our findings may be related to the nature of the shared environment consistent with the findings of Tucker-Drob et al. (2017). Perhaps as noted by Liu et al. (2017), mothers and children have more synchrony of their stress responses in extremely stressful environments such as poverty, as they are exposed to similar stressors. It may also be that families in poverty have less access to stress-buffering resources as compared to families with SES privileges. Future studies could examine the relationship between mother and toddler stress and identify if other markers of maternal-child synchrony, such as parenting sensitivity, may affect the strength of the relationship, such as in Schloß et al. (2019).

The consideration of the strong relationship between mother and toddler stress for dyads living in poverty may also be important to consider for understanding later health and health disparities for toddlers (McLaughlin et al., 2015). Thus, when considering interventions to improve long-term health and reduce health disparities, it may be important to consider toddlerhood (or earlier) as a key period for intervention and for buffering mother and toddler stress. An example of an intervention shown to help buffer symptoms of stress in mothers and toddlers living in low-income homes is the Nurse Family Partnership, which provides a trained registered nurse to visit mothers in their home to help mothers adjust to parenting (Olds et al., 2014). In randomized controlled trials, the Nurse Family Partnership, delivered from pregnancy to 2 years of age, reduced children’s behavior problems at 9

years of age (Olds et al., 2014). Several other primary care interventions are available and have been shown to improve early childhood behaviors (for a systematic review, see Peacock-Chambers et al., 2017). Programs such as Early Head Start have lead to reduced stress between parents and toddlers (Love et al., 2005). Hence, it may be important for researchers, clinicians, and policy makers to promote or enable wider use of these programs for mothers and toddlers living in poverty.

The second notable finding of this study is that mothers in the sample who identified as Black or had a toddler identified as Black had higher chronic stress than mothers who did not identify as Black. These findings are similar to those of Bailey et al. (2017), who found that African Americans reported more distress than White European Americans, and Zilioli et al. (2017), who reported that older African Americans have higher levels of chronic stress with more neighborhood disadvantage.

While not directly measured (and a limitation of this study), one reason for the findings that Black mothers have higher chronic stress may be related to racism. Despite movements to reduce racism in the United States, it is still difficult for those who are Black to escape daily experiences with racial discrimination (English et al., 2020). For example, due to hierarchies of power in the United States, Black individuals either directly experience racial microaggressions in social environments or experience secondhand exposure to racism through hearing examples of the high rates of murders of Black people (Bor et al., 2018; Browning et al., 2020). Additionally, structural racism reinforces poor access to systems that can limit resource distribution for Black individuals (Bailey et al., 2017), limiting the extent to which Black individuals can optimize their health and limit stress (Bailey et al., 2017; Krieger, 2014). Thus, for mothers who are Black and living in poverty, experiences with racism and racism's downstream effects may be a source of significant stress because they are not able to access the same resources or social treatment as White mothers. Additionally, our findings of increased chronic physiological stress in Black mothers may be the results of racial disparities (Dwyer-Lindgren et al., 2017). Future research on these relationships is important. Meanwhile, these findings highlight the importance of providing additional support to mothers who are Black or have a Black toddler in order to reduce downstream effects of chronic stress on health.

The third notable finding is that the mothers living in poverty in this sample who were not married or employed (as compared to married or not employed mothers, respectively) had higher levels of chronic stress. There may be several reasons for this finding. For mothers in poverty, marriage may be a protective resource that can provide financial resources, emotional support, and help in caring for young children (Wilcox et al., 2011), all of which could reduce caregiver burden and potentially reduce chronic stress even while parenting within poverty. However, we did not test positive or negative aspects of marriage. Marriage quality can have differential effects on stress and health (Kiecolt-Glaser, 2018), and perhaps this quality and the effects on stress may vary by SES resources. Further, we found that mothers who were employed had higher chronic stress than those who were not employed. This was an unexpected finding. However, in the context of poverty, employment and managing childcare may be stressful, especially in the United States where childcare is expensive and not always available for parents who work varying shifts or who

have a sick child. The COVID-19 pandemic also illustrated this complicated relationship between working mothers and difficulties with childcare. A mother employed in low-wage jobs and still living in poverty while paying for childcare may also ruminate about the decision to work versus staying home with her child. Working or not working can be a complicated decision; mothers out of the workforce can lose wages and work-related skills that they advanced prior to having children. Our study results may help policymakers further recognize that mothers in the United States, particularly those in poverty, need additional support to navigate difficulties surrounding working and raising children to reduce chronic stress-related disparities.

Interestingly, in this sample of mother-toddler dyads, we did not find that toddler's chronic stress was significantly related to markers of SES. This finding may be related to the sample size or because distal measures of the toddler's environment may not significantly affect the stress response. This null relationship may also be because hair cortisol levels are highly heritable (Rietschel et al., 2017; Tucker-Drob et al., 2017): more likely so in lower SES settings (Tucker-Drob et al., 2017). Tucker-Drob et al. (2017) suspected that the relationship of reduced environmental influence but higher genetic influence of chronic stress responses at lower SES may be explained by the diathesis-stress or vulnerability-stress theory in that certain genetic predispositions (i.e., inherited stress perceptions and responses) may be more vulnerable to stressful conditions (i.e., low SES environments). Consistent with this theory and in a slightly different interpretation of the experiential canalization in the context of adversity theory (Blair & Raver, 2012), perhaps in overall stressful environments (e.g., low SES), young children demonstrate resiliency by relying more on inherited stress activity than by demonstrating stress reactivity to distal aspects of their environment (i.e., SES). This interpretation would explain the strong mother-child hair cortisol association in this sample living in poverty, the Liu et al. (2017) sample of mothers and infants living in abject poverty in Brazil, and perhaps the null findings in the SES-advantaged sample by Liu et al. (2016). The null SES relationships could also be related to the relatively distal environment we measured – that is, markers of overall SES. Instead, young children's stress response may be more related to their most proximal environment, that is interactions with their caregivers, including the role of protective parenting, such as that found in a sample of mothers and preschoolers in poverty (Clowtis et al., 2016). Finally, while we did not find significant effects of sociodemographic factors on toddler stress, effects could compound over time and be more evident in later years. Future research could test these associations within a sample of mother-toddler dyads navigating poverty over time.

While there were strengths of this study, including measurement of multiple sociodemographic factors, there were several limitations. First, our study was a correlational observational design, and thus no causal conclusions can be reached. Other unmeasured variables may explain our findings. Second, our sample was homogenously socioeconomically disadvantaged without sufficient socioeconomic variability to significantly detect effects. Additionally, we did not investigate chronic stress relationships with fathers; these relationships are noticeably absent in the literature. This gap may be because fathers typically have shorter hair or may have male pattern baldness from the posterior vertex where hair cortisol is reliably sampled. Future work could investigate these

relationships longitudinally and in more socioeconomically diverse samples that include fathers.

In summary, this is one of the first studies to expand work on examining the relationship between sociodemographic factors and chronic stress, as measured by hair cortisol, in mothers and their toddlers living in poverty in the United States. We hope this research continues the important conversation on early childhood origins of stress and outcomes later in life and providing additional support to families with Black mothers or toddlers living in poverty.

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Table 1

Sample Demographics

	Total Sample *n* = 94	Mothers with valid hair cortisol *n* = 75	Toddlers with valid hair cortisol *n* = 71
Variable	**% or Mean**	**% or Mean**	**% or Mean**
Child sex female	54.3	56.0	53.5
Child age (months)[a]	22.6	22.7	22.6
Maternal age (years)[a]	28.5	28.7	28.3
Ethnicity			
Child Hispanic Latino	11.7	14.7	15.5
Mother Hispanic Latino	8.3	10.8	11.1
Child race			
Child Black/African American	43.0	40.5	37.1
Child White	55.9	56.8	61.4
Child American Indian/Alaskan Native	0.0	0.0	0.0
Child Asian	2.2	2.7	2.9
Child Other Race	0.0	0.0	0.0
Mother race			
Mother Black/African American	35.8	33.9	28.8
Mother White	55.6	56.5	62.7
Mother American Indian/Alaskan Native	2.5	1.6	1.7
Mother Asian	1.2	1.6	1.7
Mother Other Race	4.9	4.8	3.4
Parental marital status married	28.7	25.0	30.8
Maternal employment			
Full-time	39.1	38.2	40.0
Part-time	12.6	13.2	13.8
Self-employed	2.3	2.9	3.1
Out of work and looking for work	11.5	13.2	9.2
Unable to work	11.5	11.8	13.8
Out of work but not looking for work	5.7	7.4	6.2
Homemaker	18.4	19.1	15.4
Retired	0.0	0.0	0.0
Maternal education			
None	0.0	0.0	0.0
8th grade or less	3.5	4.5	4.8
Some high school, no diploma	10.6	9.1	7.9
High school graduate	36.5	39.4	42.9
Some college, no degree	36.5	33.3	30.2
AA or AS 2-year degree	4.7	4.5	6.3
Bachelor’s	8.2	9.1	7.9

	Total Sample *n* = 94	Mothers with valid hair cortisol *n* = 75	Toddlers with valid hair cortisol *n* = 71
Variable	**% or Mean**	**% or Mean**	**% or Mean**
Paternal education			
None	1.2	1.5	1.5
8th grade or less	3.6	4.4	4.6
Some high school, no diploma	25.0	20.6	24.6
High school graduate	47.6	48.5	44.6
Some college, no degree	13.1	13.2	10.8
AA or AS 2-year degree	3.6	2.9	4.6
Bachelors	6.0	5.9	6.2
Household income			
$10,000/year or less	31.4	29.9	34.4
$10,0001–20,000/year	26.7	29.9	21.9
$20,001–30,000/year	19.8	20.9	17.2
$30,001–40,000/year	3.5	4.5	4.7
$40,001–50,000/year	8.1	7.5	9.4
$50,001–60,000/year	4.7	0	4.7
$60,000 or more each year	5.8	7.5	7.8

Note. Demographics of those who provided hair. Mothers could select more than one race and employment status. Samples from those who participated in hair cortisol sampling and those with valid hair cortisol results.

[a] indicates that these are the only variables reported as means.

Table 2

Descriptive Data on Analytic Variables from Hair Sampling Participants (n = 94)

	n	%	Min	Max	Mean	SD
Dependent Variables						
Child stress						
HCC pg/mg	71		0.70	189.66	17.14	28.59
Log10 HCC	71		−0.16	2.28	0.89	0.55
Mother stress						
HCC pg/mg	75		0.10	31.26	6.18	7.04
Log10 HCC	75		−0.98	1.50	0.48	0.60
Independent Variables						
Child race (Black/African American)	93	43.0				
Mother race (Black/African American)	81	35.8				
Maternal education (high school graduate)	85	85.9				
Paternal education (high school graduate)	84	70.2				
Household poverty ratio	85		0.01	0.91	0.23	0.20
Maternal employment (not working)	87	43.7				
Economic hardship (severe)	85	52.9				
Marital status (not married)	87	71.3				
Child sex (female)	94	54.3				

Note. HCC = hair cortisol concentration.

Table 3

Pearson Correlations of Analytic Variables (n = 94)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Child chronic stress	--												
2. Mother chronic stress	.50**	--											
3. Child Black	.21^	.30**	--										
4. Mother Black	.19	.28*	.81**	--									
5. Mother high school grad	.09	.04	.08	.00	--								
6. Father high school grad	.02	−.09	−.06	−.17	.33**	--							
7. Poverty ratio	−.09	−.08	−.28*	−.21	.27*	.20^	--						
8. Severe economic hardship	.06	−.02	−.26*	−.27*	.02	.24*	.14	--					
9. Mother not working	−.16	−.26*	−.02	−.06	−.12	.02	−.23*	.07	--				
10. Mother not married	.08	.28*	.45**	.36**	−.04	−.12	−.16	−.17	.00	--			
11. Child female	.07	.08	.02	−.04	.16	−.08	−.08	−.16	−.12	.05	--		
12. Mother age	.07	.10	.05	−.13	.09	−.01	−.09	.07	.04	.06	−.06	--	
13. Child age	.05	.13	.09	.07	−.08	−.04	−.27*	.28**	.05	.06	.02	.01	--

Note. Stress is reported as the log10 hair cortisol (pg/mg) value. Age is from the time of hair sampling.

^ $p < .10$

* $p < .05$

** $p < .01$

Table 4

Independent Samples t-Tests for Differences in Chronic Stress by Dichotomous Sociodemographics

	Toddler Chronic Stress							Mother Chronic Stress						
	n	**Mean**	***t***	***p***	**Mean Difference**	***SE* Difference**	**Cohen's *d* [95% *CI*]**	***n***	**Mean**	***t***	***p***	**Mean Difference**	***SE* Difference**	**Cohen's *d* [95% *CI*]**
Toddler Race Black	26	1.04	1.85	.07^	0.24	0.13	0.43 [−.06, 0.92]	30	0.70	2.72	.01**	0.37	0.14	0.64 [0.16, 1.11]
Toddler Race not Black	44	0.80						44	0.33					
Mother race Black	17	1.01	1.48	.15	0.22	0.15	0.41 [−0.16, 0.98]	21	0.75	2.28	.03*	0.35	0.15	0.61 [0.07, 1.14]
Mother race not Black	42	0.79						41	0.40					
Mother HS grad	55	0.90	0.65	.53	0.16	0.24	0.28 [−0.47, 1.02]	57	0.47	0.52	.61	0.07	0.14	0.13 [−0.58, 0.83]
Mother not HS grad	8	0.74						9	0.39					
Father HS grad	43	0.88	0.18	.86	0.03	0.15	0.05 [−0.48, 0.58]	48	0.42	−0.72	.48	−0.12	0.17	−0.20 [−0.74, 0.34]
Father not HS Grad	20	0.86						18	0.54					
Severe economic hardship	34	0.90	0.44	.66	0.06	0.14	0.11 [−0.38, 0.60]	37	0.47	−0.13	.90	−0.02	0.15	−0.03 [−0.52, 0.45]
Less economic hardship	30	0.84						29	0.49					
Mother notworking	15	0.92	−1.26	.21	−0.18	0.14	−0.32 [−0.81, 0.18]	32	0.31	−2.18	.03*	−0.31	0.14	−0.53 [0.10, 1.22]
Mother working	50	0.87						36	0.62					
Not Married	45	0.91	0.56	.58	0.09	0.16	0.16 [−0.36, 0.69]	51	0.57	2.13	.04*	0.38	0.18	0.66 [−1.01, −0.04]
Married	20	0.82						17	0.19					
Toddler female	38	0.92	0.61	.54	0.08	0.13	0.15 [−0.32, 0.61]	42	0.52	0.70	.49	0.10	0.14	0.16 [−0.29, 0.61]
Toddler male	33	0.84						33	0.42					

Note. Equal variances not assumed. Following Cohen's (1988) guidelines, effect sizes for *d* of 0.2 ≈ small, 0.5 ≈ moderate, and 0.8 ≈ large.

^ $p < .10$

* $p < .05$

** $p < .01$ (Bonferonni corrections for five socioeconomic status variables = alpha level of .01)