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Exploring Direct and Intergenerational Effects of Discrimination on the Sleep Health of Pregnant Black American Women and Their Children

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Exploring Direct and Intergenerational Effects of Discrimination on the Sleep Health of Pregnant Black American Women and Their Children

By

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M.A., Emory University, 2019

Advisor: Patricia A. Brennan, Ph.D.

An abstract of
a dissertation submitted to the Faculty of the James T. Laney School of Graduate Studies of Emory University in partial fulfillment of the requirements for the degree of
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Abstract

Exploring Direct and Intergenerational Effects of Discrimination on the Sleep Health of Pregnant Black American Women and Their Children
By Madeleine F. Cohen

This dissertation explores the association between discrimination and poorer sleep health in pregnant Black American women and their young children. Consistent with an intersectionality framework, we expanded upon the racial/ethnic discrimination and sleep health literature by also examining pregnant Black American women's lifetime experiences of gendered racism as an additional discriminatory stress exposure variable. In Study 1, we investigated the association between pregnant Black American women's lifetime exposure to discrimination – using the Krieger Experiences of Discrimination measure and the Jackson, Hogue, Phillips Contextualized Stress measure – and their self-reported sleep quality – using the Patient Reported Outcomes Measurement Information System Sleep Disturbance Short Form – during the first and second trimesters of pregnancy. Greater lifetime exposure to racial/ethnic discrimination or gendered racial stress was associated with poorer sleep quality at both timepoints in pregnancy, even when we statistically controlled for women's concurrent prenatal depressive symptomatology – using scores from the Edinburgh Postnatal Depression Scale. In Study 2, we employed an intergenerational study design informed by the life course approach to development. We explored whether pregnant Black American mothers' lifetime exposure to discrimination was associated with maternal reports of poorer sleep health in their two-year-old children, and whether these associations were mediated by women's prenatal sleep quality and/or depressive symptoms. We found partial support for our proposed model, in that greater lifetime exposure to racial/ethnic discrimination was indirectly associated with poorer sleep health in two-year-old children – as measured by the Children's Sleep Habits Questionnaire, Abbreviated – via women's prenatal depressive symptomatology. In contrast, higher levels of lifetime exposure to gendered racism were directly associated with poorer sleep health in women's two-year-old children. Taken together, efforts to mitigate the harmful interpersonal effects of racism and gendered racism on Black American women may benefit their sleep quality during pregnancy and the sleep health of their two-year-old children. Findings from the current dissertation highlight the need to consider important contextual factors such as exposure to discrimination when examining maternal child health outcomes.

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General Introduction

Sleep health is a multidimensional construct that has clinical implications for the global health and wellbeing of both children and adults (Buysse, 2014). For instance, optimal sleep is associated with improved cardiometabolic, social emotional, and cognitive functioning (Alvaro et al., 2013; Luyster et al., 2012). Despite cross-cultural variations in sleep practices (Jenni & O'Connor, 2005), sleep is a universal phenomenon that transcends culture and is integral to the human experience. As humans, it is estimated that we spend one third of our lives in a state of sleep (Carskadon & Dement, 2011). Human sleep health is multiply determined and can be measured in terms of quality (i.e., how "good" one's sleep is), duration (e.g., nocturnal length), timing (i.e., time of day when sleep occurs), efficiency (e.g., night wakefulness), and daytime functioning (e.g., napping behavior; Buysse, 2014). Notably, optimal sleep health is not equally distributed across the population. In the United States, Black American adults (Durrence & Lichstein, 2006; N. J. Williams et al., 2015), perinatal women (Swanson et al., 2020) and children (Guglielmo et al., 2018; Smith et al., 2019) report and experience poorer sleep health than white Americans even after adjusting for differences in socioeconomic status (SES). This racial/ethnic disparity in sleep health suggests that the lived experience associated with being Black in the United States may hold negative consequences for sleep at multiple points throughout the life course, from pregnancy to early childhood and beyond. Compared to their white counterparts, Black American children and adults are disproportionately exposed to racial/ethnic discrimination (D. R. Williams, Lawrence, Davis, et al., 2019), leading researchers to consider interpersonal exposure to discrimination as a potential contributor to the poor sleep health observed among Black American individuals.

Associations between higher levels of interpersonal exposure to racial/ethnic discrimination and poorer sleep health are well-established among non-pregnant Black American adults (Slopen et al., 2016), but these associations have received limited research attention within samples of pregnant Black American women and their young children. Sleep is a transdiagnostic marker of health and wellbeing in both pregnant women and young children: enhanced sleep health during pregnancy is associated with lower levels of depressive symptoms (L. M. Tomfohr et al., 2015) and better infant health outcomes, such as a lower risk of preterm birth (Okun et al., 2011). Similarly, optimal sleep health in infancy and toddlerhood is associated with better cognitive and social emotional functioning (Mindell et al., 2017; Page et al., 2018) which is predictive of improved health outcomes across the lifespan.

Pregnancy constitutes a critical period during which health risks may be transmitted across two generations. Parallel evidence from the literature on racial/ethnic disparities in maternal and infant mortality underscores the importance of considering the unique life stressors experienced by Black American women (e.g., racial/ethnic discrimination, gendered racism) and the negative effects that these stressors may hold for maternal/child health outcomes (Giscombé & Lobel, 2005). With this in mind, in the current dissertation study, we are interested in examining whether Black American women's exposure to racial/ethnic discrimination and/or gendered racism across the life course may "get under the skin" and have negative bearing on (1) their own sleep quality during pregnancy and (2) the sleep health of their two-year-old children, at least partly via prenatal pathways of transmission.

Racial/Ethnic Discrimination

Racial/ethnic discrimination is an unfair and targeted pattern of treatment and behavior that pointedly affects the members of a specific racial/ethnic group, typically individuals who

may be classified as members of a racial/ethnic minority (D. R. Williams, Lawrence, Davis, et al., 2019). While racial/ethnic discrimination undoubtedly has detrimental effects on individuals belonging to multiple racial/ethnic groups, the focus of the current dissertation study is on the lived experiences of Black American individuals, given marked Black/white disparities in sleep health that persist across levels of age and SES (Guglielmo et al., 2018; Johnson et al., 2019; Smith et al., 2019).

Williams and colleagues (2019) offer a helpful conceptual model to explain the ways in which higher levels of exposure to racial/ethnic discrimination are associated with poorer health outcomes. In their model, "The House that Racism Built" (p. 1376), the authors assert that racism is an overarching, harmful, and particularly insidious dogma that, in the United States, situates white individuals at a markedly higher level of social status than Black American members of society. The authors explain that racism exerts harmful effects on Black American individuals' health and wellbeing through three intertwined pathways: cultural racism, institutional racism, and interpersonal discrimination. The latter pathway is the focus of the current dissertation study, but it is important to briefly understand how the former pathways allow for interpersonal discrimination to take hold. Broadly, cultural racism is a pervasive perspective that serves to maintain and propagate stereotypes (i.e., rigid, negative, and widely held beliefs about a specific group). Cultural racism spreads rampantly and informs institutional racism. In turn, institutional racism engenders political and economic policy measures that unfairly restrict and/or eliminate Black American individuals' opportunities for social advancement. A primary example of institutional racism is residential segregation (D. R. Williams, Lawrence, Davis, et al., 2019). The interactive effects of cultural and institutional racism are far-reaching and felt at the individual level, via interpersonal exposure to repeated

instances of racial/ethnic discrimination. Interpersonal discrimination occur between individuals, and may be deliberate or unintentional and the product of unconscious biases (D. R. Williams, Lawrence, & Davis, 2019). These interactions are rooted in cultural stereotypes, and result in unfair treatment of one member of the interaction based on their perceived – by others – race, ethnicity, and/or skin color. Such interactions may occur repeatedly across multiple settings (e.g., in a medical setting, in a store, at school, at work, in a social setting, etc.; Krieger et al., 2005). In sum, these interpersonal exposures form the basis of the association between racial/ethnic discrimination and health outcomes, including sleep health.

Gendered Racism

Black American women hold multiple, interrelated identities, including, but not limited to their racial/ethnic identity and their gender identity (Bowleg, 2012; Crenshaw, 1991). The concept of intersectionality posits that the lived experience associated with being a Black woman in America confers both unique strength and vulnerability. In terms of vulnerability, Black American women are at risk of interpersonal exposure to both racial/ethnic discrimination and sexism. Intersectionality theorists assert that these stress exposures occur simultaneously and may be better characterized as an interlocking construct known as gendered racism (Essed, 1991). Researchers have recommended that studies examining associations between Black American women's interpersonal exposure to racial/ethnic discrimination and their health outcomes should also include women's exposure to gendered racism as an additional predictor variable, given its particular salience for this population (J. A. Lewis et al., 2017). To our knowledge, no study to date has examined associations between pregnant women's lifetime exposure to gendered racism and their sleep quality during pregnancy or the sleep health of their children. As such, in our review of the extant literature on discrimination and sleep health, we

focus on evidence for associations between racial/ethnic discrimination and sleep health, rather than evidence for associations between gendered racism and sleep health. Consistent with recommendations to incorporate an intersectionality conceptualization in studies of discrimination and sleep health (Johnson et al., 2019), in the current dissertation study, we broaden the operational definition of discrimination and include measures of both racial/ethnic discrimination and gendered racism as our predictor variables. This methodological approach emphasizes intersectionality and allows us to better tap Black American women's unique lived experiences and exposure to multiple aspects of discriminatory stress. This novel approach will allow us to better understand the ways in which racism *and* gendered racism are associated with the sleep health of pregnant Black American women and their children.

Pathways Linking Discrimination and Sleep Health

Elevated exposure to discrimination may result in poorer sleep health via several potential cognitive and physiological pathways. Although these pathways are not the focus of the current dissertation study, we describe them here to provide the larger context for our research questions. One pathway by which discrimination might negatively affect sleep health is through increased vigilance to threat. More specifically, Black American individuals who (1) are themselves exposed to repeated instances of interpersonal discrimination and/or (2) who anticipate being exposed to discriminatory situations based on the modal experiences of others in their community may develop a sense of "racism-related vigilance" (Hicken et al., 2013). This anticipation of threat (i.e., discrimination) may hold negative implications for sleep health via both cognitive and physiological processes. Cognitively, individuals who are subjected to more frequent and chronic racial/ethnic discrimination may experience increased worry or rumination in anticipation of and/or in response to harmful events (Beatty et al., 2011). Importantly,

rumination precludes restful sleep among both the general adult population (Alvaro et al., 2013; Kahn et al., 2013) and pregnant women (Kalmbach, Cheng, Ong, et al., 2020; Kalmbach, Roth, et al., 2020). Physiologically, chronic exposure to racial/ethnic discrimination is associated with higher nighttime blood pressure among Black American adults (D. R. Williams, Lawrence, Davis, et al., 2019), which is itself a physiological risk factor for poor sleep health. In sum, greater cumulative exposure to discrimination may predispose individuals to be at greater risk of developing certain cognitive and physiological features that inhibit healthy sleep.

Associations Between Women's Lifetime Exposure to Discrimination and Sleep Health During Pregnancy

Understanding associations between greater lifetime exposure to racial/ethnic discrimination or gendered racial stress and poorer maternal-child sleep health is particularly important during pregnancy. Poor sleep health during pregnancy is associated with higher levels of psychological distress both during pregnancy itself and in the postpartum period (L. M. Tomfohr et al., 2015), which in turn is linked to a myriad of poor health outcomes for both mothers and infants. Maternal and child health outcomes are intricately linked during gestation. As an example of this, poorer sleep health during pregnancy is associated with a greater likelihood of preterm birth (Okun et al., 2011), a phenomenon that is disproportionately more common among Black versus white American women (Behrman & Butler, 2007). Taken together, women's sleep health during pregnancy has clinical implications for maternal health outcomes that set the stage for the later health and development of their children.

To date, the literature examining sleep health during pregnancy has been limited in terms of both sample and measurement selection. The vast majority of research on prenatal sleep health has examined associations between expectant mothers' anxiety symptoms, depressive symptoms,

and/or stress and their sleep health during pregnancy, and this research has primarily been conducted in samples of white pregnant women (Swanson et al., 2020). Collectively, these findings suggest that heightened psychological distress is associated with poorer sleep health during pregnancy, but they are limited in terms of generalizability. The extant work on sleep health during pregnancy does not particularly capture the unique lived experiences of Black American women, first, because Black American women are rarely and/or sparingly included in study samples (Swanson et al., 2020), and second, because the metrics of psychological distress that are employed tend to be agnostic to racial stressors. Compared to white women, throughout their lifetimes (i.e., both prior to and during pregnancy), Black American women are more likely to experience racial/ethnic discrimination (Canady et al., 2008; Ertel et al., 2012) and gendered racism (Bowleg, 2012; Crenshaw, 1991).

To our knowledge, only one study to date has investigated associations between Black American expectant mothers' lifetime exposure to racial/ethnic discrimination and their prenatal sleep quality (Francis et al., 2017). The authors found support for this association when both discrimination and sleep were measured in the same trimester of pregnancy but failed to find support for an association between these constructs when discrimination was measured at an earlier timepoint in pregnancy than sleep quality, suggesting that these associations may not hold across gestation.

Sleep health is typically compromised throughout much of pregnancy, irrespective of women's racial/ethnic background (Mindell et al., 2015). However, studies of sleep health during pregnancy that enroll women of various racial/ethnic backgrounds indicate that Black American women have poorer sleep health than women who self-identify as white (Feinstein et al., 2020). The unique contextual stress associated with the lived experience of being a Black woman in

America may hold additional poor implications for women's sleep health during pregnancy, which suggests a need for feasible and tailored prenatal sleep interventions. To further understand who may benefit from such interventions, we propose studying associations between racial/ethnic discrimination and sleep health within a sample comprised of pregnant Black American women (i.e., with no racial/ethnic comparison group). There are several studies of prenatal sleep health that include Black American women within the larger study sample (Blair et al., 2015; Christian et al., 2019; Francis et al., 2017). These studies are informative, as they make comparisons in prenatal sleep health *across* racial/ethnic minority groups and have the potential to uncover sleep health disparities. However, we must also investigate variability in prenatal sleep health *within* pregnant Black American women (Johnson et al., 2019). Doing so will permit us to better understand the risk factors that are associated with poor prenatal sleep health within this unique population of women. The current study is designed as a minority health study with these goals in mind.

Associations Between Women's Lifetime Exposure to Discrimination and Early Childhood Sleep Health

In addition to understanding associations between Black American women's lifetime exposure to racial/ethnic discrimination or gendered racial stress and their own sleep health during pregnancy, we are interested in understanding whether and how Black American women's lifetime exposure to racial/ethnic discrimination or gendered racial stress may "get under the skin," and be associated with their two-year-old children's sleep health. Black/white sleep health disparities emerge as early as two years of age (Smith et al., 2019) and persist into later childhood (Guglielmo et al., 2018). These sleep health disparities may be tied to contextual factors such as family SES and/or neighborhood quality (Grimes et al., 2019). However,

knowledge of the life course perspective on maternal child health outcomes (Braveman, 2014; Lu et al., 2010) urges us to consider the possibility that maternal stress exposures that occur both prior to and during a woman's pregnancy may also influence the sleep health of her children via intergenerational risk pathways.

The life course perspective asserts that greater maternal stress during pregnancy programs risk for a child's health and wellbeing, and also that maternal stress and adversity (e.g., racial/ethnic discrimination, gendered racism) experienced earlier in a mother's life, even prior to pregnancy, may have bearing on the health of her offspring. Thus far, researchers that employ this framework have largely focused on understanding how Black American women's lifetime exposure to discrimination is associated with child health outcomes in the neonatal period (see Heard-Garris et al., 2018 for a review). It remains to be seen whether and how Black American women's exposure to discrimination is associated with additional aspects of children's health in the early years of life, including sleep health. Early childhood sleep health is a transdiagnostic marker of pediatric health. For instance, optimal early childhood sleep health is concurrently associated with better social emotional functioning (Mindell et al., 2017), and prospectively associated with better school performance (K. E. Williams et al., 2016) and better sleep health later in childhood (K. E. Williams et al., 2017). Utilizing the life course perspective to understand factors that may promote early life sleep health will benefit both children's sleep health and their overall psychological wellbeing and development.

To our knowledge, only one study to date has explored associations between pregnant women's lifetime exposure to racial/ethnic discrimination and the sleep health of their young children (Powell et al., 2020). Powell and colleagues demonstrated that pregnant women who reported greater lifetime exposure to racial/ethnic discrimination also reported shorter sleep

duration in their six-month-old infants. The authors did not find evidence of significant associations between these constructs when children were two years old, however, the study had several limitations, including the use of sleep duration as an outcome variable. Variation in sleep duration is typical in the first years of life (Carskadon & Dement, 2011), and examining associations between mothers' exposure to discrimination and children's overall sleep health may provide more clinically relevant information. The authors called for researchers to replicate and extend their work to additional samples of racially/ethnically diverse women and their children to better understand how mothers' exposure to discrimination prior to conception and pregnancy affects children's sleep health. The lack of research focused on associations between women's exposure to racial/ethnic discrimination or gendered racial stress and early childhood sleep health stands in contrast to a number of studies that investigate associations between pregnant women's psychological distress more generally (e.g., anxiety, depression, stress) and early childhood sleep health (Kim et al., 2020; Morales-Muñoz et al., 2018; O'Connor et al., 2007). Women's experiences of psychological distress during pregnancy do not occur in isolation, but likely reflect the accumulation of relevant contextual stressors that occur throughout women's lives, such as repeated exposure to interpersonal discrimination (Behrman & Butler, 2007; Giscombé & Lobel, 2005; Dunkel Schetter, 2011). Therefore, in the current study, we aim to replicate and extend the findings of Powell and colleagues (2020), by examining direct associations between Black American women's lifetime exposure to racial/ethnic discrimination or gendered racial stress and their children's sleep health at age two. Examining children's sleep health at age two will be informative, as racial/ethnic disparities in sleep emerge as early as two years of life (Guglielmo et al., 2018).

The Current Dissertation

The current dissertation study consists of two prospective, longitudinal studies that examine associations between pregnant Black American women's lifetime exposure to racial/ethnic discrimination or gendered racial stress and (1) their sleep quality in pregnancy and (2) the sleep health of their two-year-old children. Study 1 focuses on the sleep health of pregnant women, by examining associations between women's lifetime exposure to discrimination and their own sleep quality during the first and second trimesters of pregnancy. Study 2 builds upon Study 1, and we apply a life course perspective to understand whether women's lifetime exposure to discrimination is associated with the sleep health of their two-year-old children. The extant literature on discrimination and sleep health has, to date, focused on direct associations between these constructs among non-pregnant adults and children (Slopen et al., 2016). The current dissertation study instead emphasizes that pregnancy is a critical period when the risks of discrimination may be transmitted across two generations. We examine the direct effects of women's exposure to discrimination on their own prenatal sleep quality, and the intergenerational effects of women's exposure to discrimination on their young children's sleep health. Findings from the current dissertation study may inform clinical intervention research that seeks to optimize Black American women's sleep health during pregnancy, and the sleep health of their children.

Discrimination is Associated with Poor Sleep Quality in Pregnant Black American Women

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Abstract

Heightened exposure to racial/ethnic discrimination is associated with poorer sleep health among non-pregnant adults. This relationship has received limited research attention among pregnant women, despite the importance of prenatal sleep quality for optimal maternal and child health outcomes. We utilized perinatal cohort data from a sample of Black American women (n = 600) who made retrospective reports of their lifetime experiences of racial/ethnic discrimination and gendered racial stress during early pregnancy and reported on their sleep quality and depressive symptoms during early and mid-pregnancy. Hierarchical multiple linear regression models were fit to examine concurrent and prospective associations between lifetime experiences of racial/ethnic discrimination or gendered racial stress and sleep quality during early and mid-pregnancy. We also adjusted for women's concurrent depressive symptoms and tested whether the discrimination/sleep quality association varied by socioeconomic status. Greater exposure to racial/ethnic discrimination was associated with poorer sleep quality during early ($\Delta R^2 = 0.04$, $\Delta F = 26.08$, $p < 0.001$) and mid-pregnancy ($\Delta R^2 = 0.02$, $\Delta F = 9.88$, $p = 0.002$). Similarly, higher levels of gendered racial stress were associated with poorer sleep quality during early ($\Delta R^2 = 0.10$, $\Delta F = 65.72$, $p < 0.001$) and mid-pregnancy ($\Delta R^2 = 0.06$, $\Delta F = 40.43$, $p < 0.001$). These findings largely held after adjustment for concurrent prenatal depressive symptoms. Socioeconomic status did not modify the observed associations. Efforts to decrease interpersonal experiences of racial/ethnic discrimination and gendered racism would benefit the sleep quality of pregnant Black American women, particularly during early pregnancy.

Discrimination is Associated with Poor Sleep Quality in Pregnant Black American Women

Black American adults experience poorer sleep health than their White counterparts (Johnson et al., 2019). Unexpected differences in sleep health that systematically and adversely affect historically marginalized individuals are known as sleep health disparities (C. L. Jackson et al., 2020). Sleep health disparities are the likely product of longstanding exposure to psychosocial stressors, such as racial/ethnic discrimination. Indeed, Black American adults are disproportionately exposed to racial/ethnic discrimination (Horowitz et al., 2019), and chronic racial/ethnic discrimination is concurrently, and in some cases, prospectively associated with poor sleep health among adults (Slopen et al., 2016). Heightened exposure to racial/ethnic discrimination may confer risk for poor sleep health via several pathways. Potential mechanisms of transmission include greater likelihood of exposure to environmental living conditions that negatively affect sleep health (e.g., pollution, noise, ambient lighting) among racial/ethnic minorities as a consequence of institutional racism (e.g., housing segregation; Hale et al., 2015; Johnson et al., 2018). In addition, individuals subjected to repeated instances of interpersonal and/or institutional discrimination may develop a sense of "racism-related vigilance" (Hicken et al., 2013) or hyperarousal, to subsequent threat. Such anticipatory anxiety may manifest cognitively as rumination (Beatty et al., 2011), which is positively associated with poorer sleep in both non-pregnant (Kahn et al., 2013) and pregnant individuals (Kalmbach, Cheng, Ong, et al., 2020; Kalmbach, Roth, et al., 2020).

Associations Between Women's Lifetime Exposure to Discrimination and Sleep Health During Pregnancy

To date, empirical evidence for direct associations between racial/ethnic discrimination and sleep health has largely been restricted to the non-pregnant population. However, examining

concurrent and prospective associations between these constructs among Black American adults may be particularly important during pregnancy. First, consistent with an intersectionality framework (Bowleg, 2012; Crenshaw, 1991), pregnant Black American women hold multiple, overlapping social identities including, but not limited to, their racial/ethnic and gender identities. Associations between discrimination and sleep health within this group of pregnant women may reflect women's exposure to different, but interrelated interpersonal stressors, including both racial/ethnic discrimination and gendered racial stress. Second, poor sleep quality during pregnancy is associated with systemic inflammation, with pregnant Black American women noted to have a greater inflammatory response to sleep disturbance than their white counterparts (Blair et al., 2015). Notably, this sleep-induced inflammatory profile is associated with a greater odds of preterm birth (Okun, 2019; Okun et al., 2011). Poor sleep health during pregnancy is linked with adverse birth outcomes, particularly among Black American women, who may be unfairly exposed to significant psychosocial stress by nature of their intersectional identities. Fortunately, prenatal sleep health is modifiable and responds well to clinical intervention (Bei et al., 2020; Kalmbach, Cheng, O'Brien, et al., 2020; Lee et al., 2016; Manber et al., 2019). Examining associations between racial/ethnic discrimination and gendered racial stress and modifiable health behaviors such as sleep quality is critical in addressing health disparities and improving health outcomes for those unjustly exposed to adversity.

Recent calls for research highlight a "critical need…[to understand] the role of racial disparities and systemic racism" on sleep health during pregnancy (Swanson et al., 2020). While several studies have examined racial/ethnic disparities in prenatal sleep quality (Christian et al., 2019; Feinstein et al., 2020), to our knowledge, only one study has investigated relevant predictors of prenatal sleep quality (e.g., discrimination experiences) within this research

framework. Francis and colleagues (2017) uncovered positive, concurrent associations between everyday experiences of racial/ethnic discrimination and poorer prenatal sleep quality in a sample of pregnant Black American women. The authors did not find evidence for prospective associations between these constructs; however, the prospective analyses could only be examined in a subset of their sample (n = 133 of N = 640), which may have decreased statistical power to detect effects. As this was the first study of its kind, it remains unclear whether greater experiences of racial/ethnic discrimination are both concurrently associated with poor sleep quality in early pregnancy, as well as prospectively associated with poor sleep quality later in gestation. Poor sleep quality in early pregnancy is associated with an increased risk of preterm birth (Okun et al., 2011), and poor sleep quality in late pregnancy is additionally associated with greater risk of preterm birth, longer labor, and a greater likelihood of caesarean delivery (Lee & Gay, 2004; Micheli et al., 2011). The current study design will allow us to examine both concurrent and prospective associations between discrimination and sleep quality during pregnancy in a sample with sufficient statistical power. In addition, because pregnant Black American women are exposed to additional stressors as a function of their gender, their race/ethnicity, and the interaction between these related identities (Bowleg, 2012; Crenshaw, 1991), we will also examine concurrent and prospective associations between gendered racial stress and sleep quality during pregnancy. This intersectionality framework has been recommended in studies of sleep health (Johnson et al., 2019), but has not yet been applied to studies of sleep health during pregnancy.

Discrimination, Depressive Symptoms, and Sleep Quality in Pregnancy

The majority of studies that examine heightened exposure to racial/ethnic discrimination as a predictor of poor sleep quality include depressive symptoms in predictive models (Slopen et

al., 2016). This is important, as sleep disturbances often predate and/or co-occur with depressive symptomatology (Alvaro et al., 2013), so much so that they are listed as a core diagnostic feature of clinical depression (American Psychiatric Association, 2013). Including depressive symptoms in statistical models allows researchers to determine whether greater lifetime exposure to racial/ethnic discrimination is associated with poor sleep quality beyond concurrent symptoms of depression. This is particularly relevant during pregnancy, when prevalence rates of depression range from 12 – 27% (Ponting et al., 2020). Francis and colleagues controlled for depressive symptoms in their models, but they reported only unadjusted findings (i.e., without depressive symptoms added to the models; Francis et al., 2017), making it difficult to determine how much of the variance in expectant mothers' sleep quality may have been accounted for by their current depressive symptoms. Therefore, in the current study, we will adjust for mothers' current depressive symptoms when examining racial/ethnic discrimination and gendered racial stress as predictors of sleep quality during pregnancy.

Considering Socioeconomic Status as a Moderator in the Link Between Discrimination and Sleep Quality Among Pregnant Black American Women

Consistent with recommendations to utilize an intersectionality framework in studies of sleep health (Johnson et al., 2019), racial/ethnic discrimination and gendered racial stress may have differential effects on the sleep health of pregnant Black American women at different levels of socioeconomic status (SES). The literature on sleep health among pregnant Black American women is underdeveloped (Swanson et al., 2020); as such, to date, SES has not been examined as a moderator in the association between racial/ethnic discrimination/gendered racial stress and sleep quality. However, findings from the non-pregnant adult literature suggest that

the association between racial/ethnic discrimination and sleep health may be stronger among Black American adults of higher SES.

For instance, sampling a large, population-based cohort, Johnson and colleagues demonstrated that associations between psychological distress and short sleep duration were strongest among Black Americans who received a college education or higher (Johnson, Lisabeth, Lewis, et al., 2016). The "diminishing returns" hypothesis suggests that Black American individuals of higher SES may experience greater discrimination, which may confer greater risk for poorer health outcomes, such as sleep (Farmer & Ferraro, 2005). This effect may occur because high social position predicts recurrent interactions with members of the socially powerful racial/ethnic group (i.e., whites), thus increasing exposure to potential discrimination. An increase in these interactions may concurrently result in more frequent anticipation of being discriminated against. Consistent with prior research (C. L. Jackson et al., 2013; Johnson, Lisabeth, Hickson, et al., 2016), we hypothesize that the association between racial/ethnic discrimination or gendered racial stress and sleep quality will be stronger among pregnant Black American women of higher SES.

The Current Study

The current study seeks to (1) examine associations between discrimination and sleep quality both concurrently and prospectively across pregnancy among Black American women, and (2) to do so within a framework that acknowledges the importance of intersectional identities in shaping health outcomes. We will also investigate the roles of self-reported depressive symptoms and socioeconomic status in these associations. Our use of an exclusively Black American sample of pregnant women aligns with calls for within-racial/ethnic group studies on

sleep health(Johnson et al., 2019). Such study designs allow us to better understand how the unique lived experiences of a given racial/ethnic group may influence health outcomes.

Method

Participants

The current study constitutes a secondary data analysis of a prospective, longitudinal cohort study (the Prenatal Study; 5R01NR014800-02) that has been described in detail (Corwin et al., 2017). Recruitment for the Prenatal Study is ongoing and resulted in a sample of n = 600 pregnant women available for current study analyses. All procedures were performed in accordance with the ethical standards of the Institutional Review Board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Healthy, pregnant women were recruited from prenatal clinics affiliated with two large hospitals – one private, one public – in a Southeastern city of the United States to participate in a study investigating the impacts of prenatal stress and environmental exposures on maternal and child health (Corwin et al., 2017). Inclusion criteria for enrollment in the Prenatal Study were as follows, Black/African American race/ethnicity and born in the United States (by self-report), singleton pregnancy, fluency in English, maternal age 18-40 years, and the absence of diagnoses of chronic health conditions (e.g., hypertension, diabetes) or chronic prescription medication use.

Procedure

Data were directly collected from study participants twice: once between eight- and 14-weeks' gestation (M = 11.16 weeks, SD = 2.25) and once between 24- and 30-weeks' gestation (M = 26.59 weeks, SD = 2.73). Data analyzed for the current study were collected between February 2014 and February 2021. At the first Prenatal Study visit (early pregnancy), women provided sociodemographic information, retrospectively reported on their lifetime experiences of

racial/ethnic discrimination and gendered racial stress and reported on their current sleep quality and current depressive symptoms. At the second Prenatal Study visit (mid-pregnancy), women were asked to repeat the sleep quality and depressive symptom self-report measures.

Measures

Lifetime Experiences of Racial/Ethnic Discrimination and Gendered Racial Stress

At the first Prenatal Study visit, women retrospectively reported on their lifetime exposure to racial/ethnic discrimination using the *Experiences of Discrimination* (EOD) measure (Krieger et al., 2005). Women also reported on their experiences of gendered racial stress using the *Jackson, Hogue, Phillips Contextualized Stress* (JHP) measure (F. M. Jackson et al., 2005).

EOD. The EOD asks participants to respond (yes/no) to the following question: "*Have you ever experienced discrimination, been prevented from doing something, or been hassled or made to feel inferior in any of the following [nine] situations (i.e., at school, getting hired/getting a job, at work, getting housing, getting medical care, getting service at store/restaurant, getting credit/bank loans/mortgage, in public, with police/in courts) because of your race, ethnicity, or color?*"

Women's responses on the EOD are limited to what they are willing to disclose, and do not necessarily represent the full range of discriminatory experiences. No items on the EOD reference sleep quality. Responses were summed to result in a total score (range = 0-9). This score is considered reliable and valid: it has good internal consistency, good test-retest reliability over a month timespan, and good convergent validity with other self-report measures of discrimination (Krieger et al., 2005). This measure of racial/ethnic discrimination has previously been used in work investigating pregnant Black American women's exposure to discrimination

as a predictor of psychological outcomes (Ertel et al., 2012; Hendrix et al., 2021; Powell et al., 2020). Internal consistency in the current study sample was good: Cronbach's α = 0.83.

JHP. The lived experience of Black American women is shaped by *both* racial/ethnic identity and gender identity (Crenshaw, 1991; T. T. Lewis & Van Dyke, 2018). As such, Black American women may be exposed to both racial/ethnic discrimination and gender-based discrimination, and these constructs are not wholly separable. The JHP is a 39-item self-report measure that assesses Black American women's gendered racial stress. Participants indicated whether statements broadly described their lived experience (0 = Strongly Agree, 1. = Agree, 2 = Unsure, 3 = Disagree, 4 = Strongly Disagree). Participants were not provided with a time anchor. Statements include, "*Everyone expects me to be strong for them*," "*As an African American woman, I can withstand great pressure*," "*Racism is a problem in my life*," and "*I have to work harder than White women to earn recognition*." The JHP is comprised of five subscales: burden, coping, racism, personal history, and work. Subscale scores are summed to result in a total summary score (range = 43-159). We tested current study hypotheses using summary scores from the JHP as a predictor variable, as we did not have a priori predictions about any particular subscale and wanted to tap the full construct of gendered racial stress. The JHP was developed via qualitative interviews with *n* >/= 400 women in metropolitan Atlanta, and has good convergent validity with self-report measures of anger, depressive symptoms, and anxiety (F. M. Jackson et al., 2005). In the current study sample, internal consistency for the JHP total summary score was good: Cronbach's α = 0.84.

Prenatal Sleep Quality

At both Prenatal Study visits, women reported on their sleep quality in the past week using the *Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep*

Disturbance Short Form (Yu et al., 2011). The PROMIS is a validated measure comprised of eight items that assess sleep quality (e.g., "*My sleep was restless*."). No items directly reference mood symptoms or stress. Participants were asked to decide whether statements described their sleep quality (1 = not at all, 2 = a little bit, 3 = somewhat, 4 = quite a bit, 5 = very much). Responses were summed to compute a total continuous raw score (range = 8 – 40); higher scores indicate worse sleep quality. These continuous scores were used as our outcome measure in current study analyses. The PROMIS has high internal consistency and good convergent validity with other measures of sleep quality (Buysse et al., 1989; Yu et al., 2011) and has previously been used in samples of perinatal women (Bei et al., 2020; Mersky et al., 2019). In the current study sample, internal consistency for the PROMIS was good to excellent (early pregnancy Cronbach's $\alpha = 0.90$; mid-pregnancy Cronbach's $\alpha = 0.89$).

Prenatal Depressive Symptoms

Also at both Prenatal Study visits, women's current depressive symptoms were assessed using summary scores from the *Edinburgh Postnatal Depression Scale* (EPDS; Cox et al., 2002). Participants indicated whether ten statements referencing low mood, suicidality, anhedonia, and stress described them within the past week. One item on the EPDS directly references sleep and fatigue ("*I have been so unhappy that I have had difficulty sleeping*.") and was removed from all analyses to avoid methodological overlap, resulting in a total of nine EPDS items. Scores on the EPDS range from zero to 30. In the current study sample, internal consistency for the 9-item scale was good: Cronbach's $\alpha = 0.83$ (early pregnancy), 0.86 (mid-pregnancy).

Socioeconomic Status

At the first Prenatal Study visit, women provided their highest education level and their income. Because socioeconomic status (SES) is best captured by multiple factors rather than a

single variable (Oakes & Rossi, 2003) we operationalized SES as the average of standardized measures of education and income. This methodological approach is consistent with previous discrimination and sleep health research (Cheng et al., 2020; Gaston et al., 2020; Grandner et al., 2010).

Covariates

At the first Prenatal Study visit, women also provided their age, prenatal body mass index (BMI) was calculated from measured height and weight, and gestational weeks of pregnancy were determined from the clinical record (based on last menstrual period in combination with obstetrical ultrasound according to accepted clinical standards; (Pettker et al., 2017). We selected these covariates because of their known associations with prenatal sleep quality: older age, higher BMI, and older gestational age are associated with poorer sleep quality (Feinstein et al., 2020; Sedov et al., 2018). Adjusting for these variables allowed us to better isolate the role of racial/ethnic discrimination and gendered racial stress as predictors of sleep quality in pregnancy.

Data Analytic Plan

Preliminary Analyses

All analyses were performed using IBM SPSS version 27.0 (IBM Corp, 2019). Statistical significance was set at a two-sided *p*-value of < 0.05. A priori power analyses using G*Power (Faul et al., 2007) revealed that a sample size of $n = 395$ was needed to detect small effects (Cohen's $f^2 = 0.02$; $\alpha = 0.05$; $1 - \beta = 0.80$; number of tested predictors = 1; total number of predictors = 5). All participants ($N = 600$) in the current study sample completed the measure of experiences of racial/ethnic discrimination. Of these women, $n = 597$ completed the measure of gendered racial stress. Most women ($n = 595$) completed the sleep quality measure at the first

Prenatal Study visit, and n = 406 women completed the sleep quality measure at the second Prenatal Study visit.

We examined our data for missingness in compliance with the Journal Article Reporting Standards (JARS) for Research in Psychology (Appelbaum et al., 2018). To determine whether our data were Missing Completely at Random (MCAR), Missing at Random (MAR), or Missing Not at Random (MNAR) we dummy-coded variables to signify whether participants were missing data on study variables at the first and/or second Prenatal Study visits. Next, we conducted Independent Samples T-tests and Chi-Squared tests to determine whether missingness was associated with predictor, outcome, and/or sociodemographic variables. Finally, missing data were multiply imputed using the multiple imputation package in SPSS. All results reported in the text and tables are based on the imputed data.

Primary Analyses

We plotted standardized residuals against standardized predicted values to inspect for linearity, homoscedasticity, and normality and examined our data for influential outliers. We used the PROCESS macro in SPSS (A. F. Hayes, 2016) to test our moderation hypothesis.

To test our primary hypothesis, the experiences of racial/ethnic discrimination score was evaluated as a predictor of women's sleep quality at eight – 14 weeks gestation and 24 – 30 weeks gestation, in two separate regression models. Next, the gendered racial stress score was evaluated as a predictor of women's maternal sleep quality at eight – 14 weeks gestation and 24 – 30 weeks gestation, also in two additional separate regression models. We first performed simple linear regressions to test all four associations, and then adjusted for covariates (i.e., women's age, prenatal body mass index (BMI), gestational weeks of pregnancy, prenatal depressive symptoms) in subsequent models.

We used the PROCESS macro in SPSS (A. F. Hayes, 2016) to test our third study hypothesis. As before, we tested racial/ethnic discrimination and gendered racial stress as individual predictor variables in separate models. SES was entered as the moderator variable in all models. Women's sleep quality in either early or mid-pregnancy was entered as the outcome variable. This resulted in a total of four separate PROCESS models. Women's age, prenatal BMI, gestational weeks of pregnancy (in either early or mid-pregnancy), and depressive symptoms (in either early or mid-pregnancy) were included as covariates in all four models.

Sensitivity Analyses

A portion of data collection occurred during the COVID-19 pandemic. Given recent research suggesting poorer sleep quality among pregnant women during the early phases (i.e., March-April 2020) of the pandemic (Lin et al., 2021), we repeated all analyses with all participants who completed the first and/or second Prenatal Study visit after March 1, 2020 removed. This resulted in a total sample of $N = 567$ women available for sensitivity analyses: $n = 13$ women completed both Prenatal Study visits after March 1, 2020, and $n = 20$ women completed only the second Prenatal Study visit after March 1, 2020.

Results

Participants

There were no significant differences in predictor (i.e., racial/ethnic discrimination and gendered racial stress), outcome (i.e., sleep quality), or sociodemographic variables (all p's > 0.05) between participants who did and did not have available racial/ethnic discrimination and gendered racial stress or sleep quality data at Prenatal Visit 1. However, participants who did not have available sleep quality data at Prenatal Visit 2 participated in Prenatal Visit 1 earlier during pregnancy (M gestational weeks = 10.77, $SD = 2.16$) than participants who had available sleep

quality data at Prenatal Visit 2 (*M* gestational weeks = 11.35, *SD* = 2.26, *t* = - 2.97, *p* = 0.003). There were no other significant differences between these groups (all *p*'s > 0.05). Given the significant association between gestational weeks of pregnancy at Prenatal Visit 1 and missingness at Prenatal Visit 2, we concluded that our data met Missing At Random (MAR) specifications (Nicholson et al., 2017).

Table 1 displays descriptive statistics for variables in the current study sample. On average, study participants were 25.36 years old *(SD* = 5.08 years) and for 46.3% of participants, this pregnancy was their first. The median highest level of education achieved was a high school diploma or General Educational Development (GED). Participants' median income was less than 100% of the Federal Poverty Level. Table 2 displays bivariate correlations between variables in the current study sample. Correlations between racial/ethnic discrimination/gendered racial stress and sleep quality were small to moderate (*r*'s = 0.13 – 0.32, all *p*'s < 0.001).

Table 1. Descriptive Statistics

Variable	**Imputed Data** (*N* = 600)
	***M* (*SD*) or *n* (%)**
Age (years)	25.36 (5.08)
Primiparous Women	278 (46.3%)
In a Relationship and Cohabitating	292 (48.7%)
Education	-
8th Grade or Less	1 (0.2%)
Some High School	94 (15.7%)
Graduated High School or GED	241 (40.2%)
Some College or Technical School	166 (27.7%)
Graduated College	66 (11.0%)
Some Graduate Work or Degree	32 (5.3%)
Income	-
< 100% of the Federal Poverty Level	265 (44.2%)
100-132% of the Federal Poverty Level	92 (15.3%)
133-149% of the Federal Poverty Level	54 (9.0%)
150-199% of the Federal Poverty Level	85 (14.2%)
200-299% of the Federal Poverty Level	41 (6.8%)
300-399% of the Federal Poverty Level	25 (4.2%)
>/ = 400% of the Federal Poverty Level	38 (6.3%)
Gestational Weeks	-
Prenatal Study visit 1	11.16 (2.25)
Prenatal Study visit 2	26.59 (2.73)
Body Mass Index (BMI)[a]	-
Prenatal Study visit 1	28.87 (7.83)
Racial/Ethnic Discrimination (EOD)[b]	-
Prenatal Study visit 1	2.13 (2.37)
Gendered Racial Stress (JHP)[c]	-
Prenatal Study visit 1	96.36 (20.91)
Depressive Symptoms (EPDS)[d]	-
Prenatal Study visit 1	7.18 (5.48)
Prenatal Study visit 2	7.03 (5.53)
Sleep Quality (PROMIS)[e]	-
Prenatal Study visit 1	21.47 (7.86)
Prenatal Study visit 2	22.01 (7.44)

Note. [a] BMI was calculated based on women's height and weight and was only collected at the first Prenatal Study visit. [b] Scores on the EOD range from 0 to 9. [c] Scores on the JHP range from 43 to 159. [d] EPDS scores range from 0 to 30; in racial/ethnic minority women, scores greater than or equal to 10 suggest clinically significant depressive symptomatology. EPDS means reported here include the sleep item, but when using EPDS summary scores in all study analyses, the sleep item was removed. Bivariate correlations between the 9 and 10-item EPDS scores were high ($r = 0.99$, $p < 0.001$ at Prenatal Study visit 1 and 2). [e] PROMIS scores range from 8 to 40; scores greater than or equal to 25 suggest mild sleep disturbance.

Table 2. Bivariate Correlations Between Study Variables (N = 600 for all cells)

		1	2	3	4	5	6	7	8	9	10
1)	Maternal age	-									
2)	Maternal Body Mass Index	0.13**	-								
3)	Gestational Weeks, Early Pregnancy	0.03	-0.01	-							
4)	Gestational Weeks, Mid-Pregnancy	-0.07	-0.10*	0.09*	-						
5)	Maternal SES	0.42**	-0.01	0.09*	-0.08	-					
6)	Racial/Ethnic Discrimination	0.14**	0.001	-0.05	-0.05	0.17**	-				
7)	Gendered Racial Stress	0.15**	0.05	-0.06	0.02	-0.01	0.32**	-			
8)	Sleep Quality, Early Pregnancy	0.09*	0.02	0.03	0.04	0.10*	0.20**	0.32**	-		
9)	Sleep Quality, Mid-Pregnancy	0.12**	0.06	-0.004	0.13**	0.02	0.13**	0.25**	0.51**	-	
10)	Depressive Symptoms, Early Pregnancy	-0.02	-0.02	-0.08	0.02	-0.07	0.26**	0.53**	0.38**	0.32**	-
11)	Depressive Symptoms, Mid-Pregnancy	-0.02	-0.04	-0.02	0.01	-0.06	0.19**	0.32**	0.23**	0.31**	0.54**

Note. ** $p < 0.01$, *$p < 0.05$.

Main Effects of Discrimination on Sleep Quality During Pregnancy

The results of simple linear regression analyses (Model 1a and 1b in Tables 3 and 4) reflect the bivariate correlations displayed in Table 2. Women's reports of greater lifetime experiences of racial/ethnic discrimination measured in early pregnancy were concurrently associated with poorer sleep quality in early pregnancy ($\Delta R^2 = 0.04$, $\Delta F = 26.08$, $p < 0.001$;

Model 1a, Table 3) and prospectively associated with poorer sleep quality in mid-pregnancy ($\Delta R^2 = 0.02$, $\Delta F = 9.88$, $p < 0.002$; Model 1a, Table 4). Similarly, women's reports of gendered racial stress measured in early pregnancy were concurrently associated with poorer sleep quality in early pregnancy ($\Delta R^2 = 0.10$, $\Delta F = 65.72$, $p < 0.001$; Model 1b, Table 3) and prospectively associated with poorer sleep quality in mid-pregnancy ($\Delta R^2 = 0.06$, $\Delta F = 40.43$, $p < 0.001$; Model 1b, Table 4).

When we adjusted for conceptually relevant covariates (Models 2a and 2b in Tables 3 and 4), effects attenuated slightly but the overall pattern of findings remained the same. Women's reports of greater lifetime experiences of racial/ethnic discrimination measured in early pregnancy were concurrently associated with poorer sleep quality in early pregnancy ($\Delta R^2 = 0.04$, $\Delta F = 22.10$, $p < 0.001$; Model 2a, Table 3) and prospectively associated with poorer sleep quality in mid-pregnancy ($\Delta R^2 = 0.02$, $\Delta F = 9.44$, $p = 0.002$; Model 2a, Table 4). Similarly, women's reports of gendered racial stress measured in early pregnancy were concurrently associated with poorer sleep quality in early pregnancy ($\Delta R^2 = 0.10$, $\Delta F = 66.18$, $p < 0.001$; Model 2b, Table 3) and prospectively associated with poorer sleep quality in mid-pregnancy ($\Delta R^2 = 0.05$, $\Delta F = 34.45$, $p < 0.001$; Model 2b, Table 4).

Next, we adjusted for women's concurrent prenatal depressive symptoms (Models 3a and 3b in Tables 3 and 4). In early pregnancy, our pattern of findings remained the same, although effect sizes diminished significantly. Women's reports of greater lifetime experiences of racial/ethnic discrimination ($\Delta R^2 = 0.01$, $\Delta F = 4.80$, $p = 0.03$; Model 3a, Table 3) and gendered racial stress ($\Delta R^2 = 0.01$, $\Delta F = 9.74$, $p = 0.002$; Model 3b, Table 3) were concurrently associated with poorer sleep quality, although they accounted for only a small percentage of the variance in early pregnancy sleep quality. In mid-pregnancy, after adjustment for prenatal depressive

symptomatology, associations between racial/ethnic discrimination and sleep quality were no longer significant ($\Delta R^2 = 0.004$, $\Delta F = 2.58$, $p = 0.11$; Model 3a, Table 4). In contrast, gendered racial stress continued to explain a statistically significant percentage of the variance in mid-pregnancy sleep quality, although this effect size was small ($\Delta R^2 = 0.02$, $\Delta F = 13.35$, $p < 0.001$; Model 3b, Table 4).

Table 3. Early Pregnancy Sleep Quality Regressed on Women's Exposure to Racial/Ethnic Discrimination or Gendered Racial Stress (N = 600)

Predictor Variable – Racial/Ethnic Discrimination	*B (SE)*	*95% CI (B)*	*β*	*t*	*p*
Model 1a. Unadjusted effects of Racial/Ethnic Discrimination	0.68 (0.13)	0.42 – 0.94	0.20	5.11	< 0.001
Model 2a. Effects of Racial/Ethnic Discrimination + adjustment for maternal age, gestational weeks at Prenatal Visit 1, prenatal BMI, SES	0.64 (0.14)	0.37 – 0.90	0.19	4.70	< 0.001
Model 3a. Effects of Racial/Ethnic Discrimination + adjustment for maternal age, gestational weeks at Prenatal Visit 1, prenatal BMI, SES, depressive symptoms at Prenatal visit 1	0.29 (0.13)	0.03 – 0.56	0.09	2.19	0.03
Predictor Variable – Gendered Racial Stress	*B (SE)*	*95% CI (B)*	*β*	*t*	*p*
Model 1b. Unadjusted effects of Gendered Racial Stress	0.12 (0.02)	0.09 – 0.15	0.32	8.11	< 0.001
Model 2b. Effects of Gendered Racial Stress + adjustment for maternal age, gestational weeks at Prenatal Visit 1, prenatal BMI, SES	0.12 (0.02)	0.09 – 0.15	0.32	8.14	< 0.001
Model 3b. Effects of Gendered Racial Stress + adjustment for maternal age, gestational weeks at Prenatal Visit 1, prenatal BMI, SES, depressive symptoms at Prenatal visit 1	0.05 (0.02)	0.02 – 0.09	0.14	3.12	0.002

Note. *BMI was only measured at Prenatal Study Visit 1 (early pregnancy).

Table 4. Mid-Pregnancy Sleep Quality Regressed on Women's Exposure to Racial/Ethnic Discrimination or Gendered Racial Stress (N = 600)

Predictor Variable – Racial/Ethnic Discrimination	*B (SE)*	*95% CI (B)*	*β*	*t*	*p*
Model 1a. Unadjusted effects of Racial/Ethnic Discrimination	0.40 (0.13)	0.15 – 0.65	0.13	3.14	0.002
Model 2a. Effects of Racial/Ethnic Discrimination + adjustment for maternal age, gestational weeks at Prenatal Visit 2, prenatal BMI, SES	0.39 (0.13)	0.14 – 0.64	0.13	3.07	0.002
Model 3a. Effects of Racial/Ethnic Discrimination + adjustment for maternal age, gestational weeks at Prenatal Visit 2, prenatal BMI, SES, depressive symptoms at Prenatal Visit 2	0.20 (0.13)	-0.05 – 0.45	0.06	1.61	0.11
Predictor Variable – Gendered Racial Stress	*B (SE)*	*95% CI (B)*	*β*	*t*	*p*
Model 1b. Unadjusted effects of Gendered Racial Stress	0.09 (0.01)	0.06 – 0.12	0.25	6.36	< 0.001
Model 2b. Effects of Gendered Racial Stress + adjustment for maternal age, gestational weeks at Prenatal Visit 2, prenatal BMI, SES	0.08 (0.01)	0.06 – 0.11	0.23	5.87	< 0.001
Model 3b. Effects of Gendered Racial Stress + adjustment for maternal age, gestational weeks at Prenatal Visit 2, prenatal BMI, SES, depressive symptoms at Prenatal Visit 2	0.05 (0.02)	0.03 – 0.08	0.15	3.65	< 0.001

Note. *BMI was only measured at Prenatal Study Visit 1 (early pregnancy).

Interaction Effects of Discrimination and Socioeconomic Status on Sleep Quality During Pregnancy

PROCESS analyses revealed no significant interaction between SES and racial/ethnic discrimination in the prediction of sleep quality in early (t = -0.38, p = 0.70) or mid-pregnancy (t = -0.47, p = 0.64). Similarly, there was no significant interaction between SES and gendered racial stress in the prediction of sleep quality in early (t = 0.26, p = 0.79) or mid-pregnancy (t = 1.13, p = 0.26).

In addition, we conducted interaction analyses in which we utilized the standardized education and income variables as individual modifier – rather than composite – variables. There were no significant interaction effects when education or income were tested as a moderators of the association between racial/ethnic discrimination or gendered racial stress and sleep quality during early or mid-pregnancy (data not shown).

Sensitivity Analyses

Results of sensitivity analyses, in which we limited analyses to data points collected prior to the COVID-19 pandemic, indicated the same pattern of findings for all three study hypotheses. This suggests that the inclusion of data collected during the early COVID-19 pandemic did not influence our findings (data not shown).

Post-Hoc Analyses: Examining Discrimination as a Predictor of Moderate to Severe Poor Sleep Quality During Pregnancy

We were interested in the clinical significance of our findings in terms of whether greater exposure to racial/ethnic discrimination or gendered racial stress would predict moderate to severe poor sleep quality. To test this question empirically, we performed binary logistic regression modeling in which women were grouped into two categories: those who scored less

than 60 and those who scored greater than or equal to 60 on the PROMIS, based on prior work (Yu et al., 2011) indicating that scores greater than or equal to 60 indicate “moderate” to “severe” sleep disturbance in non-pregnant adults. During early pregnancy, $n = 96$ participants’ responses (16% of participants) fell in the moderate to severe sleep disturbance category. During mid-pregnancy, $n = 98$ participants’ responses (16.33% of participants) fell in the moderate to severe sleep disturbance category. Post-hoc analyses indicated that as exposure to racial/ethnic discrimination or gendered racial stress increased, the likelihood of reporting moderate to severe poor sleep quality increased in early pregnancy (Supplemental Table 1), but not in mid-pregnancy (Supplemental Table 2). Reports of elevated depressive symptoms also increased the likelihood of reporting moderate to severe poor sleep quality at both timepoints.

Table 5. Binomial Logistic Regression of Discrimination as a Predictor of Moderate to Severe Poor Sleep Quality in Early Pregnancy

Predictor Variable	*B (SE)*	*Wald*	*p*	*Exp (B)*	[*95% CI Exp (B)*]
Maternal Age	-0.04 (0.03)	1.75	0.19	0.97	[0.92 – 1.02]
Gestational Weeks, Prenatal Visit 1	0.09 (0.05)	2.76	0.10	1.09	[0.98 – 1.21]
BMI, Prenatal Visit 1*	0.01 (0.02)	0.89	0.35	1.01	[0.99 – 1.04]
SES	0.28 (0.15)	3.27	0.07	1.32	[0.98 – 1.78]
Depressive Symptoms, Prenatal Visit 1	0.13 (0.03)	26.13	< 0.001	1.14	[1.08 – 1.19]
Racial/Ethnic Discrimination	0.12 (0.05)	6.49	0.01	1.13	[1.03 – 1.24]
Predictor Variable	*B (SE)*	*Wald*	*p*	*Exp (B)*	[*95% CI Exp (B)*]
Maternal Age	-0.05 (0.03)	2.73	0.10	0.96	[0.91 – 1.01]
Gestational Weeks, Prenatal Visit 1	0.09 (0.05)	2.78	0.10	1.09	[0.99 – 1.21]
BMI, Prenatal Visit 1*	0.01 (0.02)	0.64	0.42	1.01	[0.98 – 1.04]
SES	0.36 (0.15)	5.59	0.02	1.44	[1.06 – 1.94]
Depressive Symptoms, Prenatal Visit 1	0.10 (0.03)	13.90	< 0.001	1.11	[1.05 – 1.17]
Gendered Racial Stress	0.02 (0.01)	6.48	0.01	1.02	[1.004 – 1.03]

Note. *BMI was only measured at Prenatal Study Visit 1 (early pregnancy).

Table 6. Binomial Logistic Regression of Discrimination as a Predictor of Moderate to Severe Poor Sleep Quality in Mid-Pregnancy

Predictor Variable	*B (SE)*	*Wald*	*p*	*Exp (B)*	[*95% CI Exp (B)*]
Maternal Age	0.03 (0.03)	1.43	0.23	1.03	[0.98 – 1.08]
Gestational Weeks, Prenatal Visit 2	0.12 (0.04)	8.74	0.003	1.13	[1.04 – 1.22]
BMI, Prenatal Visit 1*	0.01 (0.02)	0.22	0.64	1.01	[0.98 – 1.04]
SES	0.01 (0.15)	0.01	0.94	1.01	[0.76 – 1.34]
Depressive Symptoms, Prenatal Visit 2	0.09 (0.02)	19.92	< 0.001	1.10	[1.05 – 1.14]
Racial/Ethnic Discrimination	0.03 (0.05)	0.28	0.60	1.03	[0.93 – 1.13]
Predictor Variable	*B (SE)*	*Wald*	*p*	*Exp (B)*	[*95% CI Exp (B)*]
Maternal Age	0.02 (0.03)	0.76	0.38	1.02	[0.97 – 1.08]
Gestational Weeks, Prenatal Visit 1	0.12 (0.04)	8.24	0.004	1.12	[1.04 – 1.21]
BMI, Prenatal Visit 1*	0.01 (0.02)	0.13	0.72	1.01	[0.98 – 1.04]
SES	0.04 (0.15)	0.08	0.77	1.04	[0.78 – 1.39]
Depressive Symptoms, Prenatal Visit 2	0.08 (0.02)	13.92	< 0.001	1.08	[1.04 – 1.13]
Gendered Racial Stress	0.01 (0.01)	3.20	0.07	1.01	[1.00 – 1.02]

Note. *BMI was only measured at Prenatal Study Visit 1 (early pregnancy).

Discussion

The current study adds to the growing literature on discrimination and women's sleep quality during pregnancy. We found positive, concurrent associations between racial/ethnic discrimination and poorer sleep quality during early pregnancy, replicating the work of Francis and colleagues (Francis et al., 2017). In addition, we broadened the definition of exposure to discrimination to include a measure of women's experiences of gendered racial stress, and found positive, concurrent and prospective associations between gendered racial stress and poorer sleep quality during early and mid- pregnancy, respectively. Each of these associations held after

accounting for sociodemographic factors such as SES, health-related factors such as women's age, BMI and week of pregnancy, and women's concurrent prenatal depressive symptoms. In contrast, we did not find evidence for prospective associations between women's exposure to racial/ethnic discrimination and their sleep quality during mid-pregnancy, after adjustment for their prenatal depressive symptoms.

In keeping with prior research methodology (Slopen et al., 2016), we examined associations between women's experiences of racial/ethnic discrimination or gendered racial stress and their prenatal sleep quality with adjustment for women's concurrent prenatal depressive symptomatology. While associations largely held – apart from prospective associations between women's exposure to racial/ethnic discrimination and their mid-pregnancy sleep quality– effect sizes diminished in all models. This may suggest that pregnant women's concurrent depressive symptoms are a better predictor of their sleep quality than their previous exposure to racial/ethnic discrimination or gendered racial stress. This finding is not entirely surprising: poor sleep quality and greater depressive symptomatology frequently co-occur during pregnancy, and likely have a bidirectional relationship, such that pregnant women who experience poor sleep quality may be more vulnerable to low mood and vice versa (Okun, 2015). This bidirectional relationship between depressive symptomatology and sleep health is reflected in both our assessment of perinatal depressive symptoms (Cox et al., 2002), and in our diagnostic classification system (American Psychiatric Association, 2013). While we aimed to eliminate statistical overlap by removing an item from our assessment of prenatal depressive symptomatology that taps prenatal sleep quality, these theoretical constructs may not be entirely separable.

Greater depressive symptomatology during pregnancy may reflect greater exposure to discrimination throughout one's lifetime. In the current study, bivariate correlations between women's exposure to racial/ethnic discrimination and their experiences of gendered racial stress and concurrent depressive symptoms ranged from small to moderate. Previous research indicates that Black American women who have experienced greater racial/ethnic discrimination report poorer psychological functioning during pregnancy (Giurgescu et al., 2017). Similarly, using a multi-ethnic sample of women (38% identified as Black American), Earnshaw and colleagues demonstrated that women's reports of greater lifetime exposure to racial/ethnic discrimination were associated with greater prenatal depressive symptoms (Earnshaw et al., 2013). Prenatal depressive symptomatology does not occur within a vacuum and may reflect the broader social context within which women exist. While women's concurrent depressive symptoms accounted for a greater proportion of the variance in prenatal sleep quality in the current study sample, it is noteworthy that women's lifetime experiences of racial/ethnic discrimination and gendered racial stress – potentially experienced prior to the conception of their children – largely remained small, but statistically significant predictors of sleep quality during pregnancy. While our questionnaire-based methods did not collect information on the timing of exposure, racial/ethnic and gendered racial/ethnic discrimination are particularly insidious because of their continuous and repetitive nature (D. R. Williams, Lawrence, Davis, et al., 2019). Our findings highlight the importance of deliberately attending to the lived experiences of racial/ethnic minority women: even in the presence of prenatal depressive symptoms, the stress associated with the lived experience of being a Black woman in America may confer additional risk for poor prenatal sleep quality, particularly during early pregnancy.

Associations between racial/ethnic discrimination/gendered racial stress and sleep quality were stronger in cross-sectional versus prospective analyses. The attenuation of effect observed in our prospective analyses likely stems from both conceptual and methodological factors. Conceptually, sleep quality worsens during the transition from the second to third trimester (Sedov et al., 2018, 2021). Mindell and colleagues collected data on women's sleep quality across all nine months of gestation, and found that women increasingly attributed their sleep difficulties to pregnancy-specific symptoms (e.g., frequency of nocturnal urination, hip/pelvic pain, fetal movement, contractions, uncomfortable sleep position) as pregnancy progressed (Mindell et al., 2015). Changes in body morphology may contribute to the increased wakefulness after sleep onset and lighter, more fragmented sleep observed during the second and third trimesters (Garbazza et al., 2020). In essence, normative physiological factors may explain more of the variance in poor sleep quality as gestational age increases, decreasing the likelihood that distally measured psychological stressors (e.g., exposure to discrimination) will explain a significant proportion of the variance in women's sleep quality. In addition, *proximal* psychological stressors (e.g., everyday versus lifetime racial/ethnic discrimination/gendered racial stress, such as exposure to microaggressions) may be better predictors of both early and mid-pregnancy sleep quality. We did not collect information on either pregnancy-specific contributors to sleep or everyday discrimination in the current study and cannot test these hypotheses empirically. Methodologically, participants retrospectively reported on their lifetime exposure to racial/ethnic discrimination and gendered racial stress only once, during early pregnancy. These measures were not repeated in mid-pregnancy, whereas sleep quality information was collected at both study timepoints. Greater effect sizes in early versus mid-pregnancy may also reflect shared method variance. We encourage future researchers to collect

information on discrimination and related stress at multiple timepoints throughout pregnancy, and to use measures that tap both lifetime and current or everyday exposure to discrimination.

In the current study, almost 40% of women reported never being exposed to racial/ethnic discrimination on the EOD, a pattern of findings that mirrors prior work. Slaughter-Acey and colleagues examined pregnant Black American women's impressions of personal and group-directed racism. In their study, 42.3% of women denied ever being personally exposed to racism whereas only 7.5% of women indicated that racism did not negatively affect the lives of other Black Americans (Slaughter-Acey et al., 2013). Our measures of racial/ethnic discrimination and gendered racial stress reflect women's personal exposure and may have resulted in underestimates of study participants' true exposure to racial/ethnic discrimination and related stress. At the same time, underreport of exposure to these stressors may be informative in and of itself. There is evidence suggesting that Black American women who underreport or deny exposure to racial/ethnic discrimination and gendered racial stress are at greater risk of poor health outcomes than those who report greater levels of exposure to these stressors (Krieger, 1990). As sleep health is a precursor to cardiometabolic health outcomes such as blood pressure (Buysse, 2014), future studies of discrimination experiences and the effects of structural racism on sleep in pregnancy are needed to understand the full extent of these associations.

We did not find evidence to support our proposed interaction model but encourage future researchers to consider different moderators in the association between racial/ethnic discrimination/gendered racial stress and prenatal sleep quality, such as neighborhood diversity and quality. When the ethnic density (i.e., proportion of individuals with racial/ethnic minority status) in an area increases, mental health problems may decrease as a function of community support (Bécares et al., 2009). Greater social support has been found to facilitate stress recovery

and prevent or diminish development of mental health problems as a response to life stress (Denton et al., 2015). However, increase in racial/ethnic minority volume is also associated with lower economic resources, so communities high in ethnic density may also lack the capital to protect members against negative mental health outcomes (Denton et al., 2015). This may contribute to why SES did not have a moderating effect on sleep quality in our sample. These competing forces may have statistically cancelled each other out, thus nullifying any potential interaction effects. In the current study sample, women who reported fewer experiences of discrimination on the EOD had lower SES (Table 2). This finding potentially supports the idea of social support as a buffering effect for women in our sample who may be more likely to work and/or live in ethnically dense environments (Postmes & Branscombe, 2002). Context matters, and while we did not find evidence of an interaction effect, SES-related factors may still differentially affect the association between racial/ethnic discrimination/gendered racial stress and sleep quality, as Black American adults at different levels of SES are differentially exposed to environmental risk and protective factors. Future studies that can better parse exposures related to SES are needed to inform sleep health interventions.

Findings from the current study suggest that efforts to decrease interpersonal discrimination would benefit the sleep quality of pregnant Black American women, particularly during early pregnancy. Racism is a complex system that is difficult to dismantle (D. R. Williams, Lawrence, Davis, et al., 2019), so clinicians should engage in multiple antiracist actions at multiple levels of influence (C. L. Jackson & Johnson, 2020). In addition to completing trainings on unconscious biases, clinicians may consider screening for women's experiences of racial/ethnic discrimination and gendered racial stress during prenatal clinic visits. These screening efforts may identify pregnant women who are most at-risk for poor prenatal

sleep quality and potential consequences (e.g., the development of a sleep disorder, preterm birth, etc.). More broadly, clinicians and sleep researchers can actively support programs and policies, through both education and advocacy, to address the determinants of sleep health disparities and mitigate these effects, especially among disadvantaged populations (C. L. Jackson & Johnson, 2020). Relatedly, clinicians should intentionally name the detrimental effects of racism as opposed to race when informing pregnant Black American women of risks to their health during pregnancy (Hardeman et al., 2020). Clinicians may also directly intervene on pregnant women's sleep quality, with particular attention to Black American women who report heightened comorbid depressive symptomatology.

Limitations

The current study has several limitations. First, the measures we selected asked women to consider their *lifetime* exposure to racial/ethnic discrimination and gendered racial stress. We were unable to obtain information on the timing of exposure, so we cannot state whether and how often these stressors occurred pre-conception or during women's pregnancies. Given evidence that daytime incidences of racial/ethnic discrimination are associated with poorer sleep health that same evening (Xie et al., 2021), future research on discrimination and sleep health in pregnant women may consider taking a more fine-grained approach to better understand how daily stressors (e.g., microaggressions) are associated with sleep. Similarly, we were only able to consider Black American women's race/ethnicity and gender, and how stress associated with these social identifiers may bear on prenatal sleep quality. We encourage future researchers to consider other aspects of women's identity, including, but not limited to, their sexual identity and their nativity status (of note, our cohort is comprised of American-born women). Second, while the PROMIS has been used in samples of pregnant and postpartum women (Bei et al., 2020;

Mersky et al., 2019), it has not been validated in this population. However, in the current study sample, there was adequate variability in the distribution of sleep quality scores in both early and mid-pregnancy suggesting that poor sleep quality was not merely associated with physiological hallmarks of pregnancy that often prohibit restorative sleep. An additional limitation is that the current study sample was comprised of women who accessed prenatal medical care during early and mid-pregnancy at urban medical centers. Importantly, pregnant Black American women who report greater lifetime exposure to racial/ethnic discrimination are more likely to delay prenatal care to the second or third trimester of pregnancy (Slaughter-Acey et al., 2019); eligibility criteria for the current study would not have allowed us to understand the experiences of these women. Finally, data on our predictor and outcome variables were obtained using self-report, rather than using objective measures of exposure to discrimination or sleep quality. With respect to discrimination, we were interested in women's perceptions of their exposure to interpersonally inflicted racism and gendered racism and its associations with their prenatal sleep quality. We aimed to add to the extant literature by applying a framework that has been used in previous studies (Earnshaw et al., 2013; Francis et al., 2017; Giurgescu et al., 2011) that examine Black American women's exposure to discrimination and its effects on prenatal health outcomes. Regarding our outcome variable, we examined women's subjective sleep quality, consistent with the only known study to date that we sought to replicate (Francis et al., 2017). The data from the current study constitute a secondary analysis of a larger study on prenatal health, and the focus of the larger study did not warrant inclusion of objective measures of prenatal sleep health or of women's sleep health prior to pregnancy. Sleep health is a multidimensional construct, and also includes sleep duration and sleep architecture, both of which may be better measured via objective measures such as actigraphy and polysomnography (Buysse, 2014). However, sleep

health also includes individuals' satisfaction with their sleep, and this can only be measured subjectively. Measures of sleep quality may better reflect pregnant women's clinical concerns (Park et al., 2013), and subjective reports of sleep are associated with important health outcomes (Johnson et al., 2020). Nonetheless, future studies on racial/ethnic discrimination and prenatal sleep health should still try to include both objective and subjective measures of sleep health.

Conclusions

Despite these limitations, the current study has several strengths. We replicated previous work demonstrating direct effects between racial/ethnic discrimination and sleep quality during early pregnancy (Francis et al., 2017), and extended these findings to mid-pregnancy. In addition to assessing women's lifetime exposure to racial/ethnic discrimination, we also included a measure of gendered racial stress as a predictor variable, to better capture the contextual stress associated with being both Black *and* female in America. Finally, we had limited missing data, but nevertheless used multiple imputation to maximize sample size in analyses. In sum, among pregnant Black American women in the current study sample, greater lifetime exposure to racial/ethnic discrimination and gendered racial stress was associated with poorer sleep quality during early, and in some cases, mid-pregnancy. Given the importance of optimal sleep quality during pregnancy for healthy birth outcomes (Okun, 2019) and maternal psychological wellbeing (L. M. Tomfohr et al., 2015), future clinical research should be devoted to mitigating sleep health disparities among pregnant Black American women (Gaston et al., 2020). Efforts to dismantle racial/ethnic and gender-based discrimination may decrease both sleep health disparities during pregnancy and adverse maternal child health outcomes that disproportionately affect Black American women and their infants.

Intergenerational Effects of Discrimination on Black American Children's Sleep Health

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Abstract

Greater exposure to racial/ethnic discrimination among pregnant Black American women is associated with elevated prenatal depressive symptomatology, poorer prenatal sleep quality, and poorer child health outcomes. Given the transdiagnostic importance of early childhood sleep health, we examined associations between pregnant women's lifetime exposure to racial/ethnic discrimination and their two-year-old children's sleep health. We also examined women's gendered racial stress as a predictor variable. In exploratory analyses, we examined prenatal sleep quality and prenatal depressive symptoms as potential mediators of the prior associations. We utilized data from a sample of Black American women and children (n = 205). Women self-reported their lifetime experiences of discrimination during early pregnancy (using the Krieger Experiences of Discrimination measure and the Jackson, Hogue, Phillips Contextualized Stress Measure), their sleep quality and depressive symptoms during mid-pregnancy (using the Patient-Reported Outcomes Measurement Information System Sleep Disturbance Short Form and the Edinburgh Postnatal Depression Scale, respectively) and their children's sleep health at age two (Children's Sleep Habits Questionnaire – Abbreviated). Hierarchical linear multiple regression models were fit to examine direct associations between women's experiences of discrimination and children's sleep health. We tested our mediation hypotheses simultaneously using a parallel mediator model. On average, mothers in the current study sample were 25.11 years old (sd = 4.75 years) during early pregnancy and did not report significantly poor sleep quality (m = 21.78, sd = 7.16) or significant depressive symptoms (m = 7.54, sd = 5.64) during mid-pregnancy. On average, mothers reported moderately poor sleep health in their two-year-old children (m = 36.34, sd = 5.43). Higher levels of gendered racial stress, but not racial/ethnic discrimination were directly associated with poorer sleep health in children. Higher levels of racial/ethnic

discrimination were indirectly associated with poorer sleep health in children, via women's prenatal depressive symptomatology, but not prenatal sleep quality. Clinical efforts to mitigate the effects of discrimination on Black American women may benefit women's prenatal mental health and their children's sleep health.

Intergenerational Effects of Discrimination on Black American Children's Sleep Health

Greater exposure to racial/ethnic discrimination is associated with poorer health outcomes in Black American children and adults (D. R. Williams, Lawrence, Davis, et al., 2019). As a function of their overlapping and interrelated racial/ethnic and gender identities, Black American women are disproportionately exposed to and affected by multiple interpersonal psychosocial stressors, including racial/ethnic discrimination and sexism (Bowleg, 2012; Crenshaw, 1991). Proponents of intersectionality theory emphasize that Black American women often experience racial/ethnic discrimination and sexism simultaneously (Bowleg, 2012; Crenshaw, 1991; J. A. Lewis et al., 2017; T. T. Lewis & Van Dyke, 2018). This co-occurrence of stressors has been termed gendered racism (Essed, 1991) and researchers have argued that studies examining associations between Black American women's exposure to racial/ethnic discrimination and health outcomes should also include women's exposure to gendered racism as a predictor variable, when possible (J. A. Lewis et al., 2017). Black American women who report higher levels of lifetime exposure to racial/ethnic discrimination report poorer mental and physical health outcomes (Ertel et al., 2012). Higher levels of gendered racism are also associated with poorer mental and physical health in Black American women (J. A. Lewis et al., 2017), although fewer studies have examined these associations. Importantly, these stress exposures affect not only the health of Black American women themselves, but also hold implications for child health outcomes.

In recent years, more attention has been paid to the Barker Hypothesis (Barker, 1992), a conceptual framework that posits that higher levels of psychological distress experienced prior to and during a women's pregnancy may place her child at risk for a range of negative developmental sequelae (Kinsella & Monk, 2009). It is important to apply this conceptual

framework to design and conduct studies of minority health that span across a woman's pregnancy and into her offspring's childhood. Black American women in particular are vulnerable to significant contextual stressors, which may place their children at greater risk for negative health outcomes. Indeed, greater lifetime exposure to racial/ethnic discrimination among pregnant Black American women is associated with an increased likelihood of preterm birth or low birthweight (Giurgescu et al., 2011; Mustillo et al., 2004). The range of childhood health outcomes that have been studied within this intergenerational framework has largely been confined to markers of child health within the neonatal period (Giurgescu et al., 2011; Lu et al., 2010; Mustillo et al., 2004). However, it is unlikely that these effects are restricted to early development. Further research is needed to understand how greater lifetime exposure to racial/ethnic discrimination or gendered racial stress among pregnant Black American women is adversely associated with aspects of children's health further in development. The current study aims to address this gap by focusing on a transdiagnostic marker of pediatric health, early childhood sleep health.

Associations Between Pregnant Black American Women's Lifetime Exposure to Discrimination and Early Childhood Sleep Health

Sleep health during early childhood is an important predictor of children's temperament, cognition, behavior, and cardiometabolic functioning (Sadeh et al., 2011). To our knowledge, only one study to date has investigated expectant mothers' lifetime exposure to racial/ethnic discrimination as a risk factor for poorer sleep health in early childhood (Powell et al., 2020). The authors did not include a measure of gendered racism, and thus did not acknowledge the possibility that for Black American women in particular, the simultaneous experience of racism and sexism may also be associated with poorer sleep health in their children. In the current study,

we seek to replicate and extend the findings of Powell and colleagues by broadening the operational definition of pregnant Black American women's exposure to racism to include measures of both racial/ethnic discrimination and gendered racial stress.

Powell and colleagues demonstrated that greater lifetime exposure to racial/ethnic discrimination, measured during early pregnancy, was associated with shorter 24-hour sleep duration in women's six-month-old infants (Powell et al., 2020). While findings attenuated by age two, the authors noted several study limitations, including the use of a sample of pregnant women that reported high education and income levels. Experiences of discrimination vary based on these contextual factors (Ertel et al., 2012), and studies that include participants from a range of socioeconomic backgrounds will better allow us to understand the effects of discrimination on health outcomes. Furthermore, Powell and colleagues relied solely on maternal reports of child sleep duration as their outcome measure of early childhood sleep health. Sleep duration is quite variable during the first years of life (Carskadon & Dement, 2011), and early childhood sleep health is a multidimensional construct (Meltzer et al., 2021). We propose replicating Powell and colleagues' work using a continuous measure of overall child sleep health that reflects multiple common clinical sleep concerns in toddlers, including sleep initiation, duration, night waking, and daytime drowsiness. Such an approach may allow us to better detect meaningful variation in healthy sleep in toddlers.

Potential Mediators in the Association Between Pregnant Black American Women's' Lifetime Exposure to Discrimination and Early Childhood Sleep Health

Empirical understanding of the potential mechanisms linking maternal racial/ethnic stress and children's sleep health remains obscure. In this study we will examine two prenatal factors that might explain this intergenerational risk process—maternal depressive symptoms and sleep

quality during pregnancy. Black American women who report greater lifetime exposure to racial/ethnic discrimination report both greater depressive symptomatology (Earnshaw et al., 2013; Ertel et al., 2012) and poorer sleep quality during pregnancy (Francis et al., 2017). Depressive symptoms and sleep difficulties occur within the broader social context and are elevated among pregnant women who identify as members of racial/ethnic minority groups and have experienced greater discrimination during their lifetimes (Cohen et al., 2022; Ertel et al., 2012). Moreover, elevated maternal depressive symptomatology during pregnancy is associated with poorer sleep health in 18- and 30-month old children (O'Connor et al., 2007). Based on these previous findings, and in accordance with the Barker Hypothesis, we will examine maternal prenatal depressive symptoms and prenatal sleep quality as potential mediators of the association between pregnant Black American women's lifetime exposure to racial/ethnic discrimination or gendered racial stress and sleep health in their two-year-old children.

Associations between greater maternal prenatal depressive symptoms and poorer offspring sleep have been documented in both animals and humans (Palagini et al., 2015). In preclinical studies, rats exposed to prenatal distress versus non-exposed controls experience greater sleep disturbances, three to four months post-birth (Dugovic et al., 1999; Santangeli et al., 2016). Within the last 15 years, clinical research in human samples has extended animal work. Field and colleagues (Field et al., 2007) sampled women (n = 253; 23% Black/African American) with and without a clinical diagnosis of depression during pregnancy and observed the sleep architecture of their newborn infants. Infants of mothers who carried a clinical diagnosis of depression spent less time in quiet sleep – a sleep stage that is similar to non-REM sleep in adults (Jenni & Carskadon, 2012). In a similar study design, researchers employed actigraphy to measure the sleep health of infants (n = 18; no participant race/ethnicity

information provided). Infants born to mothers with clinical diagnoses of depression versus those without had longer sleep onset latency, lower sleep efficiency, and shorter sleep duration at two-weeks and six-months postpartum (Armitage et al., 2009). These findings are strengthened by complementary work in large, population-based cohorts, that studied sleep health later in childhood. Using maternal reports of offspring sleep, O'Connor and colleagues (n > 10,000; Avon Longitudinal Study of Parents and Children (ALSPAC) Cohort) demonstrated positive associations between higher levels of maternal prenatal depressive symptoms and greater sleep difficulties in 18- and 30-month-old children (O'Connor et al., 2007). Associations persisted even after adjustment for women's postnatal depressive symptoms. Similarly, Kim and colleagues (n = 5,568; Growing Up in New Zealand cohort) found a twofold risk for more nighttime awakenings – as assessed by maternal report – among two-year old children exposed to greater levels of maternal prenatal, but not postnatal depressive symptoms (Kim et al., 2020). Altogether, such findings indicate that greater prenatal depressive symptomatology increases the risk of poor sleep health in early childhood, even in the context of maternal postnatal depressive symptoms. However, and importantly, the literature in this area is lacking in minority health studies (Alvidrez et al., 2019). Indeed, women's prenatal depressive symptomatology does not occur in a vacuum, but instead is subject to influence from contextual factors, such as racial/ethnic discrimination and gendered racial stress (Earnshaw et al., 2013; Ertel et al., 2012; J. A. Lewis et al., 2017). As such, it is important to examine these associations in the context of these factors for Black American women.

Finally, we will also explore prenatal sleep quality as a potential mediator in the association between women's lifetime exposure to racial/ethnic discrimination or gendered racial stress and children's sleep health at age two. Higher levels of lifetime exposure to racial/ethnic

discrimination are associated with poorer sleep quality during pregnancy (Cohen et al., 2022; Francis et al., 2017). To our knowledge, few studies have examined associations between women's prenatal sleep quality and their children's sleep health, although preliminary evidence suggests positive associations between these constructs (Newland et al., 2017). Given the co-occurrence between greater prenatal depressive symptomatology and poorer prenatal sleep quality (L. M. Tomfohr et al., 2015), we will examine both of these constructs as mediators in a parallel mediator model (Hayes & Rockwood, 2017). Sleep quality and depressive symptomatology are typically correlated during pregnancy (L. M. Tomfohr et al., 2015), and parallel mediator models assume correlation between variables. Moreover, parallel mediator models are robust – despite potential correlations between mediator variables, parallel mediator models prevent spurious indirect effects that may emerge simply because the mediator variables are correlated. In sum, we will examine both prenatal sleep quality and prenatal depressive symptoms as potential mediators of the association between women's exposure to discrimination and children's sleep health.

The Current Study

We have the following aims/hypotheses: first, (1) we predict that women who report greater lifetime exposure to racial/ethnic discrimination or gendered racial stress will report poorer sleep health in their two-year-old children, even after adjustment for women's postnatal depressive symptoms and conceptually relevant covariates. Second, (2) we will examine maternal prenatal depressive symptoms and sleep quality as potential mediators of the association between lifetime exposure to racial/ethnic discrimination or gendered racial stress and child sleep health at age two. Findings from the current study will broaden our understanding

of the ways in which expectant mothers' distress is associated with the sleep health of their young children.

Method

Participants

The current study constitutes a secondary data analysis of two prospective, longitudinal studies. Recruitment for both studies is ongoing and resulted in a sample of $N = 205$ women and children for current study analyses. All procedures were performed in accordance with the ethical standards of the Institutional Review Board and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The first study (the Prenatal Study; R01NR014800) collected data from pregnant women at two timepoints during gestation. Healthy, pregnant women were recruited from prenatal clinics affiliated with two large hospitals – one private, one public – in a Southeastern city of the United States to participate in a study investigating the impacts of prenatal stress and environmental exposures on maternal and child health (Corwin et al., 2017). Inclusion criteria for enrollment in the Prenatal Study were as follows, Black/African American race/ethnicity (by self-report), singleton pregnancy, fluency in English, maternal age 18-40 years, and the absence of diagnoses of chronic health conditions (e.g., hypertension, diabetes) or chronic prescription medication use. When their children reached age two years, mothers whose pregnancies resulted in a live birth and whose infants were born without congenital disorders (e.g., cerebral palsy, spina bifida) were asked whether they would like to enroll in a follow-up study on children's health outcomes (the Environmental Influences on Child Health Outcomes (ECHO) Study; 1UG3OD023318-01).

Procedure

During pregnancy, data were collected from participants twice: once between eight- and 14-weeks' gestation (*M* = 11.16 weeks, *SD* = 2.25) and once between 24- and 30-weeks' gestation (*M* = 26.59 weeks, *SD* = 2.73). At the first Prenatal Study visit (referred to as early pregnancy) women retrospectively reported on their lifetime exposure to racial/ethnic discrimination and their experiences of gendered racial stress and provided demographic and health information. At the second Prenatal Study visit (referred to as mid-pregnancy), women reported on their current prenatal sleep quality and depressive symptoms. When children were two years old, mothers and their children completed a two-hour study visit. At this time, mothers completed a questionnaire about their children's sleep health and reported on their own depressive symptoms.

Inclusion criteria for the current study were (1) completion of at least one measure of discrimination in early pregnancy, (2) child gestational age at birth >/ = 32 weeks (which excludes children who would have been classified as very or extremely preterm and includes children who may have been classified as moderate or late preterm (World Health Organization, 2018), and (3) completion of the child sleep health measure at child age two.

Measures

Lifetime Experiences of Racial/Ethnic Discrimination and Gendered Racial Stress

In early pregnancy, women retrospectively reported on their lifetime exposure to racial/ethnic discrimination using the *Experiences of Discrimination* measure (EOD; Krieger et al., 2005). Women also reported on their experiences of gendered racial stress using the *Jackson, Hogue, Phillips Contextualized Stress* measure (JHP; Jackson et al., 2005).

EOD. The EOD asks participants to respond (yes/no) to the following question:

> "*Have you ever experienced discrimination, been prevented from doing something, or been hassled or made to feel inferior in any of the following [nine] situations (i.e., at school, getting hired/getting a job, at work, getting housing, getting medical care, getting service at store/restaurant, getting credit/bank loans/mortgage, in public, with police/in courts) because of your race, ethnicity, or color?*"

Women's responses on the EOD are limited to what they are willing to disclose, and do not necessarily represent the full range of discriminatory experiences. No items on the EOD reference sleep quality. Responses were summed to result in a total score (range = 0-9). This score is considered reliable and valid: it has good internal consistency, good test-retest reliability over a month timespan, and good convergent validity with other self-report measures of discrimination (Krieger et al., 2005). This measure of racial/ethnic discrimination has previously been used in work investigating pregnant Black American women's exposure to discrimination as a predictor of psychological outcomes (Ertel et al., 2012; Hendrix et al., 2021; Powell et al., 2020). Internal consistency in the current study sample was good: Cronbach's $\alpha = 0.81$

JHP. The lived experience of Black American women is shaped by *both* racial/ethnic identity and gender identity (Crenshaw, 1991; T. T. Lewis & Van Dyke, 2018). As such, Black American women may be exposed to both racial/ethnic discrimination and gender-based discrimination, and these constructs are not wholly separable. The JHP is a 39-item self-report measure that assesses Black American women's gendered racial stress. Participants indicate whether statements broadly describe their lived experience (0 = Strongly Agree, 1. = Agree, 2 = Unsure, 3 = Disagree, 4 = Strongly Disagree). Participants are not provided with a time anchor. Statements include, "*Everyone expects me to be strong for them*," "*As an African American woman, I can withstand great pressure*," "*Racism is a problem in my life*," and "*I have to work*

harder than white women to earn recognition." The JHP is comprised of five subscales: burden, coping, racism, personal history, and work. Subscale scores are summed to result in a total summary score (range = 43-159). We tested current study hypotheses using summary scores from the JHP as a predictor variable, as we did not have a priori predictions about any particular subscale and wanted to tap the full construct of gendered racial stress. The JHP was developed via qualitative interviews with $n >/= 400$ women in metropolitan Atlanta, and has good convergent validity with self-report measures of anger, depressive symptoms, and anxiety (F. M. Jackson et al., 2005). In the current study sample, internal consistency for the JHP total summary score was good: Cronbach's $\alpha = 0.85$.

Prenatal Depressive Symptoms

In mid-pregnancy, women reported on their current depressive symptoms using summary scores from the *Edinburgh Postnatal Depression Scale* (*EPDS*; Cox et al., 2002). Participants decided whether ten statements referencing low mood (e.g., "*I have been able to laugh and see the funny side of things."),* suicidality (e.g., *"The thought of harming myself has occurred to me.")*, anhedonia (e.g., "*I have looked forward to things*."), and stress (e.g., "*I have been anxious or worried for no good reason*.") described them within the past week. Wording of response options varies by question, but is typically listed as: Yes, most of the time; Yes, quite often; Only occasionally; and No, not at all. One item on the EPDS directly references sleep and fatigue ("*I have been so unhappy that I have had difficulty sleeping*.") and was removed from all analyses to avoid methodological overlap, resulting in a total of nine EPDS items. Scores on the EPDS range from zero to 30; scores greater than or equal to ten suggest clinically significant depressive symptoms in Black American perinatal women (Tandon et al., 2012). Continuous scores were used in all study analyses. In the current study sample, internal consistency for the 9-item scale

was good: Cronbach's α = 0.84. Internal consistency for the 10-item scale – without the sleep item removed – was similar: Cronbach's α = 0.87.

Prenatal Sleep Quality

Women also reported on their sleep quality in mid-pregnancy using the *Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep Disturbance Short Form* (Yu et al., 2011). This measure was developed in a sample of *N* = 2,252 adult participants using Item Response Theory. Participants in the measure development sample (12.6% Black or African American) included those with and without clinically significant sleep quality concerns. The PROMIS is comprised of eight items that assess sleep quality within the past week (e.g., "*My sleep was restless*."). No items directly reference mood symptoms or stress. Participants were asked to decide whether statements described their sleep quality (1 = not at all, 2 = a little bit, 3 = somewhat, 4 = quite a bit, 5 = very much). Responses are summed to compute a total continuous raw score (range = 8 – 40); higher scores indicate worse sleep quality. These continuous scores were used as our outcome measure in current study analyses. The PROMIS has high internal consistency and good convergent validity with other measures of sleep quality (i.e., PROMIS Sleep Disturbance Full Form (Buysse et al., 2010), Pittsburgh Sleep Quality Index (41); however, the PROMIS has greater precision in identifying adults with clinically significant sleep disturbances, and it has fewer items (i.e., eight versus 27 and 19, respectively), making it less burdensome (Yu et al., 2011). This measure has previously been used in samples of perinatal women (Bei et al., 2019; Mersky et al., 2019) although it has not, to our knowledge, been normed in this population. In the current study sample, internal consistency for the PROMIS was good: Cronbach's α = 0.89.

Maternal Depressive Symptoms at Child Age Two

When children were two-years-old, mothers repeated the EPDS (Cox et al., 2002) to assess their current depressive symptoms. In the current study sample, internal consistency for the 9-item scale was good: Cronbach's $\alpha = 0.82$. Internal consistency for the 10-item scale – without the sleep item removed – was similar: Cronbach's $\alpha = 0.85$.

Child Sleep Health at Child Age Two

Mothers reported on their children's sleep health at age two using the *Children's Sleep Habits Questionnaire – Abbreviated* (CSHQ-A; NICHD SECCYD). The CSHQ-A contains 22-items and is a modified version of the 23-item Children's Sleep Habits Questionnaire – Short Form CSHQ – SF (Bonuck et al., 2017). Items on both measures assess behavioral aspects of child sleep health (e.g., difficulties falling and/or staying asleep, night wakefulness, sleep duration and regularity, daytime sleepiness) that are considered amenable to parent intervention. At child age two, mothers indicated how well (i.e., Always, Usually, Sometimes, Rarely, or Never) statements characterized their children's sleep (e.g., "Child wakes up more than once during the night.") during "the most recent typical week." Higher scores on the CSHQ-A suggest poorer child sleep health, and serve as a screener for identifying children with clinical sleep difficulties (Bonuck et al., 2017). In the current study sample, internal consistency was acceptable: Cronbach's $\alpha = 0.70$.

Covariates

We selected covariates for inclusion *a priori* based on previous work investigating associations between women's experiences of racial/ethnic discrimination (Powell et al., 2020) or prenatal depressive symptoms (Kim et al., 2020; O'Connor et al., 2007) and their young children's sleep health. We included variables that have previously been associated with early childhood sleep health, our outcome variable, as covariates. O'Connor and colleagues

demonstrated that younger maternal age and lower maternal education level were associated with greater sleep disturbances in children at ages 18 and 30 months (O'Connor et al., 2007). In the current study, in early pregnancy, women provided their age and their highest achieved education level and income. Education and income were averaged and standardized to form a composite socioeconomic status (SES) variable. SES is best captured by multiple factors rather than a single variable (Oakes & Rossi, 2003) and this methodological approach is consistent with previous research examining associations between discrimination and sleep health (Cheng et al., 2020; Gaston et al., 2020; Grandner et al., 2010). Further, O'Connor and colleagues hypothesized that greater prenatal alcohol and tobacco use would be associated with greater child sleep disturbances at age 18 and 30 months. While they failed to find a significant association between these variables, recent work indicates significant associations between greater prenatal substance use and poorer sleep health in early childhood (Chandler-Mather et al., 2021). Powell and colleagues also included prenatal tobacco use as a covariate in their models (Powell et al., 2020). In the current study, at the early and mid-pregnancy study visits, women reported whether they had used tobacco or alcohol at any point during pregnancy thus far. Women's responses at both timepoints (0 = no, 1 = yes) were summed to result in a total count variable. Next, because healthy sleep differs by developmental stage (Matricciani et al., 2019; O'Connor et al., 2007), we adjusted for children's age in months at the year two visit. In addition, we adjusted for the number of people in the home at child age two, consistent with O'Connor and colleagues' measure of 'crowding' (O'Connor et al., 2007) and the idea that environmental context (e.g., greater noise) shapes sleep health (Johnson et al., 2018). Finally, to test for prenatal specific effects and to minimize reporter bias, we controlled for mothers' self-reported depressive symptoms at child age two.

Data Analytic Plan

Preliminary Analyses

All analyses were performed using IBM SPSS version 27.0 (IBM Corp, 2019). Statistical significance was set at a two-sided *p*-value of < 0.05. A priori power analyses using G*Power (Faul et al., 2007) revealed that a sample size of $n = 199$ was needed to detect small to medium effects (Cohen's $f = 0.04$; $\alpha = 0.05$; $1 - \beta = 0.80$; number of tested predictors = 1; total number of predictors = 7). We examined our data for missingness in compliance with the Journal Article Reporting Standards (JARS) for Research in Psychology (Appelbaum et al., 2018). To determine whether our data were Missing Completely at Random (MCAR), Missing at Random (MAR), or Missing Not at Random (MNAR) we dummy-coded variables to signify whether participants were missing data on study variables. Next, we conducted Independent Samples T-tests and Chi-Squared tests to determine whether missingness was associated with predictor, mediator, outcome, and/or sociodemographic variables. Finally, missing data were multiply imputed using the multiple imputation package in SPSS.

Primary Analyses

We tested our study hypotheses using hierarchical linear regression models. To verify the assumptions of linear regression, we examined descriptive statistics and distribution fits for all included study variables. We plotted standardized residuals against standardized predicted values to inspect for linearity, homoscedasticity, and normality and examined our data for influential outliers. We used the PROCESS macro in SPSS (Hayes, 2016) to test our mediation hypothesis. We performed two parallel mediation models, consistent with recommendations from Hayes and Rockwood (2017). We obtained 95% bias-corrected confidence intervals based on 10,000 bootstrap samples for all regression coefficients (Kane & Ashbaugh, 2017).

Sensitivity Analyses

A portion of data collection occurred during COVID-19 pandemic. Given research suggesting poorer sleep quality (Lin et al., 2021) and depressive symptoms (Lebel et al., 2020) among pregnant women and poorer sleep quality among children (Dellagiulia et al., 2020) during the early phases of the pandemic, we first examined whether women completed study visits during pregnancy after March 1, 2020. In the current study sample, all data collected during pregnancy was obtained prior to March 1, 2020. However, n = 42 mother-child dyads completed the child age two visit after March 1, 2020. We repeated all analyses with these participants removed. This resulted in a total of N = 163 mother-child dyads available for sensitivity analyses.

Results

Participants

There were limited missing data (4.53% of all values) in the current study sample. All women (N = 205) completed the racial/ethnic discrimination measure during early pregnancy, and all but one participant (n = 204) completed the gendered racial stress measure during early pregnancy. In mid-pregnancy, n = 179 women completed the sleep quality measure, and n = 180 women completed the measure of depressive symptoms. At child age two, all women (N = 205) completed the child sleep health measure. Participants who did not have available sleep quality data during mid-pregnancy participated in the mid-pregnancy visit earlier (M gestational weeks = 25.28, SD = 0.38) than participants who had available data on these constructs (M gestational weeks = 26.52, SD = 2.60, t = - 4.26, p = 0.01). There were no other significant differences between these groups (all p's > 0.05). We concluded that our data met Missing At Random

(MAR) specifications (Nicholson et al., 2017). Hereafter, all results reported in the text, Tables, and Figures are based on the multiply imputed data.

Table 1 displays descriptive statistics for variables in the current study sample. On average, mothers who participated in the current study were 25.1 years old *(SD* = 4.8 years) and for 37.1% of participants, this was their first pregnancy. The median highest level of education achieved was a high school diploma or General Educational Development (GED). Participants' median income was less than 100-132% of the Federal Poverty Level. Table 2 displays bivariate correlations between variables in the current study sample. There was no significant association between women's exposure to racial/ethnic discrimination and child sleep health at age two; however, women's experiences of gendered racial stress were positively associated with their child sleep health at age two, such that higher levels of gendered racial stress were prospectively associated with poorer child sleep health ($r = 0.27$, $p < 0.001$).

Table 1. Descriptive Statistics

Variable	**Imputed Data** (*N* = 205)
	***M* (*SD*) or *n* (%)**
Maternal Age (years)	25.11 (4.75)
Primiparous Women	76 (37.1%)
In a Relationship and Cohabitating	98 (47.8%)
Education	-
8th Grade or Less	1 (0.5%)
Some High School	36 (17.6%)
Graduated High School or GED	81 (39.5%)
Some College or Technical School	52 (25.4%)
Graduated College	26 (12.7%)
Some Graduate Work or Degree	9 (4.4%)
Income	-
< 100% of the Federal Poverty Level	97 (47.3%)
100-132% of the Federal Poverty Level	37 (18.0%)
133-149% of the Federal Poverty Level	11 (5.4%)
150-199% of the Federal Poverty Level	24 (11.7%)
200-299% of the Federal Poverty Level	19 (9.3%)
300-399% of the Federal Poverty Level	6 (2.9%)
>/ = 400% of the Federal Poverty Level	11 (5.4%)
Prenatal Substance Use	-
Tobacco	30 (14.6%)
Alcohol	14 (6.8%)
Racial/Ethnic Discrimination (EOD)[a]	2.09 (2.28)
Gendered Racial Stress (JHP)[b]	96.45 (19.57)
Maternal Depressive Symptoms (EPDS)[c], mid-pregnancy	7.54 (5.64)
Maternal Sleep Quality (PROMIS)[d], mid-pregnancy	21.78 (7.16)
Gestational Weeks at Birth	38.69 (1.52)
Child Sex	102 female (49.8%)
Child Age (months)	25.84 (2.76)
Child Sleep Health (CSHQ), age two[e]	36.34 (5.43)
Maternal Depressive Symptoms (EPDS), child age two	5.58 (4.85)
Number of People in the Home, child age two	4.34 (1.60)

Note. [a] The EOD was completed in early pregnancy; scores range from 0 to 9. [b] The JHP was completed in early pregnancy; scores range from 43 to 159. [c] The EPDS was completed in mid-pregnancy and again at child age two. EPDS scores range from 0 to 30; in racial/ethnic minority women, scores greater than or equal to 10 suggest clinically significant depressive symptomatology. EPDS means reported here include the sleep item, but when using EPDS summary scores in all study analyses, the sleep item was removed. Bivariate correlations between the 9 and 10-item EPDS scores were high ($r = 0.99$, $p < 0.001$ at both study timepoints). [d] PROMIS scores range from 8 to 40; scores greater than or equal to 25 suggest mild sleep disturbance. [e]CSHQ scores range from 26 to 58; higher scores indicate poorer sleep health.

Table 2. Correlations Between Study Variables (N = 205 for all cells) [a]

	1	2	3	4	5	6	7	8	9	10	11
1) Maternal Age	-										
2) SES	0.42**	-									
3) Prenatal Tobacco Use	0.01	-0.18*	-								
4) Prenatal Alcohol Use	0.15*	0.06	0.33**	-							
5) Racial/Ethnic Discrimination	0.11	0.16*	0.04	0.09	-						
6) Gendered Racial Stress	0.12	-0.06	0.05	0.15*	0.26**	-					
7) Sleep Quality, mid- Pregnancy	0.13	0.09	0.07	0.03	0.18**	0.23**	-				
8) Depressive Symptoms, mid-Pregnancy	0.02	-0.02	0.10	0.07	0.31**	0.36**	0.44**	-			
9) Child Sleep Health	0.11	-0.03	0.07	0.04	-0.02	0.27**	0.15**	0.20**	-		
10) Child Age (in months, age two)	-0.06	0.05	-0.09	-0.13	0.01	0.03	0.19**	0.12	-0.07	-	
11) Number of People in the Home, child age two	-0.02	-0.25**	-0.01	-0.02	0.03	-0.09	0.01	-0.06	0.03	0.02	-
12) Maternal Depressive Symptoms, child age two	0.001	-0.03	0.06	-0.10	0.20**	0.20**	0.26**	0.40**	0.15*	0.13	0.08

Note. ** $p < 0.01$, *$p < 0.05$. [a] Prenatal Tobacco Use and Prenatal Alcohol Use are ordinal variables; all other study variables are continuous. Correlations performed between continuous study variables are bivariate Pearson correlations; correlations between ordinal and continuous study variables are point-biserial correlations; the correlation between the two ordinal study variables is a Kendall Tau-beta correlation.

Main Effects of Women's Exposure to Discrimination on Offspring Sleep Health

The results of simple linear regression analyses (Model 1 in Tables 3 and 4) reflect the bivariate Pearson correlations displayed in Table 2. There was no significant association between women's exposure to racial/ethnic discrimination and child sleep health at age two ($\Delta R^2 = < 0.001$, $\Delta F = 0.10$, $p = 0.76$), whereas women's experiences of gendered racial stress were positively associated with child sleep health at age two ($\Delta R^2 = 0.07$, $\Delta F = 15.35$, $p < 0.001$), such that higher levels of gendered racial stress among women were associated with poorer sleep health in their children.

Next, we adjusted for conceptually relevant covariates and performed hierarchical multiple linear regression analyses (Models 2 and 3 in Tables 3 and 4). In all cases, we observed an attenuation in effect sizes, but our pattern of findings remained the same. There was no association between women's exposure to racial/ethnic discrimination and child sleep health at age two (Table 3). Next, we examined associations between women's experiences of gendered racial stress and child sleep health at age two, with statistical adjustment for important health and environmental variables that may influence child sleep health (Model 2, Table 4; $\Delta R^2 = 0.07$, $\Delta F = 14.07$, $p < 0.001$), and maternal depressive symptoms at child age two (Model 3, Table 4; $\Delta R^2 = 0.05$, $\Delta F = 11.15$, $p = 0.001$). After adjustment for covariates, women's experiences of gendered racial stress still explained a small, but statistically significant percentage of the variance in child sleep health at age two.

Table 3. Child Sleep Health at Age Two Regressed on Women's Exposure to Racial/Ethnic Discrimination (N = 205)

	B (SE)	*95% CI (B)*	*β*	*t*	*p*
Model 1. Unadjusted effects of Racial/ Ethnic Discrimination	-0.05 (0.17)	[-0.38 – 0.28]	-0.02	-0.31	0.76
Model 2. Effects of Racial/Ethnic Discrimination + adjustment for maternal age, SES, prenatal substance use, child age, number of people in the home at child age two	-0.07 (0.17)	[-0.41 – 0.27]	-0.03	-0.41	0.68
Model 3. Effects of Racial/Ethnic Discrimination + adjustment for maternal age, SES, prenatal substance use, child age, number of people in the home at child age two, maternal depressive symptoms at child age two	-0.16 (0.17)	[-0.50 – 0.19]	-0.07	-0.90	0.37

Table 4. Child Sleep Health at Age Two Regressed on Women's Experience of Gendered Racial Stress (N = 205)

	B (SE)	*95% CI (B)*	*β*	*t*	*p*
Model 1. Unadjusted effects of Gendered Racial Stress	0.07 (0.02)	[0.04 – 0.11]	0.27	3.92	< 0.001
Model 2. Effects of Gendered Racial Stress + adjustment for maternal age, SES, prenatal substance use, child age, number of people in the home at child age two	0.07 (0.02)	[0.04 – 0.11]	0.26	3.75	< 0.001
Model 3. Effects of Gendered Racial Stress + adjustment for maternal age, SES, prenatal substance use, child age, number of people in the home at child age two, maternal depressive symptoms at child age two	0.07 (0.02)	[0.03 – 0.11]	0.24	3.34	0.001

Examining Prenatal Sleep Quality and Prenatal Depressive Symptoms as Potential Mediators in the Association Between Women's Exposure to Discrimination and Child Sleep Health

PROCESS analyses partially supported the hypothesized mediation model (Figures 1 and 2). There was evidence of a small, but significant indirect effect of prenatal depressive symptoms on the association between women's exposure to racial/ethnic discrimination and child sleep health at age two (*B* = 0.10, *SE* = 0.06; 95% *CI B* [0.001 – 0.23]). The indirect effect accounted for 65.0% of the association between women's exposure to racial/ethnic discrimination and child sleep health. Prenatal sleep quality did not mediate this association (*B* = 0.02, *SE* = 0.03; 95% *CI B* [-0.03 – 0.08]).

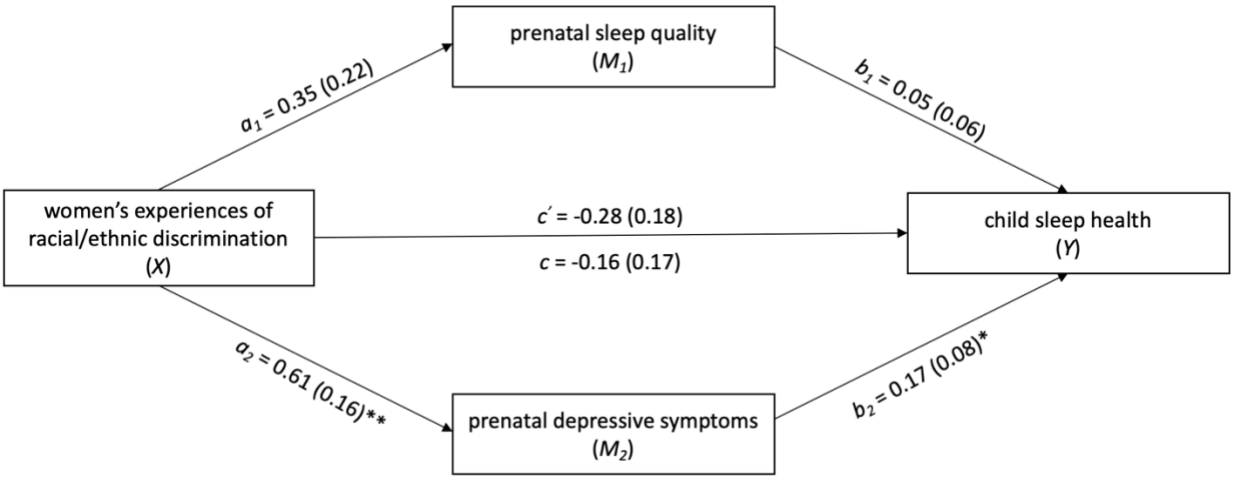
In contrast, there was no evidence of a significant indirect effect of either prenatal sleep quality (*B* = 0.002, *SE* = 0.004; 95% *CI B* [-0.01 – 0.01]) or prenatal depressive symptoms (*B* = 0.01, *SE* = 0.01; 95% *CI B* [-0.01 – 0.02]) on the association between women's experience of gendered racial stress and child sleep health at age two.

Sensitivity Analyses

Results of sensitivity analyses, in which we limited analyses to data points collected prior to the COVID-19 pandemic, indicated the same pattern of findings for both study hypotheses. This suggests that the inclusion of data collected during the early COVID-19 pandemic did not influence our findings (data not shown).

Figure 1

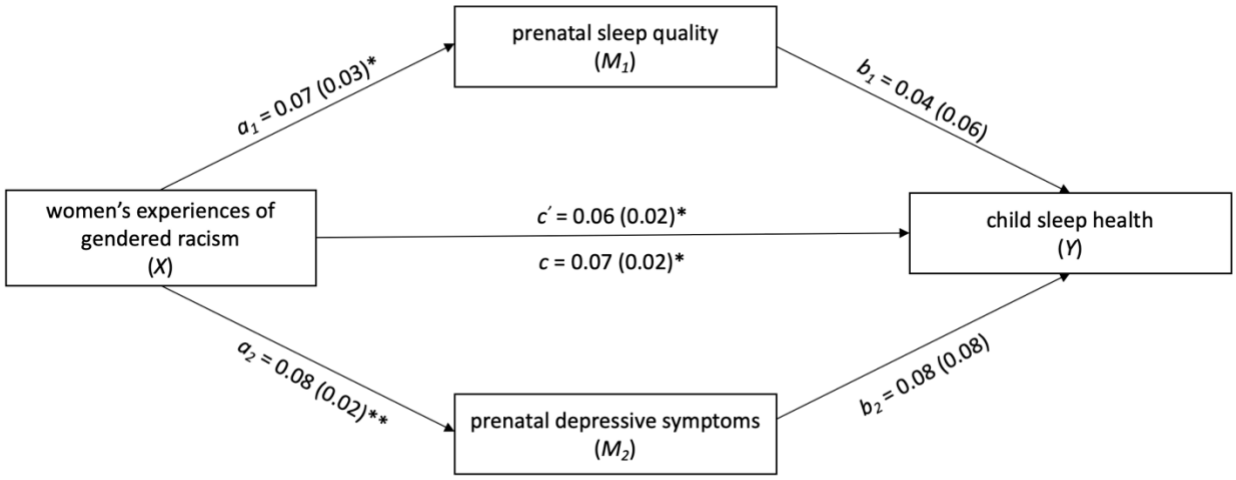
Examining Prenatal Sleep Quality and Depressive Symptoms as Parallel Mediators of the Association Between Women's Exposure to Racial/Ethnic Discrimination and Child Sleep Health at Age Two



Note. ** $p < 0.01$, *$p < 0.05$. Statistics displayed are unstandardized regression coefficients with standard errors in parentheses. The following covariates were included in the above mediation model: maternal age, SES, prenatal substance use, child age, number of people in the home at child age two, and maternal depressive symptoms at child age two. C' represents the direct effect of X on Y, or the effect of X on Y while M_1 and M_2 are held constant. C represents the total effect of X on Y, which is the sum of the direct and indirect effects of X on Y. Indirect effects (A_1*B_1 and A_2*B_2) are described in-text.

Figure 2

Examining Prenatal Sleep Quality and Depressive Symptoms as Parallel Mediators of the Association Between Women's Experience of Gendered Racial Stress and Child Sleep Health at Age Two



Note. ** $p < 0.01$, *$p < 0.05$. Statistics displayed are unstandardized regression coefficients with standard errors in parentheses. The following covariates were included in the above mediation model: maternal age, SES, prenatal substance use, child age, number of people in the home at child age two, and maternal depressive symptoms at child age two. C' represents the direct effect of X on Y, or the effect of X on Y while M_1 and M_2 are held constant. C represents the total effect of X on Y, which is the sum of the direct and indirect effects of X on Y. Indirect effects (A_1*B_1 and A_2*B_2) are described in-text.

Discussion

The results of the current study suggest that pregnant Black American women's own experiences of gendered racism are associated with poor sleep health in their two-year-old children. We also found preliminary evidence suggesting that the women's exposure to racial/ethnic discrimination indirectly influences children's sleep health via increases in women's depressive symptoms during pregnancy. Our findings are consistent with previous work demonstrating that pregnant women who report higher levels of depressive symptoms report more sleep difficulties in their toddlers, even after adjustment for postnatal depressive symptoms (O'Connor et al., 2007). In addition, pregnant women who report greater lifetime exposure to racial/ethnic discrimination report shorter sleep duration in their infants, even after adjustment for postnatal depressive symptoms (Powell et al., 2020). Chronic exposure to interpersonal

discrimination is associated with poorer health outcomes among adults (D. R. Williams, Lawrence, Davis, et al., 2019) and children (Berry et al., 2021). In the current study, we expanded the definition of exposure to discrimination by applying an intergenerational transmission of racism framework (N. J. N. J. Heard-Garris et al., 2018) to investigate how women's own experiences being discriminated against may shape the health of her young child. In doing so, we demonstrated that women's interpersonal exposure to racism and gendered racism was associated with poor sleep health in their two-year-old children.

Our findings varied by type of interpersonal exposure to discrimination. We did not find evidence of a direct association between women's lifetime exposure to racial/ethnic discrimination and two-year-old children's sleep health. However, we found evidence for a small, but significant indirect effect between these constructs. As hypothesized, we demonstrated that women's prenatal depressive symptomatology mediated the positive association between greater lifetime exposure to racial/ethnic discrimination and poor sleep health in women's two-year-old children. Prenatal depressive symptomatology occurs within the broader sociocultural context and is elevated among pregnant women who have experienced higher levels of racial/ethnic discrimination throughout their lifetimes (Earnshaw et al., 2013; Ertel et al., 2012). As mentioned previously, findings from pre-clinical and clinical study samples indicate that higher levels of prenatal stress and depressive symptomatology – respectively – are associated poorer sleep health in offspring (Palagini et al., 2015). Elevated levels of stress experienced by pregnant women may be transmitted to their offspring through biological mechanisms that occur *in utero.* The prenatal specificity of these effects is consistent with the Barker Hypothesis (Barker, 1992). One potential biological mechanism of transmission may be as follows: increased stress and/or elevated depressive symptoms during a woman's pregnancy may alter

gene expression that dictates how permeable the placenta is to glucocorticoids produced by the mother (Palagini et al., 2015). With the placenta more susceptible to glucocorticoid exposure, cortisol – rather than the benign cortisone – crosses the placental barrier, triggering alterations in fetal neural functioning and shaping aspects of infant and early childhood health (Glover, 2015). Supporting this hypothesis, recent findings from a study of fetal neural development indicate links between elevated prenatal maternal stress and sleep difficulties in women's three-year-old children. Elevated prenatal maternal stress was also associated with decreased fetal neural connectivity in the cerebellum, which the authors originally proposed as a mechanism (van den Heuvel et al., 2021). The authors did not find evidence of an indirect effect, but they suggested that different neural connectivity pathways in the fetal brain may underly links between maternal prenatal psychological distress and children's sleep in the first few years of life.

To our knowledge, the current study is the first to examine maternal prenatal depressive symptomatology as a mediator in the association between women's exposure to racial/ethnic discrimination and their young children's sleep health. We sought to first establish this relationship before examining potential biological mechanisms of transmission that may underly these associations. We encourage future researchers to expand upon findings from the current study by examining biological mediators that may serve as physiological markers of pregnant women's stress and/or mood symptoms and may explain the association between women's exposure to racial/ethnic discrimination and their two-year-old children's sleep health.

Our second mediation hypothesis – that women's prenatal sleep quality would also mediate associations between racial/ethnic discrimination and children's sleep health – was not supported. To our knowledge, few studies have examined links between pregnant women's sleep and their children's sleep (Newland et al., 2017), despite evidence that poorer sleep quality

during pregnancy is associated with higher levels of systemic inflammation, which are in turn associated with poorer child health outcomes (Blair et al., 2015). Previous work has examined levels of pro-inflammatory cytokines as a mediator in the association between prenatal sleep quality and preterm birth outcomes, but it is possible that the effects of systemic inflammation during pregnancy extend to outcomes later in children's development, past the neonatal period. Based on findings from previous research that greater interpersonal exposure to racial/ethnic discrimination is associated with poorer sleep quality during a woman's pregnancy (Francis et al., 2017), and known associations between prenatal sleep quality and depressive symptoms (L. M. Tomfohr et al., 2015), we hypothesized that women's mood and/or sleep may mediate associations between women's lifetime exposure to racism and their children's sleep health. Indeed, recent research indicates that adults who have experienced chronic stress, such as higher levels of childhood adversity, have a greater inflammatory response in the context of shortened or poor quality sleep (John-henderson et al., 2022). In the current study, there was a moderate correlation between pregnant women's depressive symptoms and their sleep quality. Our use of a parallel mediator model accounted for the correlation between these constructs, and prenatal depressive symptomatology was ultimately found to be a stronger mediator variable. However, given positive associations between women's exposure to discrimination and poorer sleep quality in pregnancy, future researchers may also consider examining objective measures of women's sleep health during pregnancy as potential mediator variables. Our measure of prenatal sleep quality has not been validated among pregnant women despite being used in several studies of perinatal health (Bei et al., 2020; Mersky et al., 2019). The use of objective prenatal sleep data may be needed to more fully assess this potential mediator. In sum, in the current study, while women's exposure to racial/ethnic discrimination was associated with poorer sleep quality

during pregnancy, prenatal sleep quality did not mediate associations between women's experiences of racism and their two-year-old children's sleep health.

Consistent with recommendations that researchers apply an intersectionality framework to better understand associations between discrimination and sleep health (Johnson et al., 2019), we additionally examined associations between Black American women's exposure to gendered racism and their two-year-old children's sleep health. There was a significant, direct effect between these constructs, such that higher levels of reported gendered racial stress were associated with poorer sleep health in women's two-year-old children, even after adjustment for important covariates, including women's depressive symptoms when children were two years old. We did not find evidence that either women's prenatal sleep quality or depressive symptomatology mediated this association. This suggests that other factors may explain the association between these constructs.

Our proposed mechanisms of transmission were specific to the prenatal period, but it is entirely possible that postnatal factors may mediate the association between women's exposure to gendered racism and their two-year-old children's sleep health. In the only known study to examine similar associations, Powell and colleagues hypothesized that greater exposure to racial/ethnic discrimination may be associated with a decreased ability to provide warm and responsive parenting (Powell et al., 2020). Parenting behaviors may mediate the association between women's exposure to racism, or in the case of the current study, gendered racism, and poorer sleep health in toddler age children. For instance, women who report elevated psychological distress experience poorer sleep themselves, which is in turn associated with lower levels of warm, responsive parenting (McQuillan et al., 2019). Lower levels of warm and responsive maternal parenting behaviors at bedtime are associated with poorer sleep health in

infants (e.g., shorter sleep duration, more night awakenings; Philbrook & Teti, 2016), consistent with the idea that young children may benefit from parents' emotional availability to learn how to self-soothe and sleep well (Sadeh et al., 2010). The ability to provide consistent warm and responsive parenting behaviors may be compromised among women who experience significant psychological burden and demand, such as women exposed to higher levels of gendered racism. In keeping with the Barker Hypothesis (Barker, 1992), in the current study, we conceptualized our mediator variables as occurring in the context of pregnancy and transmitting effects to children's sleep health via intrauterine physiological processes. As such, we did not examine potential *postnatal* exposures or mechanisms of transmission. While two-year-old children's sleep health may be shaped by prenatal processes (O'Connor et al., 2007), it is also likely that more proximal postnatal environmental variables such as parenting behaviors have bearing on young children's sleep. We recommend that future researchers examine parenting behaviors as a potential mediator in the association between women's experiences of gendered racism and their two-year-old children's sleep health.

Limitations

The current study is not without limitations. First, we assessed women's exposure to racial/ethnic discrimination and gendered racism using measures that consider interpersonal exposures. We did not specifically assess for women's exposure to institutional racism and/or gendered racism, despite evidence that societal and structural factors are associated with poorer sleep health in children (MacKinnon et al., 2020; L. M. Tomfohr-Madsen et al., 2020). For instance, infants living in neighborhoods that have a high percentage of residents whose highest education level is a high school diploma, whose incomes are below the national poverty line, and receive federal assistance have poorer sleep quality (Grimes et al., 2019). In the current study,

we were primarily interested in Black American women's interpersonal exposure to racial/ethnic discrimination as we aimed to replicate the only – to our knowledge - previous study that examined associations between this construct and children's sleep health (Powell et al., 2020). Women's reports of interpersonal exposure to racism are predictive of greater depressive symptomatology during pregnancy (Earnshaw et al., 2013; Ertel et al., 2012) and highlight women's understanding perceptions based on race, ethnicity, or skin color. Similarly, our measure of women's gendered racial stress is by nature interpersonal (F. M. Jackson et al., 2005). We did control for contextual factors such as mothers' SES (i.e., income, education level) and the number of people living in the home when children were two years old, given associations between each of these constructs and children's sleep health. However, our knowledge concerning the intergenerational impacts of discrimination on children's sleep health would be further strengthened by incorporating indices of institutional discrimination, such as neighborhood census tracts.

A second limitation is that all measures were self-report questionnaires completed by participants. Measuring women's experiences of racism, gendered racism, prenatal depressive symptomatology, prenatal sleep quality, and toddler sleep health via maternal self-report may have resulted in shared method variance. In other words, women who have experienced greater stress or are more depressed may answer questions about themselves or their children's behavior with a negative cognitive bias (Goodman & Gotlib, 1999). To account for the possibility that women predisposed to more negative emotionality may have reported worse sleep in their two-year-old children regardless of children's actual sleep health, we adjusted for women's depressive symptoms when children were two years old in all study analyses. This allowed us to isolate the effects of women's exposure to racial/ethnic discrimination or gendered racism – as

measured during pregnancy – even in the context of women's mood state at the time of the age two study visit. Relatedly, the current study would have been further strengthened had we utilized objective measures of children's sleep health such as actigraphy. The current study constituted a secondary data analysis of a larger study that did not include additional measures of children's sleep health. While maternal report of children's sleep health is informative, it may retain an aspect of bias and does not capture all aspects of children's sleep (Meltzer et al., 2021), particularly if children are sleeping in a different room than their mother, which may be the case for two-year-old children in the current study sample. We recommend that future studies examining associations between women's exposure to racism or gendered racism and their children's sleep health include both maternal report of child sleep as well as objective sleep data.

Strengths

Despite these limitations, the current study has several strengths. First, our measure of racial/ethnic discrimination has previously been used in a sample of pregnant Black American women to examine associations between discrimination and prenatal depressive symptoms (Ertel et al., 2012). In addition, this measure was used as a predictor variable in the only known – to our knowledge – study to previously investigate associations between women's exposure to discrimination and their young children's sleep health (Powell et al., 2020). Therefore, our use of the Experiences of Discrimination measure (Krieger et al., 2005) allows us to situate the current study within the extant literature on pregnant women's lifetime exposure to racism and maternal child health outcomes. Next, we additionally explored all study hypotheses using the Jackson, Hogue, Phillips Contextualized Stress measure. This measure was borne out of intersectionality theory (Bowleg, 2012; Crenshaw, 1991), and was developed to specifically understand the ways in which racism and sexism overlap and simultaneously shape Black American women's health

and wellbeing. The use of this measure of gendered racial stress strengthens the current study. It allows us to consider how discriminatory stress specific to Black American women's dual, interlocking racial/ethnic and gender identities may confer risk for their health and the health of their two-year-old children.

Additionally, our assessments of racial/ethnic discrimination and gendered racism are not time-bound and instead assess women's exposure to discrimination across the life course. This is consistent with recommendations from Gee and colleagues (2012), who assert that exposure to discrimination is cumulative. That is, earlier exposures shape individuals' vulnerability to subsequent exposures. It is the collective sum of these exposures that is associated with health outcomes, rather than any one exposure in isolation. Finally, we took a novel approach to understand whether women's experiences of discrimination were associated with their two-year-old children's sleep health, at least partly via women's prenatal depressive symptoms. While previous research has thoroughly examined associations between pregnant women's mood symptoms and their infant and toddlers' sleep health (O'Connor et al., 2007), to our knowledge, only one study to date has applied an intergenerational transmission of racism approach to examine associations between pregnant women's exposure to discrimination and their children's sleep health (Powell et al., 2020). In the current study, we united two previously siloed literatures to examine preconception and prenatal influences on two-year-old children's sleep health. We hope that future research will further expand upon our findings.

Conclusions

The current study adds to the growing literature on the intergenerational transmission of the effects of racism on pregnant Black American women to their young children (N. J. N. J. Heard-Garris et al., 2018). We demonstrated that Black American women's exposure to

gendered racism was associated with poorer sleep health in their two-year-old children, and that higher levels of exposure to racial/ethnic discrimination were associated with poorer sleep health in children, at least partly via women's depressive symptoms in mid-pregnancy. These findings highlight the importance of deliberately attending to the experiences of Black American women who present for prenatal care. Black American women are particularly vulnerable to both racism and gendered racism and these stress exposures carry risk for their own physical and mental health during pregnancy, as well as their children's sleep health, a transdiagnostic marker of overall pediatric health. Prenatal care providers should sensitively screen for and inquire about women's exposure to discrimination with the understanding that women who report higher levels of exposure may derive particular benefit from culturally sensitive interventions that target psychological outcomes and overall wellbeing. For instance, women who report higher levels of exposure to discrimination may be good candidates for CenteringPregnancy, a group based prenatal intervention that has been linked to better maternal child health outcomes in Black American women and their infants (Picklesimer et al., 2012). More broadly, larger structural factors perpetuate discrimination and put Black American women at risk for poorer health outcomes (Lu et al., 2010). Both individual and structural level changes are needed to truly mitigate consequences. Eliminating racism and gendered racism will benefit the health of women and have downstream effects on the health of their children, thereby breaking harmful intergenerational cycles of risk.

General Discussion

In the current dissertation study, higher levels of lifetime exposure to different types of interpersonal discrimination were negatively associated with Black American women's sleep quality during pregnancy and their two-year-old children's sleep health. These studies add to the extant literature on discrimination and sleep health, which has predominantly been focused on understanding associations between these constructs among non-pregnant adults or has typically examined direct rather than intergenerational associations (Slopen et al., 2016). In contrast to previous work, the current dissertation study was designed to underscore the developmental significance of pregnancy as a critical period when the risks associated with discriminatory stress exposures may be transmitted across two generations, and may therefore have negative implications for sleep health – a transdiagnostic marker of adult and pediatric health (Buysse, 2014; Meltzer et al., 2021) – in both women and their children. In Study 1, higher levels of interpersonal exposure to racial/ethnic discrimination and gendered racial stress among pregnant Black American women were associated with poorer sleep quality during both early and mid-pregnancy, although findings attenuated after adjustment for women's prenatal depressive symptoms. In Study 2, higher levels of gendered racial stress among pregnant Black American women were directly associated with poorer sleep health in their two-year-old children. Relatedly, higher levels of interpersonal exposure to racial/ethnic discrimination among pregnant Black American women were indirectly associated with poorer sleep health in their two-year-old children, via women's prenatal depressive symptoms. Taken together, findings from the current dissertation study highlight the importance of attending to Black American women's unique lived experiences when examining factors that may shape their prenatal sleep quality and the eventual sleep health of their children.

The Roles of Racial/Ethnic Discrimination and Gendered Racial Stress

We examined pregnant Black American women's lifetime exposure to both racial/ethnic discrimination and gendered racism as predictor variables in all hypothesized associations. In both studies, our findings slightly varied by type of interpersonal exposure to discrimination, such that associations between discrimination and sleep health were typically stronger when gendered racial stress was utilized as the predictor variable of interest. This pattern of findings was not entirely surprising, and likely reflects important construct-level differences in our assessments of participants' exposure to racial/ethnic discrimination (Krieger et al., 2005) and gendered racial stress (F. M. Jackson et al., 2005). These differences are not simply methodological, but instead, they indicate broad, clinically relevant differences in our understanding of the constructs of racism and gendered racism.

In all study hypotheses, we analyzed women's interpersonal exposure to racial/ethnic discrimination and gendered racism as unique predictor variables, rather than in combination. Our measure of racial/ethnic discrimination, the Krieger Experiences of Discrimination measure (Krieger et al., 2005), tapped participants' interpersonal exposure to racism in nine settings (i.e., at school, during a hiring process, in the workplace, when obtaining housing, in medical settings, in retail establishments, at a financial institution, in public, or within the criminal justice setting). Participants were instructed to consider whether they had been discriminated against in each of these settings based on their race, ethnicity, and/or skin color. There was no mention of participants' gender or their identity as women. In contrast, our measure of gendered racial stress, the Jackson, Hogue, Phillips Contextualized Stress Measure (F. M. Jackson et al., 2005), was specifically developed in response to intersectionality theory (Crenshaw, 1991) to assess the discriminatory stress associated with being both Black and female in America. Moreover, this

measure was normed and validated in a sample of Black American women in urban Atlanta, a sample demographic that mirrors that of the current dissertation study sample. Intersectionality theorists assert that Black American women are vulnerable to multiple, interlocking stressors as a function of both their race/ethnicity and their gender (Bowleg, 2012; J. A. Lewis et al., 2017). As such, the discrimination experienced by Black American women cannot be accounted for by their race/ethnicity or their gender as separate entities, but rather, by the interaction between these two interrelated and often inseparable characteristics. Illustrating this, our measure of gendered racial stress therefore includes questions such as, "Individuals assume that I am incapable of performing a job," as well as "White women have a lot more opportunities than I do." Inspection of items on the Jackson, Hogue, Phillips Contextualized Stress Measure suggests that this measure may be more nuanced in capturing the lived experiences of Black American women specifically. In contrast, while the Krieger Experiences of Discrimination measure has previously been used to assess for pregnant Black American women's lifetime exposure to racial/ethnic discrimination (e.g., Ertel et al., 2012; Powell et al., 2020), it was originally developed and validated in a sample of non-pregnant Black, Hispanic, and white American adults. This measure may be less well-suited to assessing the full spectrum of discriminatory stress exposures that Black American women are specifically vulnerable to. These differences were borne out in our pattern of findings across both studies, with associations between discrimination and sleep health typically being more robust when we utilized gendered racial stress as the predictor variable.

To our knowledge, the current dissertation study is the first to examine associations between pregnant Black American women's lifetime interpersonal exposure to *both* racial/ethnic discrimination and gendered racism and perinatal and/or pediatric sleep health outcomes. One

goal of the discrimination and sleep health literature is to inform culturally sensitive sleep interventions for populations who are disproportionately exposed to interpersonal discrimination. Racial/ethnic discrimination is unequivocally harmful for individuals' sleep health (Slopen et al., 2016), and at the same time, discriminatory exposures are not necessarily limited to features such as individuals' skin color, although they may certainly be exacerbated by one's race/ethnicity. To better inform clinical intervention development, when possible, we encourage future researchers to include measures of discrimination that capture multiple characteristics of individuals' backgrounds (e.g., race/ethnicity, gender, age, nativity status, etc.). This methodological approach is rooted in intersectionality theory (Bowleg, 2012; Crenshaw, 1991), and has previously been called for in studies of discrimination and sleep health (Johnson et al., 2019). Attending to individuals' intersectional identities will further elucidate associations between discrimination and sleep health and may provide important context in future examinations of the mechanisms that underlie these associations.

The Role of Prenatal Depressive Symptoms

Given known associations between higher levels of depressive symptomatology and poorer sleep health in both non-pregnant (Alvaro et al., 2013; Kahn et al., 2013) and pregnant adults (L. M. Tomfohr et al., 2015), we carefully considered the role of women's prenatal depressive symptoms in the current dissertation study. Sleep disturbances are a core clinical feature of depressive symptomatology (American Psychiatric Association, 2013), and indeed, our pattern of findings highlights the importance of attending to perinatal women's depressive symptoms when examining their own prenatal sleep quality and the sleep health of their two-year-old children.

In Study 1, our primary focus was on understanding whether women's lifetime

interpersonal exposure to racial/ethnic discrimination and gendered racism was associated with poorer sleep quality during the first and second trimesters of pregnancy, even in the context of women's concurrent prenatal depressive symptoms. As hypothesized, higher levels of lifetime exposure to racial/ethnic discrimination and gendered racial stress were associated with poorer sleep quality in early pregnancy even after adjustment for women's concurrent prenatal depressive symptoms. However, in mid-pregnancy, after adjustment for women's concurrent prenatal depressive symptoms, the association between women's lifetime interpersonal exposure to racial/ethnic discrimination and their prenatal sleep quality was no longer significant, whereas the association between gendered racial stress and sleep quality remained significant. In all cases, effect sizes in these associations decreased when women's concurrent depressive symptoms were added to the statistical models. One interpretation of this attenuation of effect may be that higher levels of lifetime exposure to discrimination are predictive of greater depressive symptomatology during pregnancy, which may, in some cases, may be expressed through poorer sleep quality.

There is some support for this hypothesis, in that several authors have reported associations between Black American women's lifetime exposure to racial/ethnic discrimination and poorer psychological functioning (Giurgescu et al., 2017) and higher levels of depressive symptomatology (Earnshaw et al., 2013) during pregnancy. In Study 1, we replicated the only – to our knowledge – study to examine associations between discrimination and sleep quality during pregnancy (Francis et al., 2017). We replicated the work of Francis and colleagues who reported that their findings held even after adjustment for women's prenatal depressive symptomatology. Taken together, findings from Study 1 and the preliminary extant literature suggest that associations between women's lifetime exposure to discrimination and prenatal

sleep quality persist, even in the context of concurrent depressive symptoms. However, the risk for depressive symptomatology may be heightened among pregnant women who have been subjected to repeated interpersonal discrimination, which may in turn, confer risk for poorer sleep quality. Longitudinal studies with multiple assessments of these constructs across pregnancy are needed to fully test this mediational hypothesis.

In Study 2, our primary focus was on investigating associations between women's lifetime interpersonal exposure to discrimination and their two-year-old children's sleep health. Based on previous work in human and non-human animal studies (Palagini et al., 2015), we also focused on prenatal mechanisms that might mediate this association. Specifically, we predicted that higher levels of interpersonal exposure to discrimination across women's lifetimes would be associated with higher levels of prenatal depressive symptomatology and/or poorer prenatal sleep quality, which, in turn, would be associated with poorer sleep health in women's two-year-old children, even after adjusting for the effects of women's postnatal depressive symptomatology. While we did not find evidence for prenatal sleep quality as a mediator, prenatal depressive symptoms were a small, yet statistically significant mediator of the association. In essence, greater lifetime exposure to racism may confer risk for women's psychological wellbeing during pregnancy. Higher levels of prenatal depressive symptomatology may in turn confer risk for offspring functioning and behavior, including offspring sleep health, and this risk may be transmitted via biological processes that occur *in utero.*

The current dissertation study was designed to provide preliminary support for these associations but was not designed to examine prenatal biological mechanisms of transmission that may occur in the context of prenatal depressive symptomatology – such as alterations in the hypothalamic-pituitary-adrenal (HPA) axis that result in higher levels of glucocorticoid

transmission from mothers to their offspring. This has previously been cited as a gap in studies that examine intergenerational associations between maternal prenatal stress and early childhood sleep health (O'Connor et al., 2007) We encourage future researchers to further examine prenatal biological factors that may mediate the association between women's exposure to discrimination and their young children's sleep health. In addition, future studies should also include postnatal risk factors (e.g., parenting behaviors, postnatal maternal depressive symptoms) that may shape children's sleep health, as this aids in assessing the prenatal specificity of effects. Indeed, more proximal – relative to prenatal biological processes of intergenerational transmission – environmental factors may have intergenerational influences on children's sleep health, including parenting behaviors (Philbrook & Teti, 2016) and the broader family makeup and context (Covington et al., 2021) A multimethod approach that includes biological and behavioral markers of prenatal depressive symptomatology as well as known postnatal correlates of children's sleep health will allow us to better understand whether the risk for poorer pediatric sleep health begins during fetal development because of maternal psychological functioning and/or is primarily the result of early childhood environmental factors.

Future Directions – The Role of Environmental Factors

The current dissertation study was designed to examine the effects of interpersonal exposure to racial/ethnic discrimination and gendered racial stress on prenatal sleep quality and pediatric sleep health. We aimed to replicate and extend preliminary findings from emerging studies on these topics that also employed measures of lifetime exposure to interpersonal discrimination. As such, we did not examine the broader role of institutional discrimination and its influence on environmental factors that are additionally associated with sleep health, including the neighborhood context, for example (Hale et al., 2015). For instance, longstanding

policies of institutional discrimination have resulted in ongoing residential segregation, such that Black American individuals are more likely than their white counterparts to live in neighborhoods that are predominantly occupied by other Black American individuals (D. R. Williams & Collins, 2001). These neighborhoods tend to be more socioeconomically disadvantaged, with lower levels of household income than the national average and higher rates of neighborhood conflict and crime (D. R. Williams & Collins, 2001). These environmental characteristics have potential consequences for perinatal women's wellbeing. For instance, within a sample of postpartum Black American women, those who reported higher levels of perceived neighborhood disorder and crime also reported higher levels of psychological distress 24-72 hours post-birth. Furthermore, objective measures of neighborhood disorder (i.e., yearly crime data) were additionally associated with higher levels of postnatal psychological distress (Giurgescu et al., 2012), suggesting that women's perceptions of their neighborhood as safe or unsafe relatively aligned with objective data. Importantly, both perceived (Johnson et al., 2015) and objective metrics of neighborhood safety (DeSantis et al., 2013) are associated with poorer sleep health among non-pregnant adults. In the current dissertation study, we did not include environmental measures of neighborhood safety (e.g., self-report, census tract data, crime reports) that may reflect indirect pathways through which institutional discrimination exerts influence on sleep health (Johnson et al., 2018). This is an important future direction, one that to our knowledge, has not been explored within samples of pregnant women. However, recent evidence suggests that higher levels of objectively-measured neighborhood deprivation are associated with longer and more frequent night awakenings in three-month old infants (Grimes et al., 2019). Environmental context matters for child and family functioning and development (Bronfenbrenner, 1986). We therefore encourage future researchers examining associations

between discrimination and perinatal and pediatric sleep health to reconceptualize discrimination as both an interpersonal and environmental or institutional stressor.

Future Directions - Pathways Linking Discrimination and Sleep Health

The current dissertation study was designed to replicate and extend recent research indicating direct (Francis et al., 2017) and intergenerational associations (Powell et al., 2020) between discrimination and sleep health in Black American women and children during pregnancy and early childhood, respectively. As these studies are, to our knowledge, some of the first of their kind, we did not aim to examine potential biological pathways of transmission between these constructs in either study, but particularly in Study 1, in which our focus was on establishing direct effects. However, as stated previously, it is important to provide context for pathways that may underlie direct associations between discrimination and sleep health, as sufficient context helps to strengthen the interpretation of study findings and generate new research questions and potential intervention targets. Several biological mechanisms of transmission may underlie direct associations between women's lifetime exposure to discrimination and poorer sleep quality during pregnancy, including disturbances in sleep staging and architecture, for example.

Higher levels of discrimination experienced by non-pregnant Black American adults are associated with disturbances in sleep architecture. These individuals may spend less time in Slow Wave Sleep – a restorative phase in the nightly sleep cycle – and greater time in Stage 2 sleep – a phase of light sleep that is less physiologically restorative for the body and brain (Tomfohr et al., 2012). Such disturbances in sleep architecture may be linked to non-pregnant adults' own perceptions of their sleep quality (Ohayon et al., 2017) although during pregnancy, these markers of sleep health do not tend to be highly correlated (Garbazza et al., 2020). We recommend that

future work focus on understanding what – if any – *physiological* aspects (e.g., alterations in sleep architecture, difficulties with sleep onset, prolonged night awakenings, etc.) of poor sleep quality are negatively affected by pregnant women's lifetime exposure to chronic stressors such as discrimination. This information will be particularly useful to clinicians who assess and treat poor sleep quality during the perinatal period, as different aspects of poor sleep quality may be more or less responsive to components of cognitive behavioral therapy for insomnia, an effective treatment for poor sleep quality during pregnancy and the postpartum (Bei et al., 2019; Kalmbach, Cheng, O'Brien, et al., 2020; Lianne M. Tomfohr-Madsen et al., 2017).

Limitations – Sampling and Measurement

The current dissertation study is not without limitations. With respect to sample diversity, both studies were conducted within samples of Black American women and their children, with no racial/ethnic comparison group. The larger sample from which both study samples were drawn consists of a cohort of women who received prenatal care – beginning with their first prenatal care visit – at either a public or private hospital in urban Atlanta (Corwin et al., 2017). This larger cohort study was developed with the intention of sampling pregnant Black American women across a wide range of socioeconomic backgrounds, to better understand the risk factors associated with preterm birth across socioeconomic strata. We view this minority health perspective as a strength of the current study (Alvidrez et al., 2019), as it permits us to better understand the full range of experiences among pregnant Black American women. However, results from the current dissertation study may not generalize to women in rural areas who did not obtain healthcare in metropolitan Atlanta, to women who initiated prenatal care later in pregnancy, or to women who never initiated prenatal care. Black American women face significant barriers to obtaining quality prenatal healthcare. Compared to their white

counterparts, they report longer wait times and greater difficulty physically getting to prenatal care appointments (Beckmann et al., 2000), and a greater percentage of Black American women do not initiate prenatal care until their final trimester of pregnancy or never initiate care (10% versus 4% of white women; Gadson et al., 2017). The current dissertation study was not equipped to capture the experiences of these women, though it is possible that associations between discrimination and prenatal sleep quality and/or pediatric sleep health would have been stronger among women who may be at greater risk of discriminatory stress exposures. While the current dissertation study is fairly representative of the greater Atlanta community, we acknowledge that research sampling methods still carry bias, and we encourage future researchers to thoughtfully design studies that seek to mitigate these biases.

The larger, prospective longitudinal study from which participants in the current dissertation study were recruited was specifically designed to examine biopsychosocial influences on maternal/child health in Black American women and children across multiple levels of SES. Participants in both studies that comprise the current dissertation study were recruited during pregnancy from two hospitals in metropolitan Atlanta, one private, and one public (Corwin et al., 2017), in an effort to understand the lived experiences of pregnant Black American women from a variety of sociocultural backgrounds. While this was an *a priori* goal of the larger study, in the current dissertation study, we did not have *a priori* predictions that results would vary across study recruitment sites, which is somewhat inconsistent with our hypothesis in Study 1 that associations between discrimination and sleep quality would be stronger among women who reported higher levels of SES. To address this limitation, we examined the distribution of Study 1 and 2 participants across by recruitment site and performed post-hoc analyses with study recruitment site as a potential moderator of all hypothesized associations.

Sample distribution by study recruitment site was similar across studies in the current dissertation: in Study 1, n = 223 of all N = 600 (37%) participants were recruited from a private hospital; in Study 2, n = 74 of all N = 205 (36%) were recruited from a private hospital. Study recruitment site did not significantly moderate any of the hypothesized associations in Study 1 or Study 2 (data not shown). The fact that study recruitment site did not emerge as a significant moderator is somewhat supported by findings from Study 1, in which SES did not emerge as a significant moderator of the association between women's lifetime exposure to discrimination and their sleep quality during pregnancy. Study recruitment site may be a proxy for SES, in that one recruitment site was a private hospital, which typically offers healthcare services to women who have consistent access to private health insurance. In contrast, the second study recruitment site was a public hospital, which services women with a broader range of health insurance coverage options, including women who receive healthcare during pregnancy via Medicaid (D'Angelo et al., 2015). We performed post-hoc independent samples t-tests to examine potential differences in demographic variables by study recruitment site. As expected, in Study 1 and 2, participants recruited from private versus public hospital prenatal clinics tended to have higher levels of completed education and income (data not shown). However, despite differences in participants' demographic backgrounds, our pattern of findings remained the same across study sites, suggesting that, at least in the current dissertation study, higher levels of lifetime exposure to discrimination are associated with 1) poorer sleep quality during a woman's pregnancy as well as with 2) poorer sleep health in their two-year-old children, irrespective of several proxies for women's socioeconomic standing, including income level, education, and health insurance. It is altogether possible that other markers of SES may moderate these associations (e.g., home location and/or quality, relationship status). However, current data

suggest that exposure to discrimination is a contextual stressor that negatively shapes prenatal and early childhood sleep health, across multiple levels of a woman's social standing, and that several markers of SES do not serve as additional risk or protective factors in strengthening or weakening these associations.

An additional limitation of the current dissertation study is the exclusive use of self-report measures of prenatal sleep quality and early childhood sleep health. As mentioned previously, the current dissertation study was a secondary data analysis of a larger prospective longitudinal cohort study examining biopsychosocial influences on maternal child health. The larger cohort study was not specifically designed as a sleep health study, and thus did not include objective sleep data a priori (i.e., actigraphy or polysomnography). Fortunately, both the prenatal and early childhood components of the larger study included self-reports of pregnant women's and two-year-old children's sleep, but the use of *both* objective and self-report sleep health data may have strengthened the interpretation of findings from the current dissertation study. Multimodal assessments of sleep health are valuable, as they have the potential to uncover differences and overlap in individuals' perceptions of problematic sleep and their objective sleep patterns. For example, in a sample of women in their third trimester of pregnancy, higher levels of depressive and anxiety symptoms were associated with poorer self-reported sleep quality, but not with markers of sleep health obtained via actigraphy (Volkovich et al., 2016). However, moderation analyses indicated that for women who reported the highest levels of depressive and anxiety symptoms, self-reported sleep quality and actigraphic sleep health data were moderately correlated. In other words, pregnant women experiencing greater psychological impairment appeared more accurate in their reports of poor sleep quality. This is clinically relevant, as individuals are more likely to seek treatment for sleep difficulties based on self-perception that

their sleep is in some way poor and may have bearing on other aspects of their wellbeing, including their mood (Khader et al., 2021). The use of self-report measures of sleep in the current dissertation study is valuable, inasmuch as we captured participants' perceptions of their own sleep and the sleep of their children. However, comparison with objective sleep measures would have increased the robustness of our findings. In sum, while the use of self-report data to assess prenatal sleep quality and pediatric sleep health was valuable, future researchers should consider multimodal study designs that additionally incorporate objective sleep data to better understand the links between perception and physiology.

Conclusions

The current dissertation study built upon the extant discrimination and sleep health literature, by examining associations between these constructs in the largely understudied pregnant population and additionally examining intergenerational associations between these constructs from mothers to their two-year-old children. Consistent with recent recommendations for researchers examining associations between discrimination and sleep health (Johnson et al., 2019), the two studies in this dissertation were informed and strengthened by an intersectionality framework. When operationalizing discrimination as a stress exposure, the current dissertation study considered pregnant Black American women's lifetime exposure to both interpersonal racial/ethnic discrimination and gendered racism as potential risk factors for their prenatal sleep quality and their two-year-old children's sleep health. In sum, higher levels of self-reported discrimination were associated with poorer sleep quality during women's pregnancies, and with poorer sleep health in their children. Optimal sleep health is a transdiagnostic marker of health in both perinatal women and children (Armstrong et al., 2021; Sedov et al., 2018). Given marked sleep health disparities in both pregnant women (Feinstein et al., 2020) and children as young as

age two (Smith et al., 2019), such that Black American women and children experience shorter, poorer quality sleep, ongoing exploration of the links between sleep health and stressors that disproportionately affect Black Americans such as discrimination is needed. Fortunately, sleep is a modifiable target for clinical intervention. Examining these questions in the context of pregnancy or across the perinatal period into early childhood aids in identifying critical social risk factors and treatment targets for maternal child sleep health. This work highlights the importance of mitigating and eliminating harmful direct and intergenerational effects of racism and gendered racism on Black American women and their families.

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