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Social Determinants of Maternal Antenatal Depression

Lucinda L Scott

A dissertation

submitted in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy in the Department of Psychology

Idaho State University

Summer 2022

Committee Approval

To the Graduate Faculty:

The members of the committee appointed to examine the dissertation of Lucinda L. Scott find it satisfactory and recommend it be accepted.

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Human Subjects Committee Approval

April 19, 2021

Lucinda Scott
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RE: Study Number IRB-FY2021-127: Social Determinants of Maternal Antenatal Depression

Dear Ms. Scott:

Thank you for your responses to a full-board review of the study listed above. Your responses are eligible for expedited review under FDA and DHHS (OHRP) regulations. This is to confirm that I have approved your application.

Notify the HSC of any adverse events. Serious, unexpected adverse events must be reported in writing within 10 business days.

You may conduct your study as described in your application effective immediately. The study is subject to renewal on or before April 19, 2022, unless closed before that date.

Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Tom Bailey (208-282-2179; email humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

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Table of Contents

Social Determinants of Maternal Antenatal Depression

Dissertation Abstract – Idaho State University (2022)

Social determinants of health (SDH) have a demonstrable impact on maternal health throughout pregnancy and postpartum, with systematic reviews indicating that such factors (including racial-ethnic group, income, educational attainment, employment status, and social support) are determinants of maternal antenatal depressive symptoms. Research further suggests potentially higher prevalence rates and severity of depressive symptoms among maternal antepartum and postpartum participants residing in "rural" areas as compared to those in the general population. Similarly, those residing in health professional shortage areas (HPSAs) may have worse health outcomes than those in the general population. However, there is a dearth of literature regarding the impact of residence in an HPSA on mental health or maternal mental health during pregnancy.

This study sought to determine the impact of SDH, including racial-ethnic group, income, educational attainment, employment status, social support, and area of residence, on the severity of maternal antenatal depressive symptoms, and to clarify the potential interactive impact of residing in a HPSA for primary care (pcHPSA) or HPSA for mental health (mhHPSA), on the relationship between SDH and maternal antenatal depressive symptoms.

Findings indicate a significant, protective relationship between level of social support and antenatal depressive symptoms. Statistically significant increases in depression symptoms were demonstrated for individuals endorsing a Spanish/Hispanic/Latino ethnic background and/or Black or African American, Hispanic/Latino, or Asian origin as compared to those who identified as Non-Hispanic and White in the context of pcHPSA status, and when residing outside of a mhHPSA. No significant differences in depression symptoms by racial-ethnic group

was demonstrated for those residing within a mhHPSA. An association between increased hours typically worked and increased maternal antenatal depression symptoms was demonstrated in the context of mhHPSA status. A significant interactive effect of mhHPSA status on the relationships between racial-ethnic group and maternal antenatal depressive symptoms, and difficulty paying expenses and depressive symptoms was also found. Results, strengths, limitations, implications, and future directions are discussed in detail.

Key Words: HPSA, SDH, mental health, pregnancy, prenatal, partum, women

Social Determinants of Maternal Antenatal Depression

Chapter I: Introduction

Social determinants of health (SDH) have a demonstrable impact on maternal health throughout pregnancy and postpartum, as well as offspring outcomes. They influence pregnancy planning (Kelly, 2014; Maness & Buhi, 2016), health behaviors utilized by mothers during pregnancy (Cannella et al., 2018; Do et al., 2018; Ishitsuka et al., 2020; Kelly, 2014; Mahmoodi et al., 2019; Maness & Buhi, 2016), initiation of prenatal care (Gadson et al., 2017; Howland et al., 2019), disparities in pregnancy outcomes among racial-ethnic groups (Gadson et al., 2017; Howland et al., 2019; Thoma et al., 2019), and detrimental neonatal outcomes (Amjad et al., 2019; Mahmoodi et al., 2019). Research suggests that SDH may have a similar impact on maternal mental health during pregnancy.

In particular, systematic reviews indicate that sociodemographic factors such as racial-ethnic group (Biaggi et al., 2016; Mukherjee et al., 2016), income, educational attainment, employment status, and social support (Biaggi et al., 2016; Lancaster et al., 2010) are determinants of maternal antenatal depressive symptoms. Research also suggests higher prevalence rates and severity of depressive symptoms among maternal antepartum (Jesse & Swanson, 2007; Price & Proctor, 2009) and postpartum (Dolbier et al., 2013; Mollard et al., 2016; Nidey et al., 2020; Ross et al., 2011) participants residing in “rural” areas than those in the general population. Similarly, those residing in health professional shortage areas (HPSAs) have worse health outcomes than those in the general population (Allen et al., 2011; Durant et al., 2012; Liu, 2007). However, there is a dearth of literature regarding the impact of residence in an HPSA on mental health or maternal mental health during and after pregnancy.

This study aims to determine the impact of SDH, including ethnicity, income, educational attainment, employment status, social support, and area of residence, on the severity of maternal antenatal depressive symptoms. Further, this study aims to clarify the potential interactive impact of residing in a health professional shortage area for primary care (pcHPSA), health professional shortage area for mental health (mhHPSA), and outside of an HPSA, on the relationship between SDH and maternal antenatal depressive symptoms.

Chapter II: Literature Review

Social Determinants of Health (SDH)

The World Health Organization (WHO) brought SDH to the international foreground with the development of the Commission on Social Determinants of Health (CSDH) in 2006 (CSDH, 2006; WHO, 2010). The CSDH were created to develop an understanding of how child development, globalization, health systems, urban settings, women and gender equity, social exclusion, employment conditions, and public health conditions contribute to barriers to health care utilization and health inequities (CSDH, 2006). Health inequities indicate those disparities that are unjust, or "preventable and unnecessary" (Arcaya et al., 2015). The CSDH framework indicates that the "most important" structural mechanisms, or factors that "generate stratification and social class divisions in society and that define individual socioeconomic position" most responsible for health inequities, are "income, education, occupation, social class, gender, and race/ethnicity" (WHO, 2010, p.5). Such SDH are at the individual level, impacting people and groups directly (Singh et al., 2017). SDH have been suggested to differentially impact groups at the population level as well. For example, health inequities have been demonstrated for people who reside in less populated geographic areas, such as rural areas, and for those who reside within HPSAs, as compared to those living in urban or non-HPSA areas (Singh et al., 2017). There is a dearth of literature regarding maternal antenatal mental health outcomes related to SDH, with research instead focusing on maternal health behavior and infant outcomes, therefore the review of the literature will include discussion of each domain.

Maternal Health Behaviors

SDH have had a documented impact over the entire pregnancy process, beginning with the risk of unintended or unwanted pregnancy (Kelly, 2014; Maness & Buhi, 2016). During

pregnancy, lower income, education, age, and social support, as well as being unemployed, are negatively associated with beneficial maternal health behavior such as nutritious food intake, prenatal care, exercise and stress management (Cannella et al., 2018). Determinants such as younger age, lower educational attainment, and unmarried marital status are associated with secondhand smoke exposure during pregnancy, and unmarried marital status is associated with maternal smoking during pregnancy (Do et al., 2018). Maternal smoking during pregnancy and older age are significantly associated with increased risk of maternal alcohol consumption during pregnancy, and high educational attainment and high household income are significantly associated with decreased risk of alcohol consumption during pregnancy (Ishitsuka et al., 2020). In their path analysis of the relationship between structural and intermediate SDH and LBW, Mahmoodi et al. (2019) found that the relationship between increased maternal age and educational attainment was related to increased prenatal care at 24-28 weeks gestation, which positively impacted infant birth weight.

Infant Outcomes

Research regarding SDH highlights the role of race, SES, area of residence, level of education, occupation, and social capital (social and partner support) in risk of adverse maternal and infant health outcomes in adolescents (ages 13 to 20), such as obstetric complications, caesarean birth, preterm rupture of membranes (PROM), maternal mortality, neonatal death, pre-term birth (PTB; birth before 37 weeks gestational age), low birth weight (LBW), and small for gestational age (SGA) infants (Amjad et al., 2019). When considered as predictive variables for infant outcomes, increased educational attainment (both maternal and paternal) and smaller household size were predictive of increased social support, which was protective against prenatal symptoms of depression (Mahmoodi et al., 2019). Endorsement of any experience of domestic

violence during pregnancy was associated with an increase in depressive symptoms (Mahmoodi et al., 2019). Increased maternal depression, anxiety, and pregnancy specific stress/worry was associated with increased stress, indicating a complex interrelationship between SDH and mental health during pregnancy. Importantly, the path model tested by Mahmoodi et al. (2019) represented those relationships with infant birth weight as the outcome, and not mental health.

Disparities in Outcomes by Race/Ethnicity

Individuals from historically marginalized racial or ethnic groups are differentially impacted by SDH. For example, individual SDH (e.g., SES, insurance status, social support, childcare, housing, immigration status, and social status) and community SDH (e.g., neighborhood and transportation) interact with racial/ethnic identity to predict later, low adherence, and low-quality prenatal care, which increases the risk of severe maternal morbidity and maternal mortality (Gadson et al., 2017; Howland et al., 2019). Similarly, geographic, sociodemographic, and health determinants contribute to disparities in PTB and very preterm birth (VPTB; birth before 32 weeks gestational age) between non-Hispanic White and non-Hispanic Black infants (Thoma et al., 2019). Specifically, the sociodemographic factors of education, marital status and paternity acknowledgement, and Medicaid status accounted for 25% and 20% of the variance in PTB and VPTB, respectively (p. 677). Geographic factors, including state of residence, index of concentration at the extremes (ICE; a -1 to 1 scale indicating the extent to which an area population is concentrated with ethnic/racial and economic segregation), and county population size accounted for 7% of the variance in PTB and 5% in VPTB, and health factors including delayed prenatal care, BMI, smoking status, and the presence of diabetes, hypertension, and infection accounted for 6% and 7% of the variance in PTB and VPTB, respectively (Thoma et al., 2019, pp. 682–683).

Sociodemographic Correlates of Maternal Mental Health

SDH have a demonstrated impact on maternal mental health, however the majority of the literature focuses on the maternal and infant health outcomes detailed above. SDH are not commonly the explicit focus when investigating maternal prenatal mental health. Instead, similar sociodemographic variables are often identified as predictor or correlate variables in maternal mental health outcome research. A review of such literature, organized by demographic variable, follows.

Racial-Ethnic Group

Women who identify as Black, Latina, or Asian have higher prevalence rates of prenatal depression when compared to White mothers (Biaggi et al., 2016; Mukherjee et al., 2016). However, the research is inconsistent, and often differs based on the research design (i.e., method and demographic variables included) and the sample involved (Biaggi et al., 2016; Mukherjee et al., 2016). Koleva et al. (2011) found that identifying as Caucasian predicted lower symptoms of prenatal depression as indicated by lower scores on the BDI. However, they noted that in line with the demographic make-up of the geographic location of the study, individuals who did not identify as Caucasian were underrepresented. Similarly, belonging to a "non-White" racial-ethnic group was one of the significant demographic predictors of elevated maternal prenatal depressive symptoms (EPDS scores>10) among a sample of women between 25- and 40-weeks gestation (Verreault et al., 2014). Women who identified as Black, Hispanic, or another racial-ethnic group and those who identified as US immigrants had significantly increased risk of depressive symptoms in the second trimester of pregnancy, as measured by the EPDS, when compared to women who identified as White (Rich-Edwards, 2006). However, those relationships were explained by household income (<$40,000 per year), partnership status

(unmarried or not cohabitating), and unwanted pregnancy (Rich-Edwards, 2006). Some findings indicate that correlates of maternal antenatal depressive symptoms differ between racial-ethnic groups. For example, while parity and stress were associated with elevated levels of depressive symptoms (as indicated by BDI-II scores ≥16) for non-Hispanic Black participants, lack of social support was associated with increased depressive symptoms in non-Hispanic White participants, and only increased stress was associated with elevated scores among a sample of pregnant women in rural counties (Jesse & Swanson, 2007).

Educational Attainment

In their 2016 systematic review of risk of antenatal anxiety and depression, Biaggi et al. reported mixed findings in relation to educational attainment as a risk factor for prenatal anxiety and depression. Specifically, they found that while anxiety and depression seemed "more common in women with low educational achievements," some studies found an increased likelihood of anxious and depressive symptoms in women with more years of education, and some reported that level of education was not associated with antenatal depression (Biaggi et al., 2016, p. 67). Fortner et al. (2011) found that women who graduated high school, or attended college or graduate school had a decreased risk of elevated depressive symptoms on the EPDS (score<12) at less than 20 weeks gestation. Koleva et al. (2011) found that increased years of education was independently associated with lower BDI scores throughout pregnancy (4 to 41 weeks gestation). Lancaster et al. (2010) found that while there was no significant association between total socioeconomic status (SES) and prenatal depressive symptoms, there were inconsistent associations between depressive symptoms and components of SES, such as educational attainment. Studies reviewed that conceptualized sociodemographic predictors as bivariate indicated that educational attainment was associated with depressive symptoms during

pregnancy, those associations were not present in the multivariate studies (Lancaster et al., 2010).

Employment Status

Biaggi et al. (2016) reported a higher prevalence of antenatal anxiety and depression in unemployed women overall as compared to employed women, however mentioned that "a few studies" found no significant association between employment status and antenatal symptoms of depression (p. 67). Koleva et al. (2011) found that employment status (being employed) was associated with lower BDI scores throughout pregnancy (4 to 41 weeks gestation). For those who were employed, experiencing workplace adversity (e.g., lack of access to or difficulty in negotiating maternity leave, and experiencing discrimination based on pregnancy status) has been independently associated with increased EPDS score (Cooklin et al., 2007).

Income

For symptoms of depression in the antenatal period, most studies reviewed found associations with low income or financial difficulties, though some studies found no significant correlations (Biaggi et al., 2016). In their model of risk factors for depressive symptoms during pregnancy, Koleva et al. (2011) found that increased household income independently predicted lower BDI symptoms. In their meta-analysis of risk factors for depressive symptoms, Lancaster et al. (2010) found that the income component of socioeconomic status (SES) was associated with depressive symptoms during pregnancy in their bivariate analysis, but there were not enough studies to include income in multivariate analyses. Rich-Edwards (2006) found significantly increased risk of depressive symptoms in the second trimester, as measured by the EPDS, for women with a household income below $40,000. In their sample of women of "Puerto Rican or Dominican Republic heritage," Fortner et al. (2011) found that increased income and

cohabitation with a spouse/partner was associated with a decreased risk of elevated depressive symptoms on the EPDS (score<12) at less than 20 weeks gestation. Finally, Verreault et al. (2014) found that the demographic predictors of elevated maternal prenatal depressive symptoms (EPDS scores >10) between 25 and 40 weeks gestation included lower household income. However, the relationship did not maintain significance when predictors, including racial-ethnic group, were added, among others (Verreault et al., 2014).

Social Support

Sociodemographic variables categorized as social support are most often marital status, cohabitation with partner, and/or a specific measure of social support. Being married and/or cohabitating with a partner has been found as a unique protective variable in maternal prenatal mental health research. Fortner et al. (2011) found that women cohabitating with a spouse/partner had a decreased risk of elevated depressive symptoms on the EPDS (score<12) at less than 20 weeks gestation. Marital status/cohabitation has been demonstrated as protective throughout pregnancy (4 to 40 weeks gestation), as indicated by lower BDI scores (≤15) in married/cohabitating women, as compared to women who were single, divorced, unmarried, or widowed (Koleva et al., 2011). In their investigation of antenatal depressive symptoms, Jesse et al. (2014) found that social support partially mediated the relationship between elevated stress and increased risk of elevated symptoms of depression (as indicated by a BDI-II score<16), such that the impact of increased stress on depressive symptoms during pregnancy was partially reduced by increased perceived social support (Jesse et al., 2014). Associations between social support and EPDS scores did not significantly differ between groups in different areas of residence. Among those who resided in varying levels of urban/rural areas, antenatal women

with lower levels of prenatal social connectedness (i.e., low social support, high social conflict, and low social capital) had increased depressive symptoms (Ross et al., 2011).

Area of Residence

Rurality. Area of residence is underrepresented in SDH research. Often research focuses on outcome differences between "rural" and "urban" areas. However, "rural" is defined in many different ways, which can obfuscate potential relationships (Villegas et al., 2011). The term also is defined based on assumptions of rurality given the healthcare setting (e.g., health department, prenatal clinics designated as "rural" settings; Hutto et al., 2011). Further, residence in a "rural" area in a developed country has a different impact on individuals than residing in a "rural" area in a developing country (Villegas et al., 2011). As such, this section will focus on maternal mental health outcomes given population-based definitions of area of residence within developed countries. The majority of studies found that included participants from "rural" communities, or compared them to "urban" counterparts, utilized postpartum depressive symptoms as the outcome variable. As such, both postpartum and antenatal depression are discussed below.

Postpartum Depression. In their integrative review of postpartum depression in rural communities in the US, Mollard et al. (2016) suggested that prevalence rates for postpartum depression, which ranged from 17% to 33% among the studies reviewed, were higher than the general prevalence rates reported by the CDC (10-15%). However, none of the studies reviewed utilized a semi-rural or urban comparison group, which make direct comparisons of prevalence difficult. Interestingly, one study examined postpartum depressive symptoms in women in rural, semi-rural, and urban areas (population <10,000, 10,000 to 20,000, and over 2.5 million, respectively) of Canada (Ross et al., 2011). They found no significant differences in severity or

prevalence of depressive symptoms at 1 month postpartum among rural, semi-rural, and urban participants (Ross et al., 2011).

Nidey et al. (2020) utilized population-level data (Pregnancy Risk Assessment Monitoring System; PRAMS) from 14 US states to investigate the odds of perinatal depression status based on urban or rural classification. They found that the differences between prevalence rates of depression between women in urban versus rural areas were attenuated when accounting for whether they received public assistance from WIC or Medicaid (Nidey et al., 2020). However, rural classification was at the state level, with differing definitions based on the US state of residence, and "depression" was based on the endorsement of one of three self-report questions, with a single prenatal retrospective item ("during your most recent pregnancy, did you have any of the following health conditions (Depression, Yes/No)") or the endorsement of one of two symptoms of postpartum depression (Nidey et al., 2020). One study examined relationships between race and SES in participants who resided in rural Eastern North Carolina. Researchers oversampled participants who were both low in SES (as determined by income) and identified as African American. When utilizing a 10-point threshold on the EPDS, none of the sociodemographic characteristics investigated (including marital status, poverty status, education level, subjective SES, and race) were found to uniquely significantly contribute to depressive symptoms at 1 month postpartum after all were included in the multivariate model (Dolbier et al., 2013). Further, at 6 months postpartum utilizing scores ≥13 threshold indicating elevated depressive symptoms on the EPDS, no sociodemographic predictors were found to significantly predict elevated depressive symptoms at 1 month postpartum, and only subjective SES remained as a significant, unique predictor at 6 months postpartum. Across studies reviewed by Mollard et al. (2016), most found no significant differences between postnatal depression prevalence rates

among those identifying as Native American, African American, Hispanic, or Non-Hispanic White rural women, with the exception of a study by Baker and Oswalt (2008), wherein they found that participants identifying as Hispanic had significantly lower postnatal depression scores (as cited in Mollard et al., 2016).

Antenatal Depression. There is some evidence that individuals who reside in rural areas have unique risk factors for antenatal depressive symptoms. While studies have found no significant differences between rates of depressive symptoms among African American, Caucasian, and Hispanic participants, identifying as African American was found to be a significant predictor of elevated antenatal depressive symptoms (BDI-II score≥16) in a rural sample of low-income women in the US (Jesse & Swanson, 2007). Overall, women with elevated prenatal depressive symptoms endorsed low satisfaction with social support, as measured by the Prenatal Psychological Profile (PPP) social support subscales, however that risk was only significant for women who identified as Caucasian (Jesse & Swanson, 2007). Finally, higher levels of stress predicted risk of elevated depressive symptoms for women who identified as African American and Hispanic, but not women who identified as Caucasian (Jesse & Swanson, 2007). While the outcome variable of interest was postpartum depressive symptoms, Ross et al. (2011) reported that at the prenatal assessment (approximately 35 weeks gestation), there were no significant between-group differences in depressive symptoms between those residing in rural, semi-rural, and urban areas, as measured by mean scores or proportion of participants with scores >12 on the EPDS. These findings indicate that while there may be demographic differences between groups identified as residing in rural areas, level of rurality itself may not be indicative of increased depressive symptoms.

One study utilized a federally recognized definition of "rural" with a perinatal sample. Specifically, Price and Proctor (2009) defined rural as lacking a federally classified urbanized area in the 5-county region where data were collected. They investigated depressive symptoms in women who resided in rural areas and accessed services through an outreach program (Healthy Head Start) during the perinatal period (Price & Proctor, 2009). Utilizing the 9-item Patient Health Questionnaire (PHQ-9), they found prevalence rates of 36% for depressive symptoms, although the authors included a "subthreshold" category (total scores from 5-9), with no significant sociodemographic differences among groups (non-depressed, subthreshold, minor, and major depressive symptoms; Price & Proctor, 2009). Importantly, this study did not compare those residing in a rural area to urban counterparts. Without such a comparison group, the impact of residence in a rural area, or a potential interaction between residence in a rural area on other sociodemographic variables cannot be determined. Further, this study included women who identified as pregnant or postpartum, such that direct assertions regarding depressive symptoms in the antenatal period or the timing of such symptoms during or after pregnancy similarly cannot be determined.

Summary. The complex and sometimes conflicting findings in the research regarding rural antenatal and postpartum mental health highlights the obstacles with such research. The lack of significant differences between urban and rural groups and the influence of socioeconomic disparities may not be fully captured utilizing a rural identifier, particularly one so inconsistently defined. Rather, a lack of access to care based on area of residence may be more indicative of prenatal mental health status in relation to area of residence. Additionally, the few studies that do exist suggest that interactive effects between SDH and important other risk

factors (e.g., rurality, social support, and perceived stress) are necessary to consider in relation to maternal depression symptoms during or shortly after pregnancy.

Health Professional Shortage Areas (HPSAs). A more contemporary and well-defined area of residence to consider with regard to prospective moderation effects is an HPSA. HPSAs are defined as those with a "shortage of health services for an entire population within an established geographic area," or high patient to provider ratios, or those with a "shortage of services for a specific population subset" within that area, including those who are eligible for Medicaid, low income, migrant farmworkers, Native American/Alaskan Native, or those experiencing homelessness (Health Resources & Services Administration [HRSA], 2020). HPSA designations include those for primary care physicians (pcHPSA), mental health professionals (mhHPSAs) and dental providers.

Medical and Mental Health Outcomes. Health status, or the mental and physical health and wellbeing of an individual, has an established relationship to the availability of health professionals in their area (Kohrs, 1995; Liu, 2007). Specifically, individuals located in HPSAs lack access to an adequate number of health care providers, which can detrimentally impact their mental and physical health (Kohrs, 1995; Streeter et al., 2020). However, there is a dearth of research regarding the specific risk involved with residing in an HPSA. Thus far, residence has been significantly correlated with lower overall health ratings, worse physical health, a lack of established routine medical care, and decreased likelihood of seeking care when needed or receiving outpatient care within the past 6 months (Liu, 2007). In areas designated as pcHPSA, individuals are less likely to have health insurance and have a higher prevalence of cardiovascular disease (CVD) risk factors (Allen et al., 2011; Durant et al., 2012). Risk of specific mental health outcomes in areas designated as mhHPSA have largely been

uninvestigated (Johnson & Brookover, 2020). Rather, mhHPSA research has focused on geographic predictors of designation and hospital and inpatient admissions (Hendryx, 2008; Moseley et al., 2008). Overall, research indicates that residents of mhHPSAs are at an increased risk of suicide deaths, and residents with sensory disabilities' increased depressive symptoms may be related to HPSA status (Armstrong et al., 2016; Johnson & Brookover, 2020). However, research highlighting the unique or interactive impact of residing in a pcHPSA and/or mhHPSA on maternal prenatal mental health was not found.

HPSA and SDH. Residing in an HPSA may have a differential impact on residents' SDH given the number of other county-level SDH. Streeter et al. (2020) published an article detailing the differences in county-level SDH in areas designated as pcHPSA among regions in the US. SDH, or "markers" at the county level included a high proportion of the population in the county who were 65 years of age and older, a high proportion of births per 1,000 live births that were low birth weight, a median household income of less than the 25th percentile of average income in the US, a high proportion of unemployment, a high proportion of the population below the federal poverty line (FPL), a high proportion of the population above the age of 65 or below the age of 18 living at or below 50% of the poverty line, counties that were in "persistent poverty," or those identified as having poverty rates at 20% or greater for at least 30 years, high proportion of adults without a high school diploma, high proportion of individuals who identified as racial-ethnic underrepresented groups, uninsured, low population density, rurality, designation as a pcHPSA county, and high pcHPSA count (Dalaker, 2019; Streeter et al., 2020). As such, Streeter et al. (2020) demonstrated that while approximately 89% of US counties were classified as pcHPSAs, the percentage of those counties that were comprised of individuals with greater than six of SDH markers varied by region, and ranged from 0 to 39% (see Table 1). For example,

while the 98% of the counties in the Region 6 are pcHPSA counties, only 13% of those counties included populations with greater than 6 markers. Comparatively, while 93% of the counties in Region 1 were designated as pcHPSAs, none of their counties included populations with greater than 6 markers, and in Region 4 where 91% of total counties were designated as pcHPSAs, 39% of those counties had greater than 6 markers (Streeter et al., 2020). This information supports the potential differential impact of residing in an HPSA for those with co-occurring SDH. Specifically, that HPSA status may directly, or through interaction with other SDH, increase risk of elevated depressive symptoms that women experience during pregnancy. However, studies investigating such direct or interactive effects were not found. Interestingly, Price and Proctor (2009) investigated depressive symptoms in women who resided in rural areas and accessed services through an outreach program (Healthy Head Start) during the perinatal period (as discussed in detail in the previous section). Authors noted that all of the counties represented in the study were federally designated as pcHPSAs (Price & Proctor, 2009). The prevalence of elevated depressive symptoms in their study was 36%, which was quite high compared to the work of Ross et al. (2011) whose rural, semi-rural, and urban sample ranged from 0% to 7%. This may indicate a unique contribution of lack of access to healthcare in the form of professional shortages, rather than rurality. As mentioned previously, without a comparison group, the differential impact of residence in a pcHPSA cannot be determined.

Table 1

Summary of pcHPSA Counties, by HHS Region, 2017

HHS Region	US States + DC	Total Number of Counties	Total Number of pcHPSA-Counties	pcHPSA Counties, as Percentage of Total Number of Counties	pcHPSA Counties with >6 Markers	pcHPSA Counties with >6 Markers, as Percentage of Total Number of Counties
1	CT, ME, MA, NH, RI, VT	67	62	92.5%	[none]	--
2	NJ, NY	83	69	83.1%	3	3.6%
3	DC, DE, MD, PA, VA, WV	283	223	78.8%	49	17.3%
4	AL, FL, GA, KY, MS, NC, SC, TN	736	672	37.3%	288	39.1%
5	IL, IN, MI, MN, OH, WI	524	443	84.5%	22	4.2%
6	AR, LA, NM, OK, TX	503	459	91.3%	184	36.6%
7	IA, KS, MO, NE	412	358	86.9%	29	7.0%
8	CO, MT, ND, SD, UT, WY	291	271	93.1%	44	15.1%
9	AZ, CA, HI, NV	95	95	100%	24	25.3%
10	AK, ID, OR, WA	148	145	98.0%	19	12.8%
All Regions	**50 US States + DC**	**3,142**	**2,797**	**89.0%**	**662**	**21.1%**

Note. Table reprinted from Streeter et al. 2020
Total counties includes county-equivalent jurisdictions (e.g., parishes in Louisiana).
The total number of counties and county equivalents reflects the number of jurisdictions in 2017.
pcHPSA: HRSA-designated primary care Health Professional Shortage Area.

Summary. While the effects of SDH are often studied indirectly, there is evidence that sociodemographic variables, including area of residence, racial-ethnic group, income, educational attainment, employment status, and social support, influence the severity of maternal depressive symptoms throughout pregnancy. Further, there is evidence that one SDH, area of

residence, may uniquely, and through interactions with other SDH, predict differential prenatal mental health outcomes. While rurality, or residing in rural areas, has been indicated as a potential predictor of postpartum maternal mental health, the relationship between residence in a rural area and depressive symptoms during pregnancy is unclear due to differences in defining rural and the lack of research focusing on the prenatal period. However, one study, which utilized a rural sample from a pcHPSA demonstrated no significant demographic differences in level of depressive symptoms during the perinatal period, indicating that the increased prevalence rates determined in the study (38% exhibiting major, minor, or subthreshold levels of depressive symptoms) may be due to the lack of access to care rather than their rural status.

Current Study

There is evidence that SDH, including racial-ethnic group, education, employment status, income, and social support, contribute to poorer maternal antenatal mental health. However, SDH research does not often account for the unique contribution of each determinant, and the potential cumulative contribution of multiple SDH. Further, there are notable gaps in the literature regarding the unique or interactive contribution of residence in a health professional shortage area for primary care (pcHPSA) or mental health (mhHPSA) on maternal mental health given the presence of other SDH, though prior literature highlighting variability in SDH within HPSAs supports the feasibility of an investigation of interactive relations between SDH and HPSAs. Furthermore, research regarding the impact of such SDH often focuses on maternal postpartum mental health rather than mental health in the antenatal period. Given the support for the interrelated nature of SDH, this study seeks to elucidate the unique and cumulative impact of SDH, including residence in an HPSA, on maternal antenatal depressive symptoms. This is the first known study to seek a national sample and compare antenatal depressive symptom severity

within and between those who live in pcHPSAs or mhHPSAs, and those who do not. This will help us to better understand potential risk factors for prenatal depression and highlight future targets for prevention/intervention research. Further, this is the first known study to investigate the cumulative impact of SDH and the potential interactive impact of other SDH with residence in an HPSA on antenatal depressive symptom severity. This may allow for earlier and more efficient screening for individuals at elevated risk for depressive symptoms during pregnancy, and allow for earlier intervention when necessary.

Hypotheses

Hypothesis 1. SDH at the individual level, including racial-ethnic group, educational attainment, employment status, income, and social support, and at the population level, including residence in a pcHPSA or mhHPSA, will be significantly associated with maternal antenatal depressive symptoms. Specifically, residing in a pcHPSA or mhHPSA, identifying with an underrepresented racial-ethnic group, lower levels of education, hours of weekly employment, income, and social support will predict significantly higher levels of antenatal depressive symptoms.

Hypothesis 2. The cumulative impact of endorsing multiple SDH (i.e., a greater number of endorsed SDH) will significantly predict higher levels of antenatal depressive symptoms.

Hypothesis 3. The relationship between individual level SDH and antenatal depressive symptom severity will be moderated by residence in a pcHPSA or mhHPSA, such that the relationship between each endorsed SDH and elevated antenatal depressive symptoms will be stronger for those who reside in a pcHPSA or mhHPSA. Specifically, the relationship between racial-ethnic group, educational attainment, employment status, income, and/or social support

and elevated antenatal depressive symptoms will be stronger for those who reside in a pcHPSA or mhHPSA, as compared to those who do not live in an HPSA.

Hypothesis 4. The relationship between the number of endorsed SDH and antenatal depressive symptom severity will be moderated by residence in a pcHPSA or mhHPSA, such that the relationship between increased number of endorsed SDH and increased antenatal depressive symptoms will be stronger among those who reside in a pcHPSA or mhHPSA, as compared to those who do not reside in an HPSA.

Statistical Analyses

Given the complex and interrelated nature of SDH and their potential impact on maternal antenatal depressive symptoms, multiple statistical analyses were proposed. The review of the literature suggests that regional differences exist between the number and type of SDH at the population level (Streeter et al., 2020). However, the relationship between population level SDH and those at the personal level in regard to maternal antenatal depressive symptoms is unclear. In order to determine how SDH at the individual level influence maternal antenatal depressive symptoms directly, the following analyses will be utilized.

Specifically, to test **Hypothesis 1**, correlation analyses with continuous predictors (i.e., years of education, hours of weekly employment, annual gross income, and perceived social support scores) and antenatal depression scores were performed. One-way analysis of variance (ANOVAs) will be used to examine group differences in antenatal depression based on racial-ethnic group, and given that HPSA status is not a mutually exclusive category (i.e., participants may reside in both a pcHPSA and mhHPSA), four categories (pcHPSA, mhHPSA, neither, or both) will be will be analyzed. For **Hypothesis 2**, one multiple regression model, wherein depressive symptom severity was added as the outcome variable and all seven SDH were added

as predictors (i.e., years of education, hours of weekly employment, annual gross income, perceived social support scores, racial-ethnic group, pcHPSA (Y/N), and mhHPSA (Y/N)) were completed. Significance of the *F* value and effect size (R^2) in this model were examined to test the second hypothesis, and the relative effect sizes across predictors while controlling for all other predictors in the model were examined. In order to test **Hypothesis 3** and determine the influence of HPSA residence on the relationship between individual SDH and maternal antenatal depressive symptoms, moderation models are proposed. In particular, 10 multiple regression analyses (five for each SDH except for HPSA residence status paired with pcHPSA or mhHPSA in separate analyses) were tested including the two main effects (each SDH paired with either pcHPSA or mhHPSA residence status) and interaction effect. The significance of R^2 change and the regression coefficient corresponding to the interaction term was examined to determine the significance and effect size, respectively, of the moderation. For analyses in which the R^2 change is statistically significant ($p<.05$), follow-up analyses were used to compare group differences (i.e., between pcHPSA or mhHPSA) in relations between SDH and antenatal depression severity. Regarding **Hypothesis 4**, two multiple regression analyses with two main effects (the number of SDH excluding HPSA residence status from 0 to 5 and pcHPSA or mhHPSA residence status in separate analyses) and one interaction effect was completed. The significance of R^2 change and the regression coefficient corresponding to the interaction term was examined to determine the significance and effect size of the moderation. For analyses in which the R^2 change were statistically significant ($p<.05$), follow-up analyses were used to compare group differences (i.e., between pcHPSA or mhHPSA) in relations between SDH and antenatal depression severity.

All analyses were conducted using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp, 2020). Analyses will also include descriptive statistics for all variables. Potential

covariates that significantly correlate with both predictor and outcome variables were included in regression equations and models as covariates.

Multiple Regression. To determine the unique impact of each predictor variable, multiple regression was used. Multiple regression methods evaluate a potentially predictive relationship between multiple predictor variables and a single dependent variable (DV), and can be utilized in cases where predictors correlate with each other and the DV (Tabachnick & Fidell, 2013). The regression equation follows:

$$Y' = A + B_1X_1 + B_2X_2 + \ldots + B_kX_k$$

In this equation, *Y'* represents the predicted value of the DV, *A* represents the value of *Y* when all predictor variables are held at zero, *X* represents each predictor variable, and *B* represents the regression coefficients (Tabachnick & Fidell, 2013), The regression coefficients are the values of each predictor that brings the *Y'* value closest to the *Y* actually obtained from the sample, the difference between which is used to create a prediction equation. To determine the cumulative impact of SDH on depressive symptoms, R^2 were calculated for the model. R^2 represents the proportion of the variation in the DV attributable to the combination of the predictors (Tabachnick & Fidell, 2013). Statistical significance of R^2 was determined via the significance of *F* in the output for the standard multiple regression analysis. Given the probable intercorrelation of the predictors in this study, in addition to the *F* for each predictor, and the r_{iy}, or the correlations between the DV and the predictors were reported (Tabachnick & Fidell, 2013).

Moderation Models. Moderation models were tested using Model 1 in the Hayes PROCESS macro 4.0 (Hayes, 2017). As the regression equation determines the impact of each predictor holding all others constant, it is not possible to determine the potential interaction of one predictor on others through such a technique. Moderation models determine the impact of a

predictor variable (x) on a DV (y) in the presence of a potential moderator (w), as illustrated conceptually in Figure 1. The moderation equation follows:

$$Y = A + B_1X_1 + B_2W_1 + B_3XW + e_Y$$

In this equation, *Y* represents DV, *A* represents the value of *Y* when all predictors are held at zero, *X* represents each predictor, W represents the potential moderator, *B* represents the regression coefficients, and e_Y represents error in estimation (Hayes, 2013). In moderation, a change by one unit in X on Y is represented by the expression $\theta_{X\rightarrow Y} = b_1 + b_3W$, where $\theta_{X\rightarrow Y}$ is the conditional effect of X on Y, or "the amount by which two cases that differ by one unit on X are estimated to differ on Y" (Hayes, 2013, p. 227). Adjusting the value of W in this equation produces an estimation of "how much a one-unit change in X changes Y given that value of W" (Hayes, 2013, p. 227). Moderation model outputs indicate main and interaction effects via R^2 change, F score, p-values, and confidence intervals, which were reported. Interaction effects with p-values of <.05 and confidence interval ranges excluding zero were considered significant. For dichotomous moderators such as those being used in this study, the PROCESS macro automatically probes interactions and determines the significance of the difference between slopes by reverse coding the variables and reporting the difference between the two (Hayes, 2013). Specifically, PROCESS utilizes a "pick-a-point" approach for every moderation model to determine whether a significant difference exists between the relationship of X and Y with and without W, and reports standard errors, confidence intervals, and p-values (Hayes, 2013, p. 253). Moderations were considered significant given a p-value of <.05 and confidence interval ranges excluding zero. For models with multiple predictor variables under the same SDH (i.e., multiple indices of income), the Benjamini-Hochberg false discovery rate correction was used to adjust for type 1 error inflation, with q-values set at .05 (Benjamini & Hochberg, 1995).

Moderation model outputs with continuous moderators (W) include a conditional effect of the predictor at specific values of the moderator, and the value of the variable at which the moderator significantly impacts the relationship between X and Y. The level of the moderator at which the moderator significantly impacts the relationship between X and Y was utilized to dichotomize the variable for follow-up cumulative hypotheses (Hayes, 2013). Specifically, the level of moderator variable indicated by the PROCESS output was utilized as a cut-off for inclusion or exclusion of the variable in proceeding cumulative SDH models.

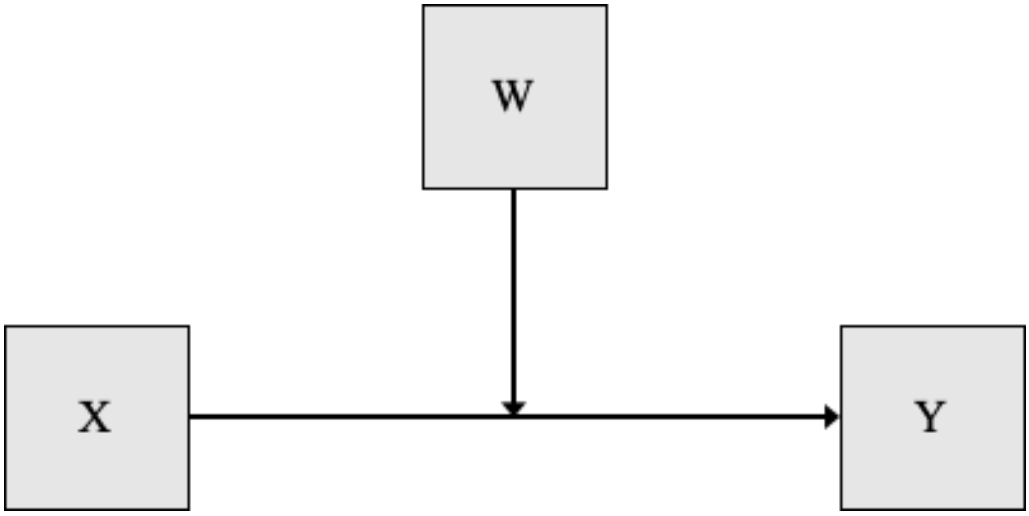

Figure 1. Conceptual diagram of moderation model, where X represents an SDH, Y represents EPDS score, and W represents residence in an HPSA.

Chapter III: Methods

Sample Size

An *a-priori* power analysis in G*Power (version 3.1; Faul et al., 2007) suggested that a sample size of 104 would be sufficient to determine a medium effect size (f^2=.15), with low Type I error probability (α=0.05), and power of .80 in a linear multiple regression for a fixed model, R^2 increase with 7 predictors and up to 7 covariates. At the end of data collection, a total of 77 participants completed both stages of the study, and as many as four variables were determined to be covariates for included models. Following the variable selection and covariate determination and prior to analysis, another *a-priori* power analysis was performed in G*Power to determine the level of detectable effect size with the current sample. For a linear multiple regression with a fixed model, R^2 increase with 9 predictors, the sample size of 77 participants allows the detection of a medium-to-large effect size (f^2=.23) while maintaining adequate power (.80) and low Type I error probability (α=0.05). For moderation models with 2 predictors and up to 4 covariates, this sample size allows the detection of a small-to-medium effect size (f^2=.13) with the same level of power and error probability.

Data Collection Platform

To obtain a geographically diverse sample of pregnant women, the current study utilized Amazon's Mechanical Turk (MTurk). MTurk is an online platform through which people (requesters) requiring human intelligence task (HIT) completion recruit individuals who can complete such tasks (workers) quickly and at a low cost (Litman et al., 2017). MTurk workers have been found to be slightly younger and have a lower income, but are more highly educated than the general US population, and more diverse than internet and US college samples (as cited in Posch et al., 2018). Further, according to the MTurk Analytics Tool, when asked "Which of

the following best describes the area you live in," 32% of respondents self-reported living in an urban area, 50% reported living in a suburban area, and 18% reported living in a "rural" area (dates restricted to January 1, 2020 to August 31, 2020; Turkprime, 2020). When recruiting parents, MTurk was found to be faster, with more than 600 participants completing surveys within 1 day, and more "demographically diverse (e.g., race, socioeconomic status, gender)" than Facebook and Listserv options, with the lowest amount of missing data (ranging from 0% to 5%; Dworkin et al., 2016, p. 7). Researchers were able to collect more high-quality data from pregnant women using MTurk when compared to other online recruiting platforms, such as Soapbox, Qualtrics, and Reddit (Ibarra et al., 2018). Further, they were able to collect information on health behaviors that they may not be willing to report during in-person data collection, such as cigarette or e-cigarette usage (Ibarra et al., 2018; Wagner et al., 2017).

Measures

Variables of interest include sociodemographic identifiers, such as racial-ethnic group, income level, educational attainment, employment status, social support, HPSA status, and the presence and level of depressive symptoms. To determine pregnancy timing and context, each participant completed a pregnancy context questionnaire adapted from the Pregnancy Risk Assessment Monitoring System (PRAMS) standard questionnaire (Adams et al., 1991). As indicated by prior research, potential covariates include maternal age, insurance status, level of acculturation, onset of prenatal care, and parity. Further, given the potential impact of the recent COVID-19 pandemic, questions were included in the sociodemographic and pregnancy context questionnaires. Specifically, questions from the Household Pulse Survey regarding the potential impact on variables of interest were included (U.S. Census Bureau, 2020).

Sociodemographic Questionnaire

This study utilized a detailed sociodemographic questionnaire (see Appendix A) to assess many of the predictor variables.

Area of Residence. In order to determine participant residence in a pcHPSA and/or mhHPSA, participants were asked to provide their zip code, and to visit the Rural Health Information Hub's "Am I Rural?" tool, a search tool that categorizes addresses under HPSA status, among other rural or medically underserved statuses (Rural Health Information Hub, 2019). Participant HPSA status was self-categorized as residing in a pcHPSA or mhHPSA.

Educational Attainment. Educational attainment was measured in both continuous and categorical forms. Specifically, participants were asked the number of years of education completed and the highest level of education attained. Participants selected from the options of Less than High School, High School Diploma, GED, Associate's Degree, Technical Certificate, Bachelor's Degree, Master's Degree, or Doctorate or Professional Degree. Individuals who selected "Less than High School" were asked to input the last grade they completed (see Appendix A).

Employment Status. To obtain employment status, the questionnaire asked how many hours of employment that participants were working each week, in addition to whether participants are employed full-time (35+ hours per week), part-time (less than 35 hours per week, per job), or not working for pay or profit. Those who indicated that they were employed were asked how many jobs they were working at that time, and those who indicated that they were not working for pay or profit were asked to specify why (see Appendix A).

Income. For a precise measurement of annual household income, participants were be asked to report their annual gross household income (their annual household income before tax

and benefit withholdings), annual net household income (annual income after taxes are withheld, or "take home pay"), and personal annual gross and net income. In addition to monetary income, participants were asked how difficult it had been "pay for usual household expenses, including but not limited to food, rent or mortgage, car payments, medical expenses, student loans, and so on?" (U.S. Census Bureau, 2020) in order to determine participant perceptions of whether their income sufficiently covered cost of living expenses. Further, participants were asked how many individuals were included in their household, and how many household members were contributing financially to the household (see Appendix A).

Racial-Ethnic Group. Racial-ethnic group was assessed utilizing questions implemented for the US 2020 Census, with two exceptions. This study utilized a 2-question format with the first question addressing potential Spanish/Hispanic/Latino ethnicity and the second addressing race (see Appendix A). In line with the research guidelines from the American Psychological Association (APA), separate White and Middle Eastern or North African (MENA) categories were available, as well as including Hispanic/Latino as a racial identification and an ethnic identity (APA, 2019). To address potential issues regarding lack of representation or personal identification in any given racial category, an "Other, please specify:" category was available. To allow for those who identify with multiple racial identities, multiple selections ("select all that apply") was available.

Pregnancy Context Questionnaire

Participants were asked questions related to their current pregnancy (see Appendix B), including their due date, planning, past pregnancy(ies), current and past health behavior, onset of prenatal care, marital status, and cohabitation.

Social Support. Given the diverse ways in which social support is assessed in the reviewed literature, social support was measured in multiple ways to better understand the level of social support in the current sample. Questions regarding marital status and cohabitation were measured in self-report, "check all that apply" form on the Pregnancy Context Questionnaire (see Appendix B). Perceived social support was measured through the use of the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988), detailed below.

Multidimensional Scale of Perceived Social Support (MSPSS)

The MSPSS was designed to provide a psychometrically sound measure of participant perceptions of sufficient levels of social support from three separate sources: the significant other, family, and friends (Zimet, Dahlem, Zimet, Farley, et al., 1988; see Appendix C). The MSPSS is a 12-item questionnaire that utilizes a 7-point Likert scale, ranging from 1 (very strongly disagree) to 7 (very strongly agree), with higher scores indicating more perceived support (Zimet et al., 1988). The MSPSS was initially validated with a university sample, and demonstrated high internal consistency for overall score and the significant other, family, and friends subscales (Cronbach's α range .85-.91; Zimet, Dahlem, Zimet, Farley, et al., 1988). Factor analysis revealed high loadings with items intended for each factor, with low cross-loadings, moderate intercorrelations between significant other and friends subscales (r=.63), and low intercorrelations between those and the family subscale (r=.24 and .34, respectively; Zimet, Dahlem, Zimet, Farley, et al., 1988). When validated with a sample in their third trimester of pregnancy, the MSPSS demonstrated high internal consistency for total score and subscales (Cronbach's α range .90-.94; Zimet et al., 1990). Among samples of pregnant Turkish and Iranian women, the MSPSS total score has demonstrated adequate concurrent validity, with significant, negative correlations with DASS-21 Depression, Anxiety, and Stress subscales and

the total score (range r=-.269 to –.349, p's<.01), and significant correlations between each subcategory and total score with the BDI (range r=-.221 to –.338, p's<.001; Aktas & Yesilcicek Calik, 2015; Mirabzadeh et al., 2013). In this study, the MSPSS demonstrated high internal reliability (Cronbach's α=.96).

Edinburgh Postnatal Depression Scale (EPDS)

Depressive symptoms were measured by the EPDS (see Appendix D; Cox et al., 1987). The EPDS evaluates experiences and feelings over the previous 7 days, such as feeling sad or miserable, scared or panicky, unhappy to the extent of crying, or unable to cope, using a 10-item questionnaire on a 4-point Likert scale (i.e., 0=not at all, 1=not much, 2=sometimes, 3=quite a lot/often, or similar), with items 3 and 5-10 reverse scored (Cox et al., 1987). The EPDS has been validated for use during pregnancy, with high test-retest correlation coefficients from 12 to 24 weeks, 12 to 36 weeks, and 24 to 36 weeks gestation (r=.55 to .61; Bergink et al., 2011). When compared to the Symptom Checklist-90 items (SCL-90) anxiety and somatization subscales throughout pregnancy, the EPDS demonstrated high concurrent validity (r's>.50; p's<0.001; Berginket al., 2011). EPDS scores in this study demonstrated high internal consistency (Cronbach's α=.89).

Potential Covariates

Maternal Age. Maternal age has been associated with antenatal depressive symptoms for adolescents (age 18 or younger) and young adults (Biaggi et al., 2016; Price & Proctor, 2009) or significantly, negatively correlated with age (Koleva et al., 2011). However, some studies found no significant associations between age and antenatal depressive symptoms (Fortner et al., 2011; Jesse & Swanson, 2007; Verreault et al., 2014), or that associations between age and symptom severity were explained by other variables (Rich-Edwards, 2006). Given the

inconsistent findings, it is important to include age as a potential covariate in this study. However, individuals over the age of 45 have been shown to have increased pregnancy complications, which may impact mental health concerns during pregnancy (Dildy et al., 1996; Yogev et al., 2010). As such, participants were asked to provide their birthdate and age (see Appendix B), and limited those aged 18 to 44.

Parity and Gravida. Maternal parity (the number of previous live births an individual has experienced) or gravida (the number of past pregnancies regardless of live birth) are also inconsistently associated with antepartum depressive symptoms. Specifically, number of previous pregnancies has been associated with increased depressive symptoms (Koleva et al., 2011) in some but not all studies, with parity having similar findings (Biaggi et al., 2016; Fortner et al., 2011). As such, participants were asked to provide the number of previous pregnancies and live births separately (see Appendix B), and each was included as potential covariates.

History of Depression/Depressive Symptoms. Individuals who have a history of depressive symptoms and/or prior mental health treatment (e.g., therapy), have been found to be at greater risk for depressive symptoms during pregnancy (Biaggi et al., 2016; Lancaster et al., 2010; Rich-Edwards, 2006; Verreault et al., 2014). As such, participants were asked if they have ever received a formal diagnosis of depression (see Appendix B). As measured in Rich-Edwards et al. (2006), history of depressive symptoms was measured by asking "Before this pregnancy, was there ever a period of time when you were feeling depressed or down or when you lost interest in pleasurable activities most of the day, nearly every day, for at least 2 weeks?" (p. 222; see Appendix B). Past treatment was measured similarly by the question "Have you ever received treatment for depression, for example therapy or the prescription of medication?" (Rich-Edwards, 2006; see Appendix B).

Symptoms of Anxiety. Anxiety and depression are highly comorbid during pregnancy (Biaggi et al., 2016), with increased symptoms of maternal antenatal anxiety being associated with increased symptoms of maternal antenatal depression (Dalaker, 2019; Lancaster et al., 2010). Symptoms of anxiety were measured by the Perinatal Anxiety Screening Scale (PASS; see Appendix E), a 31-item measure developed to screen for problematic anxiety symptoms specific to the perinatal population (Somerville et al., 2014). The PASS evaluates symptoms of anxiety over the past month on a 4-point Likert scale (i.e., 0=not at all, 1=sometimes, 2=often, 3=almost always), with higher totaled scores indicating increased levels of anxiety (Somerville et al., 2014). The PASS has demonstrated high convergent validity with the 21-item Depression Anxiety and Stress Scale (DASS-21) Anxiety scale (Pearson r=.78, p<.01), and the STAI State and Trait Anxiety subscales (r=.75 and .83, respectively, p<.01; Somerville et al., 2014). In this study, the PASS demonstrated high internal reliability (Cronbach's α=.97).

Perceived Stress Symptoms. Increased perceived stress during pregnancy has been associated with high maternal antenatal depressive symptoms (EPDS score >12; Fortner et al., 2011), with increased stress predicting increased depressive symptom severity (Jesse et al., 2014; Jesse & Swanson, 2007). Perceived stress was measured with the 14-item Perceived Stress Scale (PSS; see Appendix F; Cohen et al., 1983). The PSS assesses the frequency of stressful thoughts, emotions, and coping behaviors over the previous month utilizing a 5-point Likert scale (i.e., never=0, almost never=1, sometimes=2, fairly often=3, and 4=very often). Scores range from 0-56, with 7 items inversely scored, and higher total scores indicating higher perceived stress. The 10-item PSS (PSS-10) has demonstrated high reliability in the second and third trimesters of pregnancy (Cronbach's α=.88 for both) with moderate test-retest reliability between trimesters (r=.64; Benediktsson et al., 2017). Correlations between the PSS-10, STAI State Anxiety

subscale and the EPDS were significant for the second and third trimester (all *r'*s=.75; (Benediktsson et al., 2017). PSS-14 scores in this study demonstrated high internal consistency (Cronbach's α=.84) in this study.

Procedures

Privacy and Confidentiality

Given the necessity of obtaining participant zip codes to confirm HPSA status, it was necessary to adhere to protocols with privacy and confidentiality as a paramount concern. Idaho State University terms of service indicate that the online survey platform Qualtrics adheres to the Health Insurance Portability and Accountability Act of 1996 (HIPAA) standards for data security. As such, survey responses were stored on the Qualtrics server and password protected, encrypted hard drive, and accessed solely by a password-protected computer until data collection was complete. Once any identifying information was utilized to match participants with their screeners, it was deleted from the Qualtrics server and encrypted drive to ensure private health information (PHI) was not stored on any physical computer. Following HPSA status determination and information deletion, participant data was accessed on the password-protected and encrypted hard drive via a password protected computer and will be stored until all analyses are complete. This process was outlined in Informed Consent documents, to which participants consented to prior to participation in each stage of data collection (see Appendices G and H).

Recruitment

Participants were recruited from MTurk. Participants were limited to workers who were between the ages of 18 and 44, live in the US, identified as assigned female at birth, and were currently pregnant. As recommended by Huff & Tingley (2015), and utilized by Wagner et al. (2017) and Ibarra et al (2018), a two-stage process was utilized to recruit pregnant and

sociodemographically diverse participants. Specifically, MTurk workers were invited to participate in a pregnancy demographic survey (see Appendix A). Those who completed the sociodemographic survey were invited to participate in the second survey. Those who screened in to the second stage were invited to participate in a "Wellness Survey" within 3 weeks of their initial screener.

Participation. Individuals registered with MTurk who passed screening were asked to complete informed consent and the sociodemographic questionnaire. Those who were invited to participate in the second stage of the study began with the informed consent process. Those who consented to participate in the second stage completed the MSPSS, PASS, PSS, and EPDS in random order, then the pregnancy context questionnaire. All participants who completed the second stage were shown a debriefing document containing resources for mental health assistance.

Data Quality. In order to facilitate a high level of data quality, multiple participant screening methods were utilized (Buchanan, 2018). Recommended methods included utilizing worker specifications, IP address restrictions, response time monitoring, attention checks, and asking open-ended questions requiring coherent and thoughtful answers (Amazon Web Services, 2020; Buchanan, 2018; Chandler et al., 2020; Litman et al., 2017). As noted in Chandler et al (2020), false claims of U.S. residency can impact the quality of responses due to a potential lack of language comprehension skills required to complete surveys. As such, the provision of their zip code by participants can be seen as a data quality screening method, as well as limiting MTurk workers to those who identified as residing in the US. Other recommendations included verifying screening criteria within the survey and requiring participants to answer questions regarding their specific experience given the characteristics required (i.e., pregnancy context;

Chandler et al., 2020). Given these recommendations, participants completed the pregnancy context questionnaire last.

As the first stage of the study included no attention checks nor open-ended questions, those who provided unusable data (e.g., improbable or inconsistent answers, etc.) were not be invited to participate in the second stage of the study and their data was excluded from analysis. Those who failed attention checks in the second stage of the study were similarly excluded from analysis. The unique nature of the sample (i.e., pregnant individuals), and the other data quality measures taken in this study (e.g., two-stage recruitment model, requiring zip codes, high level of attention and consistency, qualitative questions, etc.) were seen as facultative of gathering high quality data. Further, participants were required to provide their MTurk identification number to be compensated for participation, which will allow for duplicate surveys to be excluded from analyses (Litman et al., 2017).

Worker Specifications. It has been recommended that only high-quality workers (i.e., workers with a 95% approval rate and 1,000 to 5,000 approved assignments) be allowed to participate in academic surveys (Amazon Web Services, 2020; Chandler et al., 2020; Springer et al., 2016). The number of approved assignments indicates the number of HITs completed, while the approval ratings indicate the ratio of approved HITs to attempted HITs (Litman et al., 2017). To decrease the potential for artificial homogeneity of the sample with high approved assignments (see Springer et al., 2016), and increase the likelihood of gathering sufficient, quality work, worker specifications were set at 95% approval rate and 1000 or more completed HITs.

Attention Checks. As recommended by Buchanan (2018), attention checks were utilized in the second stage of the study. Attention checks are items included in surveys that instruct

participants to answer questions in specific ways, provide opportunities for open-ended response, or require an increased level of attention to detail (e.g., sequential or dependent dates). MTurk participants have been found to outperform participants recruited from other online platforms (such as Qualtrics and Lightspeed; Kees et al., 2017), and student subjects (Hauser & Schwarz, 2016) in attention checks. Qualitative questions requiring thoughtful and comprehensible answer and pregnancy related questions requiring attention to detail were considered as attention checks. Participants who failed to provide thoughtful, comprehensible, or consistent answers to 20% or more of questions considered as attention checks were excluded from the study.

Response Time Monitoring. The second stage of the study had a total of 85 items, excluding attention checks, with a total of 7105 characters. Trauzettel-Klosinski and Dietz (2012) determined mean character reading speed per minute, which Buchanan (2018) utilized to set a critical reading time to determine a minimum reading time per page for his study (as cited in Buchanan, 2018). In line with his determination, adding 2 standard deviations to the mean character reading speed (per minute; M=987, SD=118) and dividing the total characters by the result (1223 characters) indicates that an individual should take no less than 5.8 minutes to read through this study after informed consent. While response times were monitored and it was determined that participants who took less than 5.8 minutes on the second stage of this study would be excluded from analyses, no participants were excluded from the analysis due to response time.

Maximum Time Allotted. Estimations of completion time for each questionnaire in the second stage of the study, including the Pregnancy Context Questionnaire, indicated that participants would likely need approximately 30 minutes to complete the stage. Given the best practices recommendation by CloudResearch to give participants “3 or 4 times the expected

length of the survey" in completion time, participants were granted 120 minutes to complete the HIT (Moss & Litman, 2019). Those who did not complete the questionnaire in the allotted time were excluded from analyses.

Compensation. While MTurk workers are paid an average of $1.38 per hour of work, a "reasonable" rate of pay for MTurk workers ranges from $3.50 per hour (as indicated by workers) to $8.00 per hour (as indicated by researchers; Buchanan, 2018, p. 2587; Chandler & Shapiro, 2016). Chandler et al. (2020) suggest that well-paying studies are at higher risk for fraudulent behavior. However, level of pay was not found to be related to changes in data quality, positively or negatively (as cited in Buchanan, 2018). In prior studies recruiting pregnant samples utilizing a two-stage approach, demographic questionnaires have been unpaid, or paid at the rate at the rate of $0.01 to $0.02 per questionnaire for those who screen into and complete the questionnaire (Ibarra et al., 2018; Wagner et al., 2017). This study offered a $0.01 for every screener completed, for total of $0.15 to those who screened into and completed the demographic questionnaire. The second stage of this study had a total of 85 items requiring response, not including attention checks, which was estimated to take approximately 30 minutes to complete. As such, participants who completed all second stage measures, providing consistent, plausible data, and passing attention checks were paid $3.50.

Data Collection Timeline. This study sought to gather responses from groups representing individuals from diverse racial-ethnic backgrounds and living in within or outside of an HPSA. While some studies with specialized groups (e.g., parents of children or pregnant smokers) have recruited participants within a one-month time period, some have taken one year (Dworkin et al., 2016; Ibarra et al., 2018; Wagner et al., 2017). Given the timeline of this dissertation, data collection for the second stage of this project was given a 2-month time period.

The data collection timeline for this study ran from October 2021 to January of 2022. Participants were solicited throughout the time period in order to increase the likelihood of participation (as recommended by Springer et al., 2016).

Debriefing. Given the sensitive nature of maternal antenatal mood, participants were informed of the aims of the study and provided resources available to them if they felt the need for additional support (see Appendix I).

Data Disposal. All data will be retained and maintained according to the APA Record Keeping and Research and Publication Guidelines (APA, 2017). Specifically, de-identified data will be stored on a password protected, encrypted hard drive only accessible via password protected computer to allow for replication of research design and analyses, and will be destroyed upon the completion of projects related to the study, or after a seven-year period, whichever comes first.

Chapter IV: Results

Participants

A total of 77 participants were included in analyses. A total of 1772 responses were recorded in stage 1, with 1527 completed screening questionnaires. Of those, 969 respondents identified as being assigned female at birth and living in the US, with 221 answering "yes" to the question "are you currently pregnant?" Of those, 16 indicated that they were above the age of 44, leaving 202 respondents meeting all inclusion criteria and consenting to participate. Respondents who provided inconsistent or implausible data (e.g., birthdate and age inconsistent, patterned or discrepant responses in income field, etc.) were not given a qualification to participate in the second stage. One-hundred and fourteen respondents were given the qualification to participate in the second stage of the study, of which 91 consented to participate and completed the questionnaire. Respondents who failed 20% or more of the items considered attention checks, provided implausible or inconsistent data, and/or indicated that they were no longer pregnant were not included in analysis, leaving 77 participants for the current study.

Data Overview

Following the completion of data collection, stage 1 and 2 data were compiled utilizing MTurk ID to match completed screeners with completed questionnaires. Following which, all identifying information was removed from the working file. Microsoft Excel formulae were used to categorize participants by racial-ethnic group and HPSA status and produce a total score for measures. IBM SPSS Statistics Version 28 was utilized to convert all text responses to numeric format; determine the internal consistency reliability for MSPSS, PASS, PSS-14, and EPDS responses; and complete all following data analyses.

Descriptive Statistics

Descriptive statistics of participant demographic information are listed in Appendix J (Tables 1J-2J). The majority of participants identified racially as White (78%), with 14% of participants identifying as ethnically Spanish/Hispanic/Latino. Mean participant personal gross annual income was $36,807 (*SD*=$24,799), and mean gross household income was $60,933 (*SD*=$42,246). Most participants worked full time (74%), working an average of 33.29 hours per week (*SD*=14.45 hours/week). The largest proportion of participants had earned a Bachelor's degree (53%), and had a mean of 15.57 years (*SD*=2 years) of education. Participants most often identified as married or in a committed relationship (70% and 18%, respectively), and most were cohabitating with their spouse or significant other (82%). The majority of participants resided in an mhHPSA (57%), with approximately half living in a pcHPSA (51%), 40% living in both an mhHPSA and pcHPSA, and 33% living in neither an mhHPSA or pcHPSA. On average, participants scored 11.26 (*SD*=6.69) out of 30 possible points on the EPDS, with higher scores indicating higher levels of depressive symptoms. On the MSPSS, where higher scores indicate higher levels of social support, participants scored an average of 66 (*SD*=15) out of a possible 84 points.

Descriptive statistics of potential covariates indicated an average participant age of 31.22 years (*SD*=5.4 years). While mean number of pregnancies (gravida) for participants was 1.55 (*SD*=1.83), the mean number of live births (parity) was 0.90 (*SD*=1.22) as the largest percentage of participants were expecting their first child (49%). Most participants (58%) endorsed a history of depressive symptoms prior to pregnancy, with only 36% of participants endorsing any treatment for depression and 36% endorsing having been formally diagnosed with a depressive disorder. On the PASS, participants average score was 36.17 (*SD*=20.66) out of a

possible 93 points. Out of a possible 56 points, participant scores averaged 26 (*SD*=8.34) on the PSS-14.

Variables of Interest

Variables of interest included multiple measures of racial-ethnic group, education, employment, income, social support, and HPSA status. Statistical analyses proposed allowed for up to 7 predicting variables and 7 covariates. The covariate selection process is outlined below. As the purpose of the current study is to determine nuanced relationships between different SDH and maternal antenatal depression symptoms, continuous variables were given preference and consistently used throughout analyses. When unavailable, categorical or dichotomous predicting variables were selected based on representation and distribution in the sample for this study, and the body of literature supporting inclusion. Area of residence (HPSA status) and maternal antenatal depression symptoms (EPDS score) were dichotomous and continuous, respectively, and were included as proposed. Educational attainment and employment status were measured in ways represented by both continuous and categorical variables, and years of education and typical hours of weekly employment were selected to represent them, respectively.

Racial-Ethnic Group. Ethnicity was assessed utilizing a 2-question format with the first question addressing potential Spanish/Hispanic/Latino ethnic background and the second addressing racial identity (see Appendix A). Recruitment aimed to prioritize representation among diverse racial-ethnic groups, and 14% of participants were individuals who identified ethnically as Spanish/Hispanic/Latino(a), and included individuals who identified as Mexican, Mexican American, or Chicano (as a category), and Cuban, Guatemalan, Honduran, and Columbian. Participants identified racially as Black or African American (12%), Hispanic/Latino(a) (7%), and Asian (3%), with one participant identifying as White and Black or

African American. However, the majority of participants identified as not ethnically Spanish/ Hispanic/Latino and White (75%). As such, racial-ethnic group was considered as a dichotomous variable, combining those who endorsed a Spanish/Hispanic/Latino ethnic background and/or Black or African American, Hispanic/Latino, or Asian origin into one category, referred to as "people of the global majority" (PGM; APA, 2021, p. 3), and combining those who identified as White and did not endorse a Spanish/Hispanic/Latino ethnic background, referred to as "people of European origin (PEO, APA, 2019). This dichotomization is comparable to studies reviewed, combining those with "Hispanic and/or Non-White" racial-ethnic identities and those who could be categorized as "Non-Hispanic White" (e.g., Jesse & Swanson, 2007; Rich-Edwards, 2006; Verreault et al., 2014).

Income. Participants provided their annual gross household income and personal annual gross income, and each were retained as continuous representations of income in separate models. In addition to monetary income, participants were asked about difficulty paying expenses. This continuous variable was found to be related to several other predictor variables, covariates, and the outcome variable (EPDS score). As such, difficulty paying expenses was included as an income variable in separate analyses.

Social Support. Social support was measured in several ways related to pregnancy context, including perceived social support (MSPSS score), and marital and cohabitation status. Based on past literature, marital and cohabitation status are often used as dichotomous variables (e.g., married/committed relationship versus other, cohabitating with partner versus alone). However, participants in this study were overwhelmingly married or in a committed relationship (88%), and/or cohabitating with their spouse or significant other (82%). As MSPSS score was a

naturally continuous variable, and marital and cohabitation status was largely homogenous, MSPSS score was chosen to represent social support in the current study.

Regression Assumptions

Frequency histograms for variables of interest were inspected for normality of distributions, and skewness *z*-scores were calculated. Transformations were performed on variables with skewness *z*-scores >3.29 or <-3.29 prior to primary analyses, depending on the perceived severity and direction of the skew, as recommended by Tabachnick & Fidell (2013). As such, hours worked, household gross income, and MSPSS scores were transformed via square root transformations. Four outliers (±3 SD) were identified among three participants, including one value in personal gross income and three values in household income. Following transformation, inclusion of the outliers did not prevent personal gross income from being within appropriate skewness or kurtosis value limits (i.e., reduced *z*-score to ≤3.29) for $p<.001$, two-tailed tests (Tabachnick & Fidell, 2013, *p*. 73). However, inclusion of outliers in household gross income did prevent successful transformation of the variable to below value limits. As a result of removing personal and household income data from one participant (as recommended in Tabachnick & Fidell, 2013; i.e., marked as missing in the dataset), personal gross income did not require transformation, and household gross income was below threshold with a square root transformation. Linearity and homoscedasticity were assessed via inspection of residuals scatterplots (i.e., symmetrical distributions, clustered around zero on the y-axis, with the overall shape as rectangular) and no other violations of regression assumptions were found.

Covariates

Pregnancy Context. Pearson and point-biserial correlations of variables of interest (see Table 3J) indicated some statistically significant correlations among potential covariate,

predictor, and outcome variables. Maternal age did not significantly correlate with any predictor or outcome variable of interest. Gravida was significantly positively correlated with residence in a pcHPSA (r_{pb}=0.227, p=0.047), and perceived difficulty paying expenses (r=0.244, p=0.032), and statistically significant negative correlation with MSPSS score (r=-0.305, p=0.007). Parity was significantly positively correlated with residence in a pcHPSA (r_{pb}=0.291, p=0.010), residing in both a pcHPSA and mhHPSA (r_{pb}=0.287, p=0.011), and difficulty paying expenses (r=0.264, p=0.020), and negatively correlated with MSPSS score (r=-0.257, p=0.024).

Depression Symptoms. History of depressive symptoms prior to pregnancy shared a statistically significant, positive correlation with perceived difficulty paying expenses (r=0.279, p=0.014) and EPDS total score (r=0.406, p<0.001), and statistically significant negative correlation with MSPSS score (r=-0.339, p<0.001). Having been treated for depression was significantly, positively correlated with EPDS score (r_{pb}=0.239, p=0.037). Having been formally diagnosed with depression shared a statistically significant, positive correlation with difficulty paying expenses (r_{pb}=0.260, p=0.022) and EPDS score (r_{pb}=0.263, p=0.021), and a statistically significant, negative correlation with racial-ethnic group (i.e., a formal diagnosis of depression was related to endorsing a non-Spanish/Hispanic/Latino, White identity; r_{pb}=-0.245, p=0.032).

Anxiety and Stress Symptoms. PASS score was significantly, positively correlated with EPDS score (r=0.753, p<0.001) and significantly, negatively correlated with MSPSS score (r=-0.428, p<0.001). PSS-14 score shared a statistically significant, positive correlation with difficulty paying expenses (r=0.360, p<0.001) and EPDS score (r=0.732, p<0.001), and a statistically significant, negative correlation with number of hours worked (r=-0.294, p<0.001) and MSPSS score (r=-0.627, p<0.001).

Models. Potential covariates with statistically significant correlations between both predictor and outcome variables were included as covariates in those models. As such, formal diagnosis of depression was included as a covariate in models with racial-ethnic group as a predictor and EPDS as an outcome variable. PSS-14 scores were included as a covariate in models with number of hours worked as a predictor and EPDS score as an outcome. History of depressive symptoms, PASS score, and PSS-14 score were included as covariates in models with MSPSS score as a predictor and EPDS score as an outcome. History of depressive symptoms, formal diagnosis of depression, and PSS-14 score were included as covariates in models with perceived difficulty paying expenses as a predictor and EPDS score as an outcome. While history of depressive symptoms and a formal diagnosis are theoretically related, the distinct nature of the participants represented in each group was deemed to warrant inclusion of both in this model. For example, formal diagnosis of depression was related to endorsing a non-Spanish/Hispanic/Latino, White identity although an endorsed history of depressive symptoms did not vary by ethnicity/race, suggesting that both groups may experience similar levels of symptomatology, but participants who are non-Spanish/Hispanic/Latino and White may have greater accessibility to services that lead to a formal diagnosis.

Primary Analyses

Hypothesis 1

SDH at the individual level, including racial-ethnic group, educational attainment, employment status, income, and social support, and at the population level, including residence in a pcHPSA or mhHPSA, will be significantly associated with maternal antenatal depressive symptoms. Specifically, residing in a pcHPSA or mhHPSA, identifying with an underrepresented

racial-ethnic group, less education, hours of weekly employment, income, and social support will predict significantly higher levels of antenatal depressive symptoms.

Correlation Analyses. To test hypothesis 1, correlation analyses with continuous predictors, including years of education, hours of weekly employment, annual personal gross income, annual household gross income, perceived difficulty paying expenses, and perceived social support scores with EPDS score were performed. Analyses revealed a statistically significant positive correlation between perceived difficulty paying expenses and EPDS score (r=0.341, p=0.002), such that those who endorsed greater perceived difficulty paying household expenses over the past month endorsed higher antenatal depressive symptoms. MSPSS scores demonstrated a statistically significant, negative correlation with EPDS score (r=-0.620, p<0.001), such that lower levels of social support were associated with higher levels of antenatal depressive symptoms. While statistically significant correlations existed between predictor variables, no statistically significant correlation was demonstrated between years of education, hours of weekly employment, annual personal gross income, or annual household income and EPDS score (see Table 3J).

Analyses of Variance (ANOVAs). To examine group differences in antenatal depression based on racial-ethnic group and HPSA residence (i.e., pcHPSA, mhHPSA, neither, or both), one-way ANOVAs were performed (see Table 4J). All groups met the assumption of homogeneity of variance (Levene's test p's>0.05). No statistically significant difference in EPDS score was found between groups who resided in pcHPSAs and those who did not, those who resided in mhHPSAs and those who did not, those who resided in both a pcHPSA and an mhHPSA and those who did not, and those who resided in neither a pcHPSA nor mhHPSA and

those who resided in one, the either, or both (p's>0.05). Further, no statistically significant difference in EPDS score was found between racial-ethnic groups 1 and 2 (p's>0.05).

Hypothesis 2

The cumulative impact of endorsing multiple SDH (i.e., a greater number of endorsed SDH) will significantly predict higher levels of antenatal depressive symptoms.

Multiple Regression Model. For hypothesis 2, a multiple regression model utilizing depressive symptom severity as an outcome variable and all SDH as predictors (i.e., years of education, hours of weekly employment, annual personal gross income, annual household gross income, difficulty paying expenses, perceived social support scores, racial-ethnic group, pcHPSA (Y/N), and mhHPSA (Y/N)) was completed. The model, containing all predictor variables listed above, was statistically significant in the prediction of EPDS score (F(9, 66)=5.122, p< .001), indicating a large effect size for all variables (R^2= .411). When holding all other variables constant, only one predictor variable, MSPSS score, significantly predicted antenatal depressive symptoms (b=-2.160, t(75)=-5.388, SE=0.401, p<0.001, 95% CI [-2.961, -1.360]). All other predictor variables, including years of education, hours of weekly employment, annual personal gross income, annual household gross income, difficulty paying expenses, racial-ethnic group, pcHPSA status, and mhHPSA status, were not statistically significant (p's>0.05), with 95% confidence intervals including zero (see complete results in Appendix K).

Hypothesis 3

The relationship between individual level SDH and antenatal depressive symptom severity will be moderated by residence in a pcHPSA or mhHPSA, such that the relationship between each endorsed SDH and elevated antenatal depressive symptoms will be stronger for

those who reside in a pcHPSA or mhHPSA. Specifically, the relationship between racial-ethnic group, educational attainment, employment status, income, and/or social support and elevated antenatal depressive symptoms will be stronger for those who reside in a pcHPSA or mhHPSA, as compared to those who do not live in an HPSA.

Moderation Models. To test hypothesis 3 and determine the influence of HPSA residence on the relationship between individual SDH and maternal antenatal depressive symptoms, moderation models were analyzed. Twelve multiple regression analyses were tested, including the two main effects (each SDH paired with either pcHPSA or mhHPSA residence status) and interaction effect. Complete results are reported in Appendix L, and statistically significant relationships are described by SDH below.

Racial-Ethnic Group. In the model with pcHPSA status moderating the relationship between racial-ethnic group and EPDS scores, the direct relationship between racial-ethnic group and EPDS score, while controlling for formal depression diagnosis, was statistically significant (b=5.45, t(72)=2.46, SE=2.22, p=.0164, 95% CI[1.028, 9.876]), such that those of PGM had greater EPDS scores than PEO. However, the interaction between pcHPSA status and racial-ethnic group did not produce a statistically significant change (R^2_{CHANGE}=0.032, b= -8.851, F(1,72)=2.670, p=.107, 95% CI[-12.923, 1.281]) in the model.

The model with mhHPSA status moderating the relationship between racial-ethnic group and EPDS score demonstrated a statistically significant main effect of racial-ethnic group (b=6.37, t(72)=2.639, SE=2.414, p=.0102, 95% CI[1.558, 11.181]) on EPDS score while controlling for formal diagnosis of depression, such that those of PGM had greater EPDS scores than PEO. Additionally, there was a statistically significant amount of the explained variance in EPDS scores added by the interaction between racial-ethnic group and mhHPSA status beyond

the other predictors in the model (R^2_{CHANGE}=0.048, *b*=-6.784, *F*(1,72)=4.044, *p*=.048, 95% CI[-13.510, -0.059]), while controlling for formal depression diagnosis. Follow-up conditional effect analysis revealed that the relationship between racial-ethnic group and EPDS score was only statistically significant for those who did not reside in a mhHPSA (*b*=6.37, *t*(72)=2.639, *SE*=2.414, *p*=.010, 95% CI[1.558, 11.181]).

Education. Models with HPSA status moderating the relationship between years of education and EPDS scores did not reach statistical significance for the overall model, main, or interaction effects (*p*'s>0.05), with 95% confidence intervals including zero (see Tables L3-L4).

Employment. The model examining pcHPSA status moderating the effect of hours worked on EPDS score while controlling for PSS-14 score was not statistically significant for main or interaction effects (*p*'s>0.05), with 95% confidence intervals including zero (see Tables L5-L6).

The main effect between hours worked and EPDS score was statistically significant (*b*=1.691, *t*(72)=2.11, *SE*=0.80, *p*=.038, 95% CI [0.096, 3.287]) with mhHPSA status as a moderator and controlling for PSS-14 score. However, the interaction between hours worked and mhHPSA status did not explain a statistically significant amount of the variance in EPDS score above and beyond the main effects (R^2_{CHANGE}=0.017, *b*=-1.594, *F*(1,72)=2.843, *p*=.096, 95% CI [-3.479, 0.291]).

Income. Models with HPSA status moderating the relationship between annual personal or annual household income and EPDS scores did not reach statistical significance for the overall model, main, or interaction effects (*p*'s>0.05), with 95% confidence intervals including zero (see Tables L6-L9). The model with pcHPSA status moderating the relationship between difficulty paying expenses and EPDS scores, while controlling for PSS-14 score, history of depressive

symptoms, and formal depression diagnosis, did not demonstrate statistically significant main or interaction effects (p's>0.05), with 95% confidence intervals including zero (see Table L10).

The model with mhHPSA status moderating the relationship between difficulty paying expenses and EPDS scores, while controlling for PSS-14 score, history of depressive symptoms, and formal depression diagnosis, trended toward a statistically significant main effect (b=1.782, t(70)=1.941, SE=0.904, p=.053), with confidence intervals containing zero (95% CI[-0.201, 3.585]). While a statistically significant amount of the explained variance in EPDS scores was added by the interaction between difficulty paying expenses and mhHPSA status beyond the other predictors in the model (R^2_{CHANGE}=0.024, b=-2.300, F(1,70)=4.085, p=.047, 95% CI[-4.570, -0.031]), follow-up analysis revealed that the confidence intervals for the conditional effect of difficulty paying expenses included zero for those who resided in an mhHPSA (b=-0.518, t(70)=-0.691, SE=0.749, p=.492), 95% CI[-2.012, 0.976]), and those who did not (b=1.782, t(70)=1.971, SE=0.904, p=.053, 95% CI[-0.021, 3.585]).

Following model analysis, the Benjamini-Hochberg (1995) method for false discovery rate type 1 error correction was conducted for each set of models (pcHPSA and mhHPSA; Appendix M). Adjusted alpha levels for the models did not impact statistical significance for overall models.

Social Support. The main effect of MSPSS score in predicting EPDS score was statistically significant (b=-0.899, t(70)=-2.281, SE=.394, p=.026, 95% CI [-1.686, -0.113]) in the model with pcHPSA as a moderator and controlling for history of depressive symptoms, PASS scores, and PSS-14 scores (see Table L13). However, the interaction between MSPSS score and pcHPSA status did not account for a statistically significant amount of the explained variance in EPDS score (R^2_{CHANGE}=0.000, b=-.099, F(1,70)=0.035, p=.853, 95% CI [-1.158, 0.960).

The main effect of MSPSS score predicting EPDS score was statistically significant (*b*=-1.179, *t*(70)=-3.285, *SE*=.359, *p*=.002, 95% CI [-1.895, -0.463]), with mhHPSA status as a moderator and controlling for history of depressive symptoms, PASS scores, and PSS-14 scores (see Table L13). However, there was not a statistically significant amount of explained variance in EPDS scores added by the interaction between MSPSS score and mhHPSA status (R^2_{CHANGE}=0.006, *b*=.607, *F*(1,70)=1.434, *p*=.235, 95% CI [-0.404, 1.618).

Hypothesis 4

The relationship between the number of endorsed SDH and antenatal depressive symptom severity will be moderated by residence in a pcHPSA or mhHPSA, such that the relationship between increased number of endorsed SDH and increased antenatal depressive symptoms will be stronger among those who reside in a pcHPSA or mhHPSA, as compared to those who do not reside in an HPSA.

Statistically significant moderation models demonstrated a main effect of racial-ethnic group, hours worked, and MSPSS score, and a significant interaction with difficulty paying expenses and HPSA status, on EPDS score. As such, each of the continuous variables was included in a moderation model to determine the level at which the relationship between it and HPSA status became statistically significant in relation to the outcome. Unfortunately, none of the models resulted in meaningful cutoff points with which to dichotomize continuous variables. In other words, while the overall relationships (main effects) were statistically significant, or accounted for a statistically significant R^2 change in the outcome, none of the continuous variables indicated a statistically significant cutoff point. Given these findings, there is no statistical foundation upon which to dichotomize the continuous variables of interest in order test

hypothesis 4. However, exploratory analyses utilizing median-split dichotomy points may allow for the discovery of relationships as hypothesized.

Exploratory Analysis. As described above, four variables were found to have a statistically significant impact on EPDS score, including racial-ethnic group, difficulty paying expenses, hours worked, and MSPSS score. As racial-ethnic group is naturally dichotomous, no process for dichotomizing was used. Each continuous variable was dichotomized using the following rationale:

Difficulty Paying Expenses. Measuring difficulty covering household expenses began with the US Census Bureau's Household Pulse Survey at the start of the COVID-19 pandemic response by the US government in March of 2020 (U.S. Census Bureau, 2022). The Center on Budget and Policy Priorities published an article related to difficulty paying expenses, in which they classified participants answering "somewhat difficult" or "very difficult" to the question (assigned as values of 2 and 3 in this study) as "struggling to cover household expenses" (Center on Budget and Policy Priorities, 2021). Given this, participants were grouped into those with High Difficulty (endorsed a 2 or 3, 35 participants) and Low Difficulty (endorsed a 0 or 1, 42 participants). A two-tailed independent samples *t*-test detected statistically significant differences in mean EPDS scores based on this grouping (M_{DIFF}=3.452, SE=1.488; $t(75)$=2.321, p=.023, 95% CI[0.489, 6.416]).

Hours Worked. The literature reviewed for this study indicated that being employed, as compared to unemployed, may be protective against antepartum depression. However, most participants in this study were employed (90%), with most working >35 hours per week (74%). When conceptually splitting participants by what is typically considered full-time hours (i.e., 40 hours per week) and below full-time, participants can be divided rather evenly into 2 categories:

High Hours (41 participants with >=40 hours) and Low Hours (36 participants with <40 hours). Notably, a two-tailed independent samples *t*-tests did not detect statistically significant differences in mean EPDS scores based on this grouping (M_{DIFF}=-1.129, *SE*=1.532; *t*(75)=-0.737, *p*=.463, 95% CI[-4.180, 1.922]).

MSPSS Score. MSPSS scores have been largely used in research as a continuous variable, with high scores indicating greater perceived social support. However, scores have been split into low and high categories depending on the research area (e.g., biomedical research; see Copertaro et al., 2014). For this sample, a median split results in those with High Social Support (scores >=70, 36 participants) and Low Social Support (scores <70, 41 participants). A two-tailed independent samples *t*-test detected statistically significant differences in mean EPDS scores based on this grouping (M_{DIFF}=-6.852, *SE*=1.318; *t*(75)=-5.200, *p*<.001, 95% CI[-9.478, -4.227).

Cumulative SDH. It was hypothesized that the cumulative impact of SDH on EPDS score would be moderated by HPSA status, such that the relationship between SDH and EPDS score would be stronger in a phHPSA or mhHPSA. New variables were constructed based on characteristics discussed, with high and low categories. Variable categories were given a 0 or 1 based on its relationship to EPDS score as demonstrated in moderation analyses. As such, those who identified as PGM, those above the median in difficulty paying expenses and hours worked, and those below median MSPSS score were assigned a 1 in corresponding columns. The cumulative SDH score ranged from 0 to 4 (*M*=1.7, *SD*=1.04), with 60% of participants scoring 2 or higher.

Moderation Models. Moderation models were run using the cumulative SDH score as the predictor, EPDS score as the outcome, and pcHPSA or mhHPSA status moderating the

relationship. Covariates for each included individual SDH, including history of depressive symptoms, formal diagnosis of depression, PSS-14 scores, and PASS scores, were included as covariates in the models.

While the overall model was statistically significant (see Table L15), the main effect of cumulative SDH score predicting EPDS score was not statistically significant (b=-0.366, t(69)=-0.485, SE=0.755, p=.629, 95% CI [-1.871, 1.139]) in the model with pcHPSA as a moderator and controlling for history of depressive symptoms, formal depression diagnosis, PASS scores, and PSS-14 scores. The interaction between cumulative SDH score and pcHPSA status did not account for a statistically significant amount of the explained variance in EPDS score (R^2_{CHANGE}<0.001, b=0.311, F(1,69)=0.093, p=.762, 95% CI [-1.730, 2.353]).

While the overall model was statistically significant (see Table L16), the main effect of cumulative SDH score predicting EPDS score was not statistically significant (b=-0.576, t(69)=-0.690, SE=0.835, p=.495, 95% CI [-2.241, 1.089]) in the model with mhHPSA as a moderator and controlling for history of depressive symptoms, formal depression diagnosis, PASS scores, and PSS-14 scores. The interaction between cumulative SDH score and mhHPSA status did not account for a statistically significant amount of the explained variance in EPDS score (R^2_{CHANGE}=0.001, b=0.537, F(1,69)=0.245, p=.622, 95% CI [-1.626, 2.700]).

Chapter V: Discussion

The goal of this study was to investigate the unique and cumulative impacts of SDH, including racial-ethnic group, income level, educational attainment, employment status, social support, and HPSA status on maternal antenatal depressive symptoms. A national sample was sought from MTurk over the course of 2 months, resulting in 77 participants. Participants completed demographic, mood, and pregnancy context questionnaires. Four hypotheses focused on examining those proposed relationships were tested utilizing a variety of statistical analyses. Largely, hypotheses in the current study were not supported. However, statistically significant relationships between predictive and outcome variables were found, and statistically significant interactive effects were demonstrated.

Racial-Ethnic Group

This study hypothesized that racial-ethnic group would be associated with maternal antenatal depressive symptoms. While prior literature suggested that correlates of maternal antenatal depressive symptoms may differ between participants who identified as "Hispanic and/or Non-White" and those who identified as "Non-Hispanic White" (Jesse & Swanson, 2007; Rich-Edwards, 2006; Verreault et al., 2014), no statistically significant correlations were found between racial-ethnic group and any other predictor or outcome variable in this study. Similarly, an ANOVA demonstrated no statistically significant differences between PGM and PEO in regard to maternal antenatal depression symptom scores. Multiple regression analyses with all SDH included revealed that racial-ethnic group membership was not a significant predictor of EPDS score above and beyond the other SDH.

Point-biserial correlations indicated that identifying as Hispanic, Black, Asian, or with multiple racial-ethnic groups (PGM) was significantly, negatively correlated with having a

formal depression diagnosis (r=-0.245, p=0.032). Follow-up analysis revealed significantly fewer formal diagnoses than expected in comparison to PEO ($\chi^2(1)=4.614$, p=.032), with the crosstabulation table indicating an expected count of 12 participants without a formal diagnosis and 7 with a formal diagnosis, compared to an actual count of 16 and 3, respectively. A calculated odds ratio indicated that odds of PEO having a formal diagnosis of depression were 4 times as large as the odds of the PGM (OR=4.040, p=.041, 95% CI [1.060, 15.402]). This finding suggests that while there were no significant differences in EPDS scores between PGM and PEO, significantly fewer PGM had been formally diagnosed. This is in line with a body of literature suggesting that disparities in care exist at the individual and provider levels. Specifically, individuals in underrepresented racial-ethnic groups may have higher levels of mental health related stigma and beliefs regarding mental health that may reduce treatment seeking (Miller, 2022). This, along with existing discrepancies in diagnosis and underdiagnosis by providers to patients belonging to such groups, may result in such discrepancies in formal diagnosis (Bailey et al., 2019; Miller, 2022). However, the current study was limited in number for participants of global majority. Specifically, PGM accounted for only 25% (n=19) of the total sample. Thus, future studies should seek to replicate current study findings with relatively equal sample sizes of PGM and PEO participants to reduce potential sources of error and add support for existing study implications.

It was hypothesized that HPSA status would moderate a direct relationship between racial-ethnic group and maternal antenatal depressive symptoms. For pcHPSA status, the overall moderation model was statistically significant, with a significant main effect of racial-ethnic group on EPDS scores, suggesting that endorsing a Spanish/Hispanic/Latino ethnic background

and/or Black or African American, Hispanic/Latino, or Asian origin (PGM) is associated with higher EPDS scores. However, interaction effects were not statistically significant.

This is the first known study to investigate a relationship between racial-ethnic group and maternal antenatal depression symptoms in the context of HPSA status. The statistically significant findings in the main effect between racial-ethnic group and EPDS scores in the context of pcHPSA residence replicates and extends existing literature. For example, Koleva et al. (2011) found that "identifying as White" was associated with lower depressive symptom scores as indicated by the Beck Depression Inventory (BDI) in a study similarly limited in ethnic-racial representation. Verreault et al. (2014) demonstrated that "belonging to a non-Caucasian ethnic group" significantly predicted having elevated depression symptoms in pregnant women (EPDS scores >10). However, models in these studies did not include a measure of HPSA status, and the interaction effects of racial-ethnic group and pcHPSA status did not reach significance in the current study.

For mhHPSA status, the overall model, the main effect of racial-ethnic group on EPDS scores, and the interaction with mhHPSA status were statistically significant. Given the directions indicated by analyses, these findings suggest that identifying as a person of global majority is related to increased levels of maternal antenatal depressive symptoms as compared to people of European origin, but when separated by mhHPSA status, this relationship only remained statistically significant outside of mhHPSAs. Therefore, it appears that while identifying as a PGM outside of a mhHPSA is associated with significantly higher EPDS scores than PEO, EPDS scores not significantly different between those who reside within a mhHPSA.

In their sample of low-income, rural participants, Jesse and Swanson (2007) found elevated levels of antenatal depressive symptoms among African American participants as

compared to those of other racial-ethnic groups (Jesse & Swanson, 2007). This finding is contrary to those of this study, which found no significant differences in EPDS score between racial-ethnic group residing within mhHPSAs. However, this may be due to the differences in income, racial-ethnic identities, and/or areas of residence represented in the current study. Importantly, Jesse & Swanson's participants were more racially and ethnically diverse than the current study, with 42.6% of their participants identifying as "African American" and 26.5 identifying as "Hispanic" (2007, p. 382), with all participants identified as experiencing a "low income." Further, Ross et al. failed to find statistically significant differences between pregnant women of similarly limited racial-ethnic diversity living in rural, semi-rural, or urban areas of Canada (Ross et al., 2011). These and other studies targeted overall prevalence rates of "elevated" depression symptoms among "rural" participants (Jesse & Swanson, 2007; Price & Proctor, 2009). As HPSA and rural status may differ in important ways, future studies may include direct comparisons between diverse racial-ethnic groups residing in each.

The finding that the relationship between elevated EPDS score and racial-ethnic group was only significant outside of a mhHPSA, while contrary to the hypothesis of this study, is in line with literature suggesting that drivers of mental health disparities for underrepresented racial-ethnic minority, including "individual level, provider level, and historical [individual] experiences" such as mental health related stigma, health insurance or Medicaid acceptance, provider perceptions, and historical experiences with reporting systems (e.g., fear of child protective services), have served as barriers to seeking, receiving, and benefitting from mental health treatment (Miller, 2022). This may account for increased experiences of depressive symptoms for pregnant individuals identifying as Hispanic, Black, Asian, or with multiple racial-ethnic groups, as represented in the current study, even with the availability of mental health care

providers. However, racial-ethnic differences may no longer exist within a mhHPSA because cultural and structural barriers that may normally differentiate those outcomes do not make as much of a difference in a place wherein barriers to access, and mental health help-seeking stigma apply more broadly. Indeed, cultural beliefs regarding mental health help seeking stigma have been found among rural, low-income participants (Crumb et al., 2019). Future research on specific barriers to care in the context of HPSA status may focus on the similarities between barriers to those in underrepresented racial-ethnic groups outside of an HPSA and those who reside within an HPSA.

The current study demonstrated that identifying as Hispanic, Black, Asian, or with multiple racial-ethnic groups (people of global majority) was associated with a lower incidence of having a formal diagnosis of depression, statistically significant differences in EPDS score for participants in the context of pcHPSA status, and for those residing outside of a mhHPSA. Further, this study found that differences in EPDS scores between racial-ethnic groups were not statistically significant for those who reside within a mhHPSA. This was a novel finding in the literature, as racial-ethnic group membership in relation to maternal antenatal depression in the context of HPSA status has not been investigated. This novel finding highlights the importance of inclusion of HPSA status in studies related to maternal mental health, and the differences in findings between studies that are inclusive of or lacking in diverse racial-ethnic representation.

Income

Studies have largely found statistically significant associations when investigating the relationship between low income or financial difficulties during the antenatal period and symptoms of depression (Koleva et al., 2011; Lancaster et al., 2010; Rich-Edwards, 2006). However, some studies reported no statistically significant correlations (Biaggi et al., 2016), or

the significance of the relationship diminished following the addition of other predictors to the model (Verreault et al., 2014). As such, the current study investigated personal gross income, household gross income, and difficulty paying expenses as income variables.

Personal and Household Income

Personal gross income was significantly, negatively correlated with mhHPSA status and difficulty paying expenses, and demonstrated statistically significant, positive correlations with living in neither a primary care nor mental health HPSA, years of education, hours worked, and household gross income. These findings suggest that increased personal income is associated with residence outside of an HPSA, greater number of years of education, greater household gross income, and more hours employed. Reduced personal gross income is associated with residence in a mhHPSA and increased difficulty paying expenses. These relationships make sense given the extensive literature regarding socioeconomic status (SES), which is (broadly) formulated including income, employment status, and education (see Lancaster et al., 2010). These factors, including residence outside of an HPSA, may suggest a buffering effect against financial difficulty, as indicated by the statistically significant, negative correlation with difficulty paying expenses.

However, annual personal gross income was not significantly correlated with any mood measures (e.g., MSPSS, PASS, PSS-14, or EPDS score). Household gross income was significantly, positively correlated with hours worked, and significantly, negatively correlated with difficulty paying expenses, but was not significantly correlated with other predictor (including HPSA status) or mood measures. Multiple regression analysis revealed that the impact of personal and household income did not significantly contribute to the variance of participant EPDS scores. Similarly, moderation analyses revealed no statistically significant main effects of

personal or household gross income on EPDS score, nor statistically significant interaction effects with HPSA status.

These findings are contrary to studies that found a statistically significant relationship between antenatal depressive symptoms and income (Katz et al., 2018; Koleva et al., 2011; Rich-Edwards, 2006). Differences in research design and sample may explain some of the differences found. Specifically, Koleva et al. (2011) utilized a mixed sample of participants from a University Hospital and state-funded community maternal health centers (MHC), and found a statistically significant difference in income from each sample, with a majority of the participants from the MHCs with an annual income below $20,000 (page 103), which was the threshold for their ANOVA and linear regression analyses (page 104-105). Similarly, Katz et al. (2018) found income to be a statistically significant predictor of depressive symptoms among their low-income community sample of pregnant women. In their study, income significantly predicted depressive symptoms, and that relationship was significantly moderated by level of maternal hardship. Similar to Koleva et al. (2011), most participants in the Katz et al. study had a household income of <$20,000. Given the similarities between these studies, differences in findings in the current study may be due to the higher level of income for its participants or the differences in symptoms measured.

Specifically, Koleva et al. (2011) used a BDI cutoff score to distinguish depression level, as did Katz et al. (2018) with the PHQ-9 score. Notably, the BDI and PHQ-9 are depression screeners validated for the general population, while the EPDS has been validated specifically for pregnant populations. However, Rich-Edwards (2006) found significantly higher rates of EPDS scores >12 in participants who made less than $40,000 per year compared to those who made more (page 224). Such findings were not replicated in the current study, which may be

attributable to the higher average income of current study participants, notable sample size differences between the current study and the Rich-Edwards study (77 and 1662, respectively), or the use of cut-off scores rather than continuous scores as outcome variables.

Difficulty Paying Expenses

While other studies have researched the impact of perceived financial hardship on maternal depression (Katz et al., 2018; Rich-Edwards, 2006), this is the first known study to investigate difficulty paying expenses in this way. Specifically, this is the first known study to utilize the question from the U.S. Census Bureau's COVID-19 Household Pulse Survey regarding difficulty paying expenses to determine statistically significant relationships between it, maternal antenatal depression symptoms, and HPSA status.

Difficulty paying expenses was significantly correlated with several predictor and mood variables. Specifically, perceived difficulty paying expenses shared a statistically significant, negative correlation with years of education, personal and household income, and MSPSS score, and a significant, positive correlation with EPDS score, PSS-14 score, parity, gravida, history of depressive symptoms, and formal depression diagnosis. Given the seemingly protective relationship of personal and household income, years of education, and hours of employment (components of SES, as described above), on difficulty paying expenses, and the relationship between difficulty paying expenses on social support and mental health symptoms, this may suggest that pregnant individuals with fewer resources may be at greater risk of having less social support and greater psychological symptoms. This is particularly salient given that these women may have more children. Future research should focus on these relationships by directly investigating the relationship between income and/or SES and difficulty paying expenses, and how that relationship associates with social support and maternal mental health.

Perceived difficulty paying expenses did not significantly predict EPDS scores in multiple regression analysis with other SDH in the model. Further, while overall moderation models with HSPA status moderating the relationship between difficulty paying expenses and maternal antenatal depressive symptoms (while controlling for PSS-14 score, history of depressive symptoms, and formal depression diagnosis) were statically significant, main effects were not. Although the interaction term added a statistically significant amount of variance in explaining the outcome variable above and beyond the main effects and covariates in the model, follow-up analysis revealed that this conditional effect of difficulty paying expenses on EPDS score was not significant at either level of the moderator.

Rich-Edwards (2006) found that financial hardship (i.e., reportedly not "[having] enough money to buy" baby formula/food, diapers, buy food and pay the rent/mortgage) was a statistically significant predictor of high maternal EPDS scores (scores of >12) at 6 months post-partum. This financial hardship remained as a statistically significant risk factor after adding several other risk factors, such as partnership status and cohabitation, pregnancy intention, and social support. However, the aim of that study was to determine prevalence and predictors of high maternal EPDS scores in both the antenatal and postpartum periods, rather than determining relationships between increasing levels of depressive symptoms, nor did they assess financial hardship in the antenatal period, as did the current study.

Katz et al. (2018) operationalized their variable of "material hardship" by assessing perceptions of items not limited to finances, including having enough food, adequate transportation, appropriate clothing, safe and stable housing, and a working phone (p. 1362). Similar to difficulty paying expenses in the current study, maternal hardship was found to correlate strongly with depression and income, predict elevated depression scores (PHQ-9 >10)

via logistic regression model, and mediate a statistically significant relationship between income and elevated depression. The inclusion of difficulty paying expenses as a predictor, rather than a moderator, may have obfuscated a potential important relationship in the current study. Future studies may include difficulty paying expenses with other hardship measures, and examine a potential moderative relationship with income and maternal depression symptoms.

The finding of significant correlations between difficulty paying expenses and other predictors, covariates, maternal antenatal depression highlights the importance of inclusion of perceived difficulty paying expenses in future studies related to maternal mental health. For example, as noted above, future studies may investigate the inclusion of difficulty paying expenses as a moderator for existing relationships between income and antenatal depressive symptoms in the context of HPSA status.

Educational Attainment

Educational attainment has been inconsistently indicated as a predictor of maternal antenatal depression symptoms, with some studies finding lower depressive symptom endorsement among those with higher levels of education (Fortner et al., 2011; Koleva et al., 2011), and others finding mixed results, with some results indicating higher depression symptoms related to higher levels of education (Biaggi et al., 2016). This study investigated the relationship between maternal antenatal depression symptoms and number of years of education. While analyses revealed a statistically significant, negative correlation between years of education and difficulty paying expenses, and a statistically significant, positive relationship with personal gross income, no statistically significant correlation was found with any other predictor or mood variable. Multiple regression analysis revealed that years of education did not significantly predict changes in EPDS score. Moderation models investigating the potential role

of HPSA status (i.e., residence in a mhHPSA or pcHPSA) in moderating a main effect between years of education and EPDS scores indicated no statistically significant main or interactive effects. Overall, this study found only a tangential relationship between years of education and EPDS scores, adding to the mixed results found in other literature.

These findings differ from those of Koleva et al. (2011), who found a statistically significant, negative correlation between years of education and total BDI score in their sample of pregnant women, which remained statistically significant in follow-up linear regression analyses. While years of education was represented in ways similar to the current study, important differences in sample demographics and outcome variables exist between these studies. Specifically, participants were recruited from both community maternal health clinics and a university obstetrics clinic, with mean years of education significantly differing between the two (12.28 years and 15.26 years, respectively), and mean BDI scores of the university participants being significantly lower than community participants (7.99 and 12.27, respectively; Koleva et al., 2011, p. 101). As the mean number of years of education for the current sample (15.57 years) was similar to their university sample, it is possible that a relationship between years of education and EPDS score was undetectable due to the limited diversity of participants. In other words, a positive impact of increased years of education may not be seen in a sample of highly educated participants such as in the current study.

Fortner et al. (2011) found that among their sample of Hispanic women of Caribbean Island heritage, multivariable regression models indicated that participants who graduated high school or attended college/graduate school had lower risk of elevated EPDS scores (scores >12) than those who had less than a high school education (Fortner et al., 2011, p. 1291). Importantly, 49% of participants in their study had not completed high school, and in the current study, all

participants had either completed high school or an equivalent (GED). This highlights the need for future studies to adequately represent diversity of participants in terms of racial-ethnic group and educational background in order to capture potential risk factors related to antenatal depression symptoms.

Employment

Prior research has suggested that level of employment may significantly predict maternal depression symptoms (Biaggi et al., 2016; Koleva et al., 2011). In the current study, hours of weekly employment shared a statistically significant, positive correlation with personal and household gross income, and a statistically significant, negative correlation with PSS-14 score. In the multiple regression model, hours worked per week did not statistically significantly predict participant EPDS scores. The moderation model with hours of employment predicting EPDS score with pcHPSA status as the moderator, while controlling for PSS-14 score, demonstrated no statistically significant main or interaction effects. The moderation model investigating hours worked and mhHPSA status on EPDS score indicated a statistically significant main effect of hours worked on EPDS score, while controlling for PSS-14 score, such that increasing hours worked demonstrated an increase in EPDS scores. However, no statistically significant interaction effects were found with mhHPSA status.

Utilizing hours worked in the investigation of the impact of employment level in predicting maternal antenatal depression symptoms in the context of mhHPSA status as practiced in the current study was a novel approach. Level of employment is typically investigated as a dichotomous variable, often used to assess differences between participant groups who are employed or unemployed (see Koleva et al., 2011). Specifically, Koleva et al. (2011) found that participants who were unemployed were at greater risk for elevated depression symptoms. The

novel finding demonstrating a statistically significant, negative impact of increased hours worked on EPDS scores for participants who were overwhelmingly employed (90%) illuminates an important area of focus for future research.

Social Support

Social support has been found to be demonstrably protective for maternal mental health. Married status and/or cohabitation with a statistically significant other has been found to reduce risk of elevated depressive symptoms among pregnant participants (Fortner et al., 2011; Jesse et al., 2014; Koleva et al., 2011), and low levels of social support have been associated with increased depressive symptoms (Ross et al., 2011). In the current study, social support was found to be the strongest predictor of maternal antenatal depressive symptoms among all SDH analyzed. MSPSS score shared a statistically significant, negative correlation with difficulty paying expenses, EPDS, PASS, and PSS-14 scores, and history of depressive symptoms. A multiple regression model demonstrated a statistically significant impact of MSPSS score on EPDS score, such that a unit increase in MSPSS score indicated a 2.16 unit decrease in EPDS score, when holding all other variables constant. Follow-up analysis investigating the impact of MSPSS scores in the original (non-transformed) units on EPDS scores with PASS, PSS-14, and history of depressive symptoms included in the model, indicated that an increase of one point on the MSPSS was associated with a decrease of 0.116 points on the EPDS (b=-0.116, t(76)=-3.258, SE=0.036 p=0.002, 95% CI [-0.187, -0.045]). Given the range of the MSPSS total score in the current study (72 points), the impact of such a relationship could be a reduction of as many as 8 points on the EPDS, indicating a clinically meaningful relationship between the two.

In moderation models, main effects of MSPSS score in predicting EPDS scores were statistically significant in individual models with pcHPSA and mhHPSA status as moderators,

and controlling for history of depressive symptoms, PASS scores, and PSS-14 scores. This further suggests that social support is a key protective factor for antenatal maternal mental health, even in a sample of employed participants with relatively high education and income levels. However, neither model indicated statistically significant interaction effects of HPSA status. These findings are in line with Ross et al. (2011) who found no statistically significant difference in EPDS mean or elevated symptom prevalence (scores >12) between pregnant participants who resided in rural, semi-rural, or urban areas of Canada. Further, Ross et al. (2011) did not find a statistically significant difference in perceived social support (as measured by the MOS) between urban, rural, and semi-rural participants. However, that and the current study were similarly limited in terms of number of participants in each area of living, racial-ethnic identity, level of income, and relationship status. Thus, a lack of statistically significant findings may be attributable to the limits in number and diversity of participants in those areas.

Cumulative SDH

It was hypothesized that participants who endorsed higher numbers of individual SDH would endorse higher levels of maternal depressive symptoms, and that HPSA status would account for a statistically significant increase in those symptoms. However, while some statistically significant interactions were found, proposed analyses did not result in statistically significant cut-off points with which to dichotomize the predictor variables. This hypothesis was designed based on the research suggesting high variability in county-level SDH markers in areas that were designated as pcHPSAs (Streeter et al., 2020), which could be seen as a potential route by which individuals may experience a differential impact of HPSA status. In other words, HPSA status may differentially impact those who experience other SDH, which may increase with the number of SDH experienced. However, this study may not have allowed for the

discovery of such an impact. Given this, and the number of diverging findings in this study, it is likely that the limited and unique nature of this sample may be responsible. Specifically, the limited number and diversity of participants in terms of racial-ethnic group, income, education, and employment may have limited the ability to find the true impact of each established SDH on EPDS score in the context of HPSA status.

Exploratory analyses with median-split variables were performed. Neither model indicated a statistically significant main effect of cumulative SDH on EPDS score, nor was there a statistically significant interaction effect by HPSA status, when controlling for history of depressive symptoms, formal diagnosis of depression, PASS and PSS-14 scores. This model represents a novel investigation of a potential cumulative impact of SDH on depression symptoms in the context of HPSA status. Importantly, utilizing a median-split to dichotomize variables has been criticized for its typically negative consequences, including a loss of nuance in individual differences, among others (see MacCallum et al., 2002). This technique may highlight the limits of the current sample, rather than allowing for the exploration of relationships as intended.

HPSA Status

Prior literature has suggested that health status can be impacted by HPSA status, in that the lack of access to health care (as experienced by those who reside in an HPSA) can detrimentally impact mental and physical health (Kohrs, 1995; Liu, 2007; Streeter et al., 2020). Further, prevalence rates for perinatal depression may be significantly higher for residents in HPSAs than those surveyed from rural, semi-rural, or urban areas (see Price & Proctor, 2009; Ross et al., 2011). As such, residence in an HPSA was hypothesized to impact the level of maternal antenatal depressive symptoms both directly and indirectly through main and

interactive effects on other SDH. Participants were categorized as residents of a mhHPSA pcHPSA, both, or neither for correlation and ANOVA analyses. No statistically significant relationships were found between pcHPSA status and other predictor or outcome variables. While mhHPSA status shared a statistically significant, negative correlation with personal gross income, no other statistically significant correlative relationships were found between mhHPSA status and predictor or outcome variables. In ANOVA analyses, no statistically significant mean differences in EPDS scores were found based on HPSA status. Multiple regression analysis revealed that residence in an pcHPSA or mhHPSA did not significantly predict EPDS scores.

While this is the first known study to examine a direct relationship between residence in an HPSA and antenatal depression symptoms, these findings are similar to those who reportedly found no statistically significant differences in antenatal or perinatal depression symptoms based on areas of residence or level of rurality (Nidey et al., 2020; Ross et al., 2011). Specifically, Ross et al. (2011) found no significant differences in prenatal or postpartum EPDS score between participants who lived in rural, semi-rural, or urban areas of Canada. While Nidey et al. (2020) found a significant increased risk of endorsing depression as a health condition for rural participants during pregnancy and postpartum in an initial model, adding other social or financial factors including maternal education, insurance status, and WIC assistance reduced the significance of the difference between those who resided in urban or rural setting. As such, future research should directly investigate similarities and differences in risk factors among level of rurality and HPSA status. In anticipation of considerable overlap in HPSA status, the current study grouped HPSA status variables (i.e., pcHPSA, mhHPSA, both, or neither). Future studies may examine the dependence/independence of the HPSA variables to determine whether another analysis (e.g., 2x2 ANOVA) would be appropriate.

Study Strengths

This study had several strengths, including the use of a rigorous data collection method based on best-practice recommendations to collect meaningful, high-quality results from an online platform, and to fairly reimburse participants for their time and participation. The number of participants allowed for the investigation of predictive relationships among variables and the statistical power to detect medium-to-large effect sizes, when available. SDH investigated were established through prior research, and measures used to assess predictor variables and covariates (EPDS, MSPSS, PASS, and PSS-14) were psychometrically strong and theoretically grounded. Participants were fairly equally distributed among HPSA status. Further, the impact of SDH on maternal antenatal depression symptoms is largely understudied, and this study is the first to investigate the role HPSA status in those relationships in addition to asking specifically about difficulties paying expenses.

The current study contributes to this body of literature by replicating studies that found associations between perceived social support and decreased depression scores during pregnancy, and adds to the literature suggesting potential differences in depression score based on racial-ethnic identity and HPSA status. This is the first known study to find an association between hours typically worked and maternal antenatal depression symptoms in the context of mhHPSA status. Further, the current study is the first known to demonstrate the interactive effect of mhHPSA status on relationships between racial-ethnic group and difficulty paying expenses and maternal antenatal depressive symptoms.

Study Limitations

While it has been suggested by other research that recruitment from MTurk has resulted in the “fast” collection of large, demographically diverse samples (in terms of racial-ethnic

group, income, employment and education level; see Dworkin et al., 2016; Ibarra et al., 2018; Posch et al., 2018; Turkprime, 2020; Wagner et al., 2017), this was not the case for the current study. Specifically, this study was limited in number and largely homogenous in terms of racial-ethnic groups represented, income, employment status, and education level of participants. These limitations may also have resulted from the time constraints imposed on this study by the nature of a dissertation timeline, the fluctuating window of opportunity presented when collecting data during pregnancy, and the demographic representation of MTurk workers. Feasibly, as a result of these limitations, this study failed to find relationships between education level, personal or household income, and EPDS score. Specifically, this sample was comprised of high-earning, highly-educated, and employed participants who were largely of European origin, which may have limited the ability to find relationships that only exist among lower income, unemployed individuals, those with lower levels of educational attainment, or those of global majority. Further, the number of participants may have limited the statistical power needed for moderation analyses, and the ability to explain unique variance in outcome variables may have been limited by the number and type of covariates entered into regression models. Finally, these differences in findings may have been due to differences in representation of variables, including continuous income, education level, or dichotomous nature of racial-ethnic group.

Implications and Future Directions

Statistically significant findings from the current study highlight potential clinical and research targets for national and community efforts to reduce or prevent antenatal depression, including social support and antenatal support for underrepresented US racial-ethnic groups. Replication of studies indicating the importance of social support for maternal antenatal wellbeing suggests that funding efforts for reducing or eliminating maternal antenatal depressive

symptoms may focus on increasing awareness prior to pregnancy, increasing availability of social support opportunities at the community level prior to, during, and following pregnancy, and funding research regarding successful social support interventions.

As it has been suggested that level of social support is typically maintained throughout pregnancy and postpartum, and is unlikely to increase over that time period (Hetherington et al., 2020), it may be beneficial to increase awareness of the importance of social support prior to pregnancy. Current efforts aimed at reducing risk of perinatal depression may increase availability of materials regarding pre-pregnancy social support as part of the current education campaigns at the national and community level, which may positively impact the focus on social support for women who plan to become pregnant. Further, assessing the level of social support during family planning visits or early obstetrical care may lead to effectively targeting those who are at higher risk for prenatal and/or postpartum depression.

Non-professional social support interventions with mothers of infants (<1 year old) in Australia were examined, and increasing access to a varied number of "befriending opportunities" was found to be valued by new mothers (Small et al., 2011). Further, a non-professional mentorship model (MOSAIC), wherein "mentors" were trained to listen to mothers and provide "non-judgmental" support, including friendship, help in developing safety strategies when needed, and information about local support services and how to access them (p. 6), was found to be valued and beneficial to most women (Small et al., 2011). However, studies directly assessing the impact of interventions with pregnant or postpartum individuals on perceived social support utilizing any kind of social support measure, such as those discussed in this study, were not found. The dearth of literature regarding effective social support intervention prior to, during, or following pregnancy highlights an important gap between research and clinical practice.

Replication of studies indicating that individuals who identify as belonging to underrepresented US racial-ethnic groups, such as those represented in this study, may experience higher levels of antenatal depression symptoms based on area of residence suggests that funding efforts for reducing or eliminating maternal antenatal depressive symptoms may focus on increasing funding and outreach efforts to benefit those racial-ethnic groups. Further, given the finding that these individuals have the same levels of symptoms of depression but have a significantly lower incidence of formal diagnosis, outreach and funding efforts should not be limited to those with formal mental health diagnoses.

The strengths and limitations of the current study highlight the importance of the design and inclusivity of future research. This study was designed with mental health measures validated for use with pregnant populations. Significant correlations between measures of depression, anxiety, and perceived stress are consistent with existing literature, and demonstrate strong relationships between measures largely meant to capture the experience of pregnant individuals, specifically. However, the current study was limited in diversity.

Future studies may oversample for racial-ethnic, employment, education, and income diversity, which may allow for the discovery of important relationships with HPSA status. Given several novel findings based on the way variables were conceptualized in this study, future research may utilize variables in similar ways. Specifically, the number of hours worked along with employment status, years of education along with educational attainment, and perceived difficulty paying expenses along with income information. Further, future studies may examine the dependence/independence of HPSA status when investigating potential significant differences in EPDS score. Given our findings regarding HPSA status, future studies may compare risk factors for antenatal depression between level of rurality and HPSA status, and may

include direct comparisons between diverse racial-ethnic groups. Further, future studies may investigate specific barriers to care in the context of HPSA status, focusing on the similarities between barriers to those in underrepresented racial-ethnic groups outside of an HPSA and those who reside within an HPSA. Future studies may include questions regarding difficulty paying expenses along with other hardship measures, and examine a potential moderative relationship with income and maternal depression symptoms in the context of HPSA status.

Conclusion

Given the support for the interrelated nature of SDH and maternal antenatal depressive symptoms, this study sought to elucidate the potential individual and cumulative impacts of SDH on antenatal maternal depressive symptoms, including HPSA status. The current study was the first known study to examine the potential main and interactive effect of HPSA status in these relationships. This study sample was limited in number and largely homogenous in terms of racial-ethnic groups represented, income, employment status, and education level of participants. However, it had many strengths, including its rigorous data collection method, variables of interest established on prior research, with measures that were psychometrically strong, grounded in theory, and validated for pregnant populations. The current study replicated existing literature by finding a significant, protective relationship between level of social support and antenatal depressive symptoms. This study added to the literature by finding statistically significant increases in depression symptoms for individuals endorsing a Spanish/ Hispanic/ Latino ethnic background and/or Black or African American, Hispanic/Latino, or Asian origin as compared to those who identified as Non-Hispanic White in the context of pcHPSA status, and when residing outside of a mhHPSA, and no significant differences in depression symptoms by racial-ethnic group for those who live within a mhHPSA. This is the first known study to find an

association between hours typically worked and maternal antenatal depression symptoms in the context of mhHPSA status, and to demonstrate an interactive effect of mhHPSA status on relationships between racial-ethnic group and difficulty paying expenses on maternal antenatal depressive symptoms.

These statistically significant findings highlight the import clinical and research targets for national and community efforts to reduce or prevent antenatal depression. Funding efforts for reducing or eliminating maternal antenatal depressive symptoms may focus on increasing awareness of the importance of social support prior to pregnancy, increasing availability of social support opportunities at the community level prior to, during, and following pregnancy, and funding research regarding successful social support interventions. Existing programs should be targeted toward racial-ethnic groups who may be experiencing higher levels of depressive symptoms, and funding and outreach efforts to benefit those racial-ethnic groups should increase, and those benefits should not be limited to those who have been formally diagnosed.

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Appendix A

Sociodemographic Questionnaire

1. Mturk ID:
2. Date of Birth:
3. Age:
4. Zip code of current residence:
5. This question requires workers to follow a link in an internet browser. This is a link to a government website that provides information regarding residence in Health Professional Shortage Areas, called HPSA Find. Please click on the link below. It will open into a new browser.

   https://data.hrsa.gov/tools/shortage-area/by-address

   After entering your address of current residence into the tool, press the "search" button. Based on the information provided, please select "yes" or "no" to the following questions.

   Is your current residence:

   In a Dental Health HPSA? Yes/No

   In a Mental Health HPSA? Yes/No

   In a Primary Care HPSA? Yes/No
6. How many years of education have you completed? Please include formal education, such as pre-kindergarten, K-12, technical education (certificate/associate's degree), secondary education (college), and post-secondary education (graduate).
7. What is your highest completed educational attainment? [select one]
   - Less than High School
   - GED

[if less than high school or GED] What grade did you last complete?

- High school diploma
- Technical Certificate
- Associate's Degree
- Bachelor's Degree
- Master's Degree
- Doctorate or Professional Degree

8. What is your level of employment?
    - Full-time (35+ hours per week, per job)
    - Part-time (less than 35 hours per week, per job)

      [if employed] How many jobs are you currently working?

      [if employed] How many hours do you work in a typical week?
    - Not working for pay or profit

      [if not working] What are reason(s) for not working for pay or profit? Select all that apply.
        - I do not want to be employed at this time
        - I am unable to obtain work due to COVID-19
        - I was unable to obtain work prior to the COVID-19 pandemic or my inability to find work is unrelated to the COVID-19 pandemic
        - My employer experienced a reduction in business (including furlough), closed temporarily, or went out of business due to the COVID-19 pandemic
        - I am retired

9. In the last month, how difficult has it been for your household to pay for usual household expenses, including but not limited to food, rent or mortgage, car payments, medical expenses, student loans, and so on? Select only one answer.
    - Not at all difficult
    - A little difficult
    - Somewhat difficult
    - Very difficult
10. Getting enough food can be a problem for some people. In the last month, which of these statements best describes the food eaten in your household? Select only one answer.
    - Enough of the kinds of food (I/we) wanted to eat
    - Enough, but not always the kinds of food (I/we) wanted to eat
    - Sometimes not enough to eat
    - Often not enough to eat
11. What is your personal annual **gross** income, or income prior to paycheck withholdings (such as taxes and benefits)?
12. What is your personal annual **net** income, or income after paycheck withholdings (such as taxes and benefits), or "take home" pay?
13. What is your annual **gross** household income, or total household income prior to paycheck withholdings (such as taxes and benefits)?
14. What is your annual **net** household income, or total household income after paycheck withholdings (such as taxes and benefits), or "take home" pay?
15. How many household members contribute to the annual household income?
16. Do you identify as Spanish/Hispanic/Latino?

- No, not Spanish/Hispanic/Latino
- Yes, Mexican, Mexican American, Chicano
- Yes, Puerto Rican
- Yes, Cuban
- Yes, other Spanish/Hispanic/Latino (for example, Salvadoran, Dominican, Colombian, Guatemalan, Spaniard, Ecuadorian) [Fill in group]:

17. What race do you consider yourself to be? [select all that apply]

- White (for example, European, English, French, German, Irish, Italian)
- Black or African American (for example, African, Jamaican, Haitian, Nigerian, Ethiopian, Somali, Ghanaian, South African)
- Hispanic/Latino (for example, Mexican, Chicano, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, Guatemalan, Spaniard, Ecuadorian)
- American Indian or Alaska Native with maintained tribal affiliation — Print name of enrolled or principal tribe:
- Asian (for example, Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese, or other Asian group)
    - Chinese
    - Filipino
    - Asian Indian
    - Vietnamese
    - Korean
    - Japanese
    - Other Asian (for example, Pakistani, Cambodian, and Hmong)

- Middle Eastern or North African (For example, Lebanese, Iranian, Egyptian, Syrian, Moroccan, Israeli)
- Native Hawaiian and Pacific Islander (for example, Samoan, Chamorro, Tongan, Fijian, Marshallese)
    - Native Hawaiian
    - Samoan
    - Chamorro
    - Other Pacific Islander (for example, Tongan, Fijian, and Marshallese)
- Other Racial Group (please specify):

Appendix B

Pregnancy Context Questionnaire

1. Mturk ID:
2. Date of birth:
3. What is your due date?
4. What was the first day of your last menstrual period?
5. When did you first find out that you were pregnant?
6. Have you received prenatal care from a health provider?
7. What was the date of your first prenatal care appointment with a health care provider (if planning for future, please estimate date of first prenatal care appointment)?
8. How far along in your pregnancy was this appointment, or will this appointment be? [select one]
    - First Trimester (less than or equal to 12 weeks)
    - Second Trimester (13 to 26 weeks)
    - Third Trimester (greater than or equal to 27 weeks)
9. What was your weight prior to pregnancy? (in pounds)
10. What is your current weight? (in pounds)
11. What is your height (without shoes)? (Feet/Inches)
12. Was this pregnancy planned?
13. Is this your first pregnancy?
14. How many pregnancies have you had (including this one)?
15. How many live births have you had?
16. What is your current marital status? [select one]

- Single
- Married
- Divorced
- Widowed
- Committed relationship

17. What are your current living arrangements? [select all that apply]
    - Live with Significant Other
    - Live with Family/Relatives
    - Live with Friend(s)
    - Live with Unrelated Roommate(s)
    - Live Alone
    - Live with Minor Children
18. How many adults currently live with you? (indicate 0 to 10+)
19. How many children currently live with you? (indicate 0 to 10+)
20. Before this pregnancy, was there ever a period of time when you were feeling depressed or down, or when you lost interest in pleasurable activities most of the day, nearly every day, for at least 2 weeks?
21. Have you ever received treatment for depression, for example with therapy or the prescription of medication?
22. Have you ever received a formal diagnosis of depression?
23. Please describe how the COVID-19 pandemic impacted you during this pregnancy.
24. Please describe how the COVID-19 pandemic has impacted your health behavior, including seeking, obtaining, or accessing (e.g., telehealth visits) healthcare during this pregnancy.

25. Have you tested positive for COVID-19, or were you labeled a “probable” case, prior to or during this pregnancy?

    - Yes, prior to this pregnancy
    - Yes, during this pregnancy
    - No

26. Have you ever had an unfair experience due to your race or ethnicity?

    [if yes] When was your most recent unfair experience due to your race or ethnicity? (select one)

    - Within the past 24 hours
    - Within the past week
    - Within the past month
    - Within the past 6 months
    - Within the past year
    - Greater than one year ago

Appendix C

Multidimensional Scale of Perceived Social Support (MSPSS)

Instructions: We are interested in how you feel about the following statements. Read each statement carefully. Indicate how you feel about each statement.

		Very Strongly Disagree	Strongly Disagree	Mildly Disagree	Neutral	Mildly Agree	Strongly Agree	Very Strongly Agree
1	There is a special person who is around when I am in need.	1	2	3	4	5	6	7
2	There is a special person with whom I can share joys and sorrows.	1	2	3	4	5	6	7
3	My family really tries to help me.	1	2	3	4	5	6	7
4	I get the emotional help & support I need from my family.	1	2	3	4	5	6	7
5	I have a special person who is a real source of comfort to me.	1	2	3	4	5	6	7
6	My friends really try to help me.	1	2	3	4	5	6	7
7	I can count on my friends when things go wrong.	1	2	3	4	5	6	7
8	I can talk about my problems with my family.	1	2	3	4	5	6	7
9	I have friends with whom I can share my joys and sorrows.	1	2	3	4	5	6	7
10	There is a special person in my life who cares about my feelings.	1	2	3	4	5	6	7
11	My family is willing to help me make decisions.	1	2	3	4	5	6	7
12	I can talk about my problems with my friends.	1	2	3	4	5	6	7

Appendix D

Edinburgh Perinatal/Postnatal Depression Scale (EPDS)

As you are pregnant or have recently had a baby, we would like to know how you are feeling. Please check the answer that comes closest to how you have felt **IN THE PAST 7 DAYS**, not just how you feel today.

Here is an example, already completed.

I have felt happy:

- ☐ Yes, all the time
- ☒ Yes, most of the time
- ☐ No, not very often
- ☐ No, not at all

This would mean: "I have felt happy most of the time" during the past week.
Please complete the other questions in the same way.

In the past 7 days:

1. I have been able to laugh and see the funny side of things
   - ☐ As much as I always could
   - ☐ Not quite so much now
   - ☐ Definitely not so much now
   - ☐ Not at all

2. I have looked forward with enjoyment to things
   - ☐ As much as I ever did
   - ☐ Rather less than I used to
   - ☐ Definitely less than I used to
   - ☐ Hardly at all

*3. I have blamed myself unnecessarily when things went wrong
   - ☐ Yes, most of the time
   - ☐ Yes, some of the time
   - ☐ Not very often
   - ☐ No, never

4. I have been anxious or worried for no good reason
   - ☐ No, not at all
   - ☐ Hardly ever
   - ☐ Yes, sometimes
   - ☐ Yes, very often

*5 I have felt scared or panicky for no very good reason
   - ☐ Yes, quite a lot
   - ☐ Yes, sometimes
   - ☐ No, not much
   - ☐ No, not at all

*6. Things have been getting on top of me
   - ☐ Yes, most of the time I haven't been able to cope at all
   - ☐ Yes, sometimes I haven't been coping as well as usual
   - ☐ No, most of the time I have coped quite well
   - ☐ No, I have been coping as well as ever

*7 I have been so unhappy that I have had difficulty sleeping
   - ☐ Yes, most of the time
   - ☐ Yes, sometimes
   - ☐ Not very often
   - ☐ No, not at all

*8 I have felt sad or miserable
   - ☐ Yes, most of the time
   - ☐ Yes, quite often
   - ☐ Not very often
   - ☐ No, not at all

*9 I have been so unhappy that I have been crying
   - ☐ Yes, most of the time
   - ☐ Yes, quite often
   - ☐ Only occasionally
   - ☐ No, never

*10 The thought of harming myself has occurred to me
   - ☐ Yes, quite often
   - ☐ Sometimes
   - ☐ Hardly ever
   - ☐ Never

Appendix E

Perinatal Anxiety Screening Scale (PASS)

OVER THE PAST MONTH, how often have you experienced the following? Please select the response that most closely describes your experience for every question.

	Not at all	Sometimes	Often	Almost Always
1. Worry about the baby/pregnancy	0	1	2	3
2. Fear that harm will come to the baby	0	1	2	3
3. A sense of dread that something bad is going to happen	0	1	2	3
4. Worry about many things	0	1	2	3
5. Worry about the future	0	1	2	3
6. Feeling overwhelmed	0	1	2	3
7. Really strong fears about things (eg needles, blood, birth, pain, etc.)	0	1	2	3
8. Sudden rushes of extreme fear or discomfort	0	1	2	3
9. Repetitive thoughts that are difficult to stop or control	0	1	2	3
10. Difficulty sleeping even when I have the chance to sleep	0	1	2	3
11. Having to do things in a certain way or order	0	1	2	3
12. Wanting things to be perfect	0	1	2	3
13. Needing to be in control of things	0	1	2	3
14. Difficulty stopping checking or doing things over and over	0	1	2	3
15. Feeling jumpy or easily startled	0	1	2	3
16. Concerns about repeated thoughts	0	1	2	3
17. Being ‘on guard’ or needing to watch out for things	0	1	2	3
18. Upset about repeated memories, dreams or nightmares	0	1	2	3
19. Worry that I will embarrass myself in front of others	0	1	2	3
20. Fear that others will judge me negatively	0	1	2	3
21. Feeling really uneasy in crowds	0	1	2	3
22. Avoiding social activities because I might be nervous	0	1	2	3
23. Avoiding things which concern me	0	1	2	3
24. Feeling detached like you’re watching yourself in a movie	0	1	2	3
25. Losing track of time and can’t remember what happened	0	1	2	3
26. Difficulty adjusting to recent changes	0	1	2	3
27. Anxiety getting in the way of being able to do things	0	1	2	3
28. Racing thoughts making it hard to concentrate	0	1	2	3
29. Fear of losing control	0	1	2	3
30. Feeling panicky	0	1	2	3
31. Feeling agitated	0	1	2	3

Appendix F

Perceived Stress Scale 14-item (PSS-14)

The questions in this scale ask you about your feelings and thoughts **DURING THE LAST MONTH.** In each case, you will be asked to indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate.

	Never	Almost never	Sometimes	Fairly often	Very often
1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you dealt successfully with irritating life hassles?	4	3	2	1	0
5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?	4	3	2	1	0
6. In the last month, how often have you felt confident about your ability to handle your personal problems?	4	3	2	1	0
7. In the last month, how often have you felt things were going your way?	4	3	2	1	0
8. In the last month, how often have you found you could not cope with all the things that you had to do?	0	1	2	3	4
9. In the last month, how often have you been able to control irritations in your life?	4	3	2	1	0
10. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
11. In the last month, how often have you been angered because of things that happened that were outside of your control?	0	1	2	3	4
12. In the last month, how often have you found yourself thinking about things that you have to accomplish?	0	1	2	3	4
13. In the last month, how often have you been able to control the way you spend your time?	4	3	2	1	0
14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Appendix G

Informed Consent Stage 1

Current Study: The current study is being conducted by Lucinda Scott, M.S., and Nicki Aubuchon-Endsley, Ph.D. at Idaho State University. You are being asked to participate because you are over the age of 18, can read English, and are currently pregnant. Participation is completely voluntary.

Purpose of Research: The purpose of this questionnaire is to gather potential participants for a larger study.

Procedures: If you consent to continue, you will be asked to answer demographic questions regarding your education, employment, and racial/ethnic identity, as well as questions about your household. This survey should take 3-5 minutes to complete.

Potential Risks and Discomforts: Some of the questions on this questionnaire may be uncomfortable to answer. However, you are free to discontinue at any time. This survey platform (Qualtrics) adheres to the Health Insurance Portability and Accountability Act of 1996 (HIPAA) standards for data security. As such, survey responses will remain in storage on the Qualtrics server and accessed solely by a password-protected computer over a virtual private network (VPN) until data collection is complete. Once data collection is complete all data will be downloaded onto an encrypted drive via a password-protected computer over a VPN. Once zip codes are utilized to determine HPSA status, they will be deleted directly from the encrypted drive to ensure private health information (PHI) is not stored on any physical computer, and to safeguard against unauthorized access. No other identifying information will be stored upon completion of data collection and payment.

Anticipated Benefits to Subjects: This questionnaire may not directly benefit you.

Anticipated Benefit to Society: The larger study is intended to increase knowledge on the relationship between certain social and geographic characteristics and maternal mental health. This may help determine the necessity of early intervention and increased services during and after pregnancy.

Privacy and Confidentiality: This questionnaire will allow for recruitment in a larger survey. Mturk ID numbers will be utilized to solicit a sample based on specific attributes identified in this survey. The answers to this survey will be linked to the larger survey through Mturk ID numbers, which will be deleted following final data collection and payment. Information collected from those who do not complete the larger study will be deleted upon completion of data collection. Results will be presented and/or published in aggregate, and no individual data will be presented. Data will be disposed of after all data are analyzed for research or 7 years from the completion of data collection, whichever comes last.

Compensation: Participants who complete the survey will be reimbursed $0.01. Those who screen into the second survey will receive a bonus payment of $0.14.

Participation and Withdrawal: Your participation is completely voluntary. You are free to withdraw consent at any time without penalty. Those who withdraw consent and do not complete the questionnaire in its entirety will not be compensated.

Appendix H

Informed Consent Stage 2

Current Study: The current study is being conducted by Lucinda Scott, M.S., and Nicki Aubuchon-Endsley, Ph.D. at Idaho State University. You are being asked to participate because you are over the age of 18, can read English, and are currently pregnant. Participation is completely voluntary.

Purpose of Research: The purpose of this study is to explore the relationship between an individual's environment and their psychological wellbeing during pregnancy. Pregnancy context, social support, and maternal mood measures will help us determine the impact of sociocultural and geographic factors on maternal mental health.

Procedures: If you consent to continue, you will be asked to answer questions regarding your pregnancy, household, and social support network, as well as questions regarding your mood. This survey will take approximately 20-30 minutes to complete.

Potential Risks and Discomforts: Some of the questions on these questionnaires may be uncomfortable to answer. However, you are free to discontinue at any time. No identifying information will be stored upon completion of data collection and payment.

Anticipated Benefits to Subjects: This study may increase your awareness of your current mood. However, this study may not directly benefit you.

Anticipated Benefit to Society: This study is intended to increase knowledge on the relationship between certain social and geographic characteristics and maternal mental health. This may help determine the necessity of early intervention and increased services during and after pregnancy.

Privacy and Confidentiality: The questionnaire will be deidentified, such that Mturk ID numbers will be deleted following data collection and payment, any identifying information will be kept

separate from other data and deleted upon completion of related projects. Results will be presented and/or published in aggregate, and no individual data will be presented. Data will be disposed of after all data are analyzed for research or 7 years from the completion of data collection, whichever comes last.

Compensation: Participants who complete the entire survey, including all questions and providing usable data, will be reimbursed $3.50.

Participation and Withdrawal: Your participation is completely voluntary. You are free to withdraw consent at any time without penalty. Those who withdraw consent and do not complete the questionnaire in its entirety will not be compensated.

Appendix I

Debriefing

Thank you for participating in this survey. Your participation is very important. This study aims to determine the contribution of Social Determinants of Health (SDH), on maternal mental health. SDH, or a person's race/ethnicity, income, employment status, area of residence, social context (including the presence of a social support network), and level of educational attainment have been suggested to contribute to mental health during pregnancy. Importantly, while many SDH remain outside of an individual's control, they have been found to contribute to health disparities, or differences in health outcomes based on SDH alone. For more information about SDH, visit the Center for Disease Control and Prevention website at https://www.cdc.gov/nchhstp/socialdeterminants/index.html.

Resources

If you found that your levels of distress increased due to this survey, or found that your mood was negatively impacted, there are several, national resources that are available. If you are in distress or in crisis and need to speak to someone immediately, the National Suicide Prevention Lifeline provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week at 1-800-273-8255. To chat with someone online, visit https://suicidepreventionlifeline.org/. To find treatment, visit the Substance Abuse and Mental Health Services Administration (SAMHSA) website at https://www.samhsa.gov/find-treatment, or call 1-800-487-HELP (4357).

Appendix J

Table 1J

Demographics

Demographic Items	Min	Max	Mean(Median)	SD
Age (Years)	20	44	31.22	5.4
Education (Years)	12	22	15.57	2
Hours Working per Week	0	70	33	14
Personal Annual Gross Income	0	340000	40745	35000
Household Annual Gross Income	0	400000	65336	52000
Number of Prior Pregnancies	0	7	(2)	
Number of Live Births	0	7	(1)	
Identified Race	Count	Percentage		
White	60	78%		
Black or African American	9	12%		
Hispanic/Latino	5	7%		
Asian	2	3%		
White, Black or African American	1	1%		
Identified Ethnicity				
Not Spanish/Hispanic/Latino	66	86%		
Mexican, Mexican American, Chicano	6	8%		
Colombian	1	1%		
Cuban	1	1%		
Guatemalan	1	1%		
Honduran	1	1%		
Puerto Rican	1	1%		
Marital Status				
Married	54	70%		
Committed Relationship	14	18%		
Single	5	7%		
Divorced	3	4%		
Widowed	1	1%		
Living Arrangements				
Live with Significant Other/Spouse	63	82%		
Live with Family/Relatives	11	14%		
Live with Minor Children	1	1%		
Live Alone	1	1%		
Live with Unrelated Roommate(s)	1	1%		

HSPA Status	Count	Percentage
HPSA Mental Health	44	57%
HPSA Primary Care	39	50%
HPSA Both	31	40%
HPSA Neither	25	32%
Employment Status		
Employed Full Time	57	74%
Employed Part Time	12	16%
Not working for pay or profit	8	10%
Educational Attainment		
GED	2	3%
High School Diploma	10	13%
Technical Certificate	4	5%
Associate's Degree	12	16%
Bachelor's Degree	41	53%
Master's Degree	7	9%
Doctorate or Professional Degree	1	1%

Note. N=77. Variable responses are listed by order of graduated level or largest to smallest group. HPSA=Health Provider Shortage Area; GED=General Educational Development tests.

Table 2J

Variables of Interest

Measure	Low	High	Mean(Median)	SD
MSPSS Score	12	84	66.45(69)	15
EPDS Score	0	26	11.26(12)	6.69
PASS Score	2	3	36.17(34)	20.66
PSS-14 Score	6	47	26.09(28)	8.34
Difficulty Paying Expenses	Count	Percentage		
Not difficult	15	20%		
A little difficult	27	35%		
Somewhat difficult	23	30%		
Very difficult	12	16%		
Depression				
History of Symptoms	45	58%		
Received Treatment	28	36%		
Formal Diagnosis	28	36%		

Table 3J

Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Age	1																			
2. Person of Global Majority	0.083	1																		
3. Gravida†	.225*	0.055	1																	
4. Parity†	0.188	0.091	.898**	1																
5. Years of Education	0.112	-0.104	-0.052	-0.07	1															
6. Hours Working (Typical) †	0.067	0.122	-0.006	0.114	0.16	1														
7. Personal Gross Income	0.044	0.015	-0.121	-0.06	.272*	.429**	1													
8. Household Gross Income†	0.075	0.034	-0.123	-0.11	0.169	.312**	.772**	1												
9. Difficulty Paying Expenses	-0.08	0.096	.244*	.264*	-.250*	-0.146	-.372**	-.482**	1											
10. HPSA Mental Health Resident	-0.111	-0.113	0.082	0.107	-0.147	-0.01	-.292*	-0.206	0.208	1										
11. HPSA Primary Care Resident	-0.032	-0.218	.227*	.291*	-0.082	-0.004	-0.089	-0.099	0.101	.457**	1									
12. HPSA Both	-0.078	-0.224	0.192	.287*	-0.089	0.014	-0.111	-0.151	0.167	.711**	.810**	1								
13. HPSA Neither	0.07	0.118	-0.127	-0.12	0.149	0.029	.287*	0.164	-0.154	-.801**	-.702**	-.569**	1							
14. MSPSS Score†	0.052	-0.15	-.305**	-.257*	0.142	0.078	0.112	0.167	-.433**	-0.081	-0.203	-0.186	0.107	1						
15. EPDS Score	-0.042	0.118	0.104	0.083	-0.154	-0.121	-0.15	-0.169	.341**	-0.006	0.05	-0.008	-0.056	-.620**	1					
16. PASS Score	0.021	0.11	0.178	0.168	-0.058	-0.065	-0.018	-0.046	0.204	-0.112	-0.088	-0.093	0.115	-.428**	.753**	1				
17. PSS-14 Score	-0.087	-0.006	0.216	0.168	-0.072	-.294**	-0.135	-0.171	.360**	-0.025	0.055	0.061	0.033	-.627**	.732**	.669**	1			
18. History of Dep. Symptoms	0.000	0.055	.279*	.247*	-0.155	-0.103	-0.147	-0.128	.279*	0.068	0.116	0.101	-0.091	-.339**	.406**	.544**	.436**	1		
19. History of Dep. Treatment	0.075	-0.182	0.132	0.093	-0.095	-0.043	-0.001	-0.022	0.066	0.055	-0.01	0.04	-0.005	-0.1	.239*	.281*	0.138	.473**	1	
20. Formal Diagnosis of Dep.	-0.021	-.245*	0.128	0.096	-0.163	-0.173	-0.153	-0.177	.260*	0.055	0.044	0.095	-0.005	-0.194	.263*	.236*	0.171	.418**	.776**	1

Note. This table contains bivariate or point-biserial correlations between primary study variables and potential covariates. HPSA=Health Professional Shortage Area; MSPSS=Multidimensional Scale of Perceived Social Support; EPDS= Edinburgh Postnatal Depression Scale; PASS= Perinatal Anxiety Screening Scale; PSS-14=Perceived Stress Scale, 14-item; Dep.=Depression, †denotes a transformed variable, *p<0.05, **p<0.01.

Table 4J

Hypothesis 2 Analysis of Variance Tables

ANOVAs

EPDS Score

Variable		Sum of Squares	df	Mean Square	F	Sig.
1	Between Groups	.108	1	.108	.002	.961
	Within Groups	3396.697	75	45.289		
	Total	3396.805	76			
2	Between Groups	8.606	1	8.606	.191	.664
	Within Groups	3388.199	75	45.176		
	Total	3396.805	76			
3	Between Groups	.227	1	.227	.005	.944
	Within Groups	3396.578	75	45.288		
	Total	3396.805	76			
4	Between Groups	10.784	1	10.784	.239	.626
	Within Groups	3386.024	75	45.147		
	Total	3396.805	76			
5	Between Groups	47.470	1	47.470	1.063	.306
	Within Groups	3349.335	75	44.658		
	Total	3396.805	76			

Note. Variable 1=Health Professional Shortage Area for Mental Health Residence, Variable 2= Health Professional Shortage Area for Primary Care Residence, Variable 3=Both Health Professional Shortage Area for Mental Health and Primary Care Residence, Variable 4=Neither Health Professional Shortage Area for Mental Health nor Primary Care Residence, Variable 5=Person of Global Majority

Appendix K

Multiple Regression Model Tables

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df 1	df2	Sig. F Change
1	.641a	.411	.331	5.461	.411	5.122	9	66	<.001

a. Predictors: (Constant), Racial-Ethnic Identity, Education (Years), Hours Working per Week, Personal Gross Income, Household Gross Income, Difficulty Paying Expenses, MSPSS Score, Health Professional Shortage Area for Primary Care Residence, Health Professional Shortage Area for Mental Health Residence.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1374.835	9	152.759	5.122	<.001[b]
	Residual	1968.573	66	29.827		
	Total	3343.408	75			

a. Dependent Variable: EPDS Score

b. Predictors: (Constant), Racial-Ethnic Identity, Education (Years), Hours Working per Week, Personal Gross Income, Household Gross Income, Difficulty Paying Expenses, MSPSS Score, Health Professional Shortage Area for Primary Care Residence, Health Professional Shortage Area for Mental Health Residence

Coefficients[a]

Model		B	SE	ß	t	Sig.	95.0% CI for B Lower	Upper
1	(Constant)	5.199	7.690		.676	.501	-10.155	20.552
	Racial-Ethnic Identity	-.388	1.567	-.025	-.248	.805	-3.517	2.741
	Education (Years)	-.155	.336	-.047	-.461	.646	-.826	.516
	Hours Working per Week	-.132	.601	-.023	-.220	.827	-1.332	1.068
	Personal Gross Income	-.001	.000	-.063	-.379	.706	-.001	.001
	Household Gross Income	.001	.013	.014	.090	.928	-.025	.027
	Difficulty Paying Expenses	.549	.822	.081	.668	.506	-1.092	2.190
	MSPSS Score	-2.160	.401	-.587	-5.388	<.001	-2.961	-1.360
	HPSA Mental Health	-.580	1.528	-.043	-.380	.705	-3.630	2.470
	HPSA Primary Care	-.970	1.486	-.073	-.652	.516	-3.937	1.998

a. Dependent Variable: EPDS Score

Appendix L

Moderation Model Tables

Table L1

Person of Global Majority on EPDS Score, Primary Care HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.378a	.143	40.430	3.004	4	72	.024

a. Predictors: (Constant), Person of Global Majority, Health Professional Shortage Area for Primary Care Residence, Interaction Term (Person of Global Majority x Health Professional Shortage Area for Primary Care Residence), Formal Depression Diagnosis. Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	7.574	.1444	5.246	.000	4.696	10.452
Person of Global Majority	5.452	2.219	2.457	.016	1.028	9.876
HPSA Primary Care	2.406	1.686	1.427	.158	-.955	5.768
Interaction Terma	-8.851	3.5627	-1.634	.107	-12.923	1.281
Formal Diagnosis of Depression	4.332	1.554	2.788	.007	1.235	7.430

a. Interaction Term: Person of Global Majority x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Terma	.032	2.670	1	72	.107

a. Interaction Term: Person of Global Majority x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Table L2

Person of Global Majority on EPDS Score, Mental Health HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.390a	.152	39.992	3.234	4	72	.017

a. Predictors: (Constant), Person of Global Majority, Health Professional Shortage Area for Mental Health Residence, Interaction Term (Person of Global Majority x Health Professional Shortage Area for Mental Health Residence), Formal Depression Diagnosis. Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	8.017	1.751	5.524	.000	5.124	10.910
Person of Global Majority	6.370	2.414	2.639	.010	1.558	11.181
HPSA Mental Health	1.724	1.701	1.014	.314	-1.667	5.114
Interaction Term[a]	-6.784	3.374	-2.011	.048	-13.510	-.059
Formal Diagnosis of Depression	4.068	1.550	2.625	.011	.979	7.157

a. Interaction Term: Person of Global Majority x Health Professional Shortage Area for Mental Health. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.048	4.044	1	72	.048

a. Interaction Term: Person of Global Majority x Health Professional Shortage Area for Mental Health Residence. Outcome: EPDS Score

Conditional Effects[a]

mhHPSA	Coeff	se	t	p	LLCI	ULCI
0	6.370	2.414	2.639	.010	1.558	11.181
1	-.415	2.424	-.171	.865	-5.246	4.417

a. Conditional effects of the focal predictor at values of the moderator

Table L3

Years of Education on EPDS Score, Primary Care HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.160a	.026	45.335	.642	3	73	.590

a. Predictors: (Constant), Years of Education, Health Professional Shortage Area for Primary Care Residence, Interaction Term (Years of Education x Health Professional Shortage Area for Primary Care Residence). Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	17.821	7.698	2.315	.023	2.480	33.163
Years of Education	-.439	.484	-.906	.368	-1.404	.527
HPSA Primary Care	3.264	12.601	.259	.796	-21.850	28.379
Interaction Term[a]	-.178	.805	-.221	.826	-.783	1.428

a. Interaction Term: Years of Education x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.001	.049	1	73	.826

a. Interaction Term: Years of Education x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Table L4

Years of Education on EPDS Score, Mental Health HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.163a	.027	45.292	.666	3	73	.576

a. Predictors: (Constant), Years of Education, Health Professional Shortage Area for Mental Health Residence, Interaction Term (Years of Education x Health Professional Shortage Area for Mental Health Residence). Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	17.993	7.574	2.376	.020	2.898	33.088
Years of Education	-.421	.470	-.894	.374	-1.358	.517
HPSA Mental Health	7.890	13.115	.373	.710	-21.248	31.029
Interaction Term[a]	-.340	.840	-.405	.686	-2.014	1.334

a. Interaction Term: Years of Education x Health Professional Shortage Area for Mental Health. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.002	.164	1	73	.686

a. Interaction Term: Person of Global Majority x Health Professional Shortage Area for Mental Health Residence. Outcome: EPDS Score

Table L5

Hours of Employment per Week on EPDS Score, Primary Care HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.741a	.549	21.292	21.884	4	72	<.001

a. Predictors: (Constant), Hours of Employment per Week, Health Professional Shortage Area for Primary Care Residence, Interaction Term (Hours of Employment per Week x Health Professional Shortage Area for Primary Care Residence), Perceived Stress Scale-14 item Score. Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	-3.157	4.301	-.734	.465	-11.730	5.417
Hours of Employment per Week	.284	.677	.420	.676	-1.065	1.634
HPSA Primary Care	3.431	5.544	.619	.538	-7.621	14.482
Interaction Terma	.550	.904	.608	.545	-1.253	2.353
Perceived Stress Scale-14 item Score	.616	.067	9.197	.000	.483	.750

a. Interaction Term: Hours of Employment per Week x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Terma	.002	.370	1	72	.545

a. Interaction Term: Hours of Employment per Week x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Table L6

Hours of Employment per Week on EPDS Score, Mental Health HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.751a	.564	20.58	23.259	4	72	<.001

a. Predictors: (Constant), Hours of Employment per Week, Health Professional Shortage Area for Mental Health Residence, Interaction Term (Hours of Employment per Week x Health Professional Shortage Area for Mental Health Residence), Perceived Stress Scale-14 item Score. Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	5.187	4.815	1.077	.285	-4.411	14.785
Hours of Employment per Week	1.691	.800	2.113	.038	.096	3.287
HPSA Mental Health	-9.398	5.786	-1.624	.109	-20.932	2.137
Interaction Term[a]	-1.594	.946	-1.686	.096	-3.479	.291
Perceived Stress Scale-14 item Score	.684	.065	9.451	.000	.488	.749

a. Interaction Term: Hours of Employment per Week x Health Professional Shortage Area for Mental Health. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.017	2.843	1	72	.096

a. Interaction Term: Hours of Employment per Week x Health Professional Shortage Area for Mental Health Residence. Outcome: EPDS Score

Table L7

Personal Gross Income on EPDS Score, Primary Care HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.153a	.023	45.352	.574	3	72	.634

a. Predictors: (Constant), Personal Gross Income, Health Professional Shortage Area for Primary Care Residence, Interaction Term (Personal Gross Income x Health Professional Shortage Area for Primary Care Residence). Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	12.802	2.010	6.368	.000	8.795	16.810
Personal Gross Income	.000	.000	-1.010	.316	-.001	.000
HPSA Primary Care	.035	2.789	.013	.990	-5.525	5.594
Interaction Term[a]	.000	.000	.117	.907	-.001	.001

a. Interaction Term: Personal Gross Income x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.000	.014	1	72	.907

a. Interaction Term: Personal Gross Income x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Table L8

Personal Gross Income on EPDS Score, Mental Health HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.157a	.025	45.297	.604	3	72	.615

a. Predictors: (Constant), Personal Gross Income, Health Professional Shortage Area for Mental Health Residence, Interaction Term (Personal Gross Income x Health Professional Shortage Area for Mental Health Residence). Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	13.536	2.465	5.560	.000	8.683	18.390
Personal Gross Income	.000	.000	-1.046	.299	-.001	.000
HPSA Mental Health	-9.730	2.982	-.326	.745	-6.918	4.972
Interaction Term[a]	.000	.000	.173	.863	-.001	.001

a. Interaction Term: Personal Gross Income x Health Professional Shortage Area for Mental Health. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.000	.030	1	72	.863

a. Interaction Term: Personal Gross Income x Health Professional Shortage Area for Mental Health Residence. Outcome: EPDS Score

Table L9

Household Gross Income on EPDS Score, Primary Care HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.176a	.031	45.001	.766	3	72	.517

a. Predictors: (Constant), Household Gross Income, Health Professional Shortage Area for Primary Care Residence, Interaction Term (Household Gross Income x Health Professional Shortage Area for Primary Care Residence). Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	15.143	3.280	4.617	.000	8.606	21.681
Household Gross Income	-.017	.013	-1.307	.196	-.042	.009
HPSA Primary Care	-1.388	4.630	-.300	.765	-10.618	7.842
Interaction Term[a]	.007	.019	.348	.706	-.030	.045

a. Interaction Term: Household Gross Income x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.002	.143	1	72	.706

a. Interaction Term: Household Gross Income x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Table L10

Household Gross Income on EPDS Score, Mental Health HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.218a	.048	44.232	1.196	3	72	.317

a. Predictors: (Constant), Household Gross Income, Health Professional Shortage Area for Mental Health Residence, Interaction Term (Household Gross Income x Health Professional Shortage Area for Mental Health Residence). Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	17.447	3.457	5.047	.000	10.556	24.339
Household Gross Income	-.024	.013	-1.886	.63	-.050	.001
HPSA Mental Health	-5.561	4.698	-1.184	.240	-14.926	3.803
Interaction Term[a]	.022	.019	1.168	.247	-.016	.060

a. Interaction Term: Household Gross Income x Health Professional Shortage Area for Mental Health. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.018	1.365	1	72	.247

a. Interaction Term: Household Gross Income x Health Professional Shortage Area for Mental Health Residence. Outcome: EPDS Score

Table L11

Difficulty Paying Expenses on EPDS Score, Primary Care HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.753a	.566	21.042	15.239	6	70	<.001

a. Predictors: (Constant), Difficulty Paying Expenses, Health Professional Shortage Area for Primary Care Residence, Interaction Term (Difficulty Paying Expenses x Health Professional Shortage Area for Primary Care Residence), Perceived Stress Scale-14 item Score, History of Depression Symptoms, Formal Diagnosis of Depression. Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	-5.038	1.979	-2.546	.013	-8.985	-1.092
Difficulty Paying Expenses	.985	.866	1.138	.259	-.742	2.712
HPSA Primary Care	1.409	1.860	.758	.451	-2.301	5.119
Interaction Term[a]	-1.042	1.101	-.947	.347	-3.23	1.153
Perceived Stress Scale-14 item Score	.535	.073	7.312	.000	.389	.681
History of Depression Symptoms	.788	1.291	.611	.544	-1.786	3.363
Formal Diagnosis of Depression	1.580	1.216	1.299	.198	-845	4.004

a. Interaction Term: Difficulty Paying Expenses x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.006	.897	1	70	.347

a. Interaction Term: Difficulty Paying Expenses x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Table L12

Difficulty Paying Expenses on EPDS Score, Mental Health HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.765a	.585	20.132	16.455	6	70	<.001

a. Predictors: (Constant), Difficulty Paying Expenses, Health Professional Shortage Area for Mental Health Residence, Interaction Term (Difficulty Paying Expenses x Health Professional Shortage Area for Mental Health Residence), Perceived Stress Scale-14 item Score, History of Depression Symptoms, Formal Diagnosis of Depression. Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	-5.663	1.956	-2.895	.005	-9.965	-1.762
Difficulty Paying Expenses	1.782	.904	1.941	.053	-.201	3.585
HPSA Mental Health	2.908	1.847	1.574	.120	-.776	6.592
Interaction Term[a]	-2.300	1.138	-2.021	.047	-4.570	-.031
Perceived Stress Scale-14 item Score	.520	.073	7.182	.000	.376	.665
History of Depression Symptoms	.917	1.260	.728	.469	-1.597	3.430
Formal Diagnosis of Depression	1.969	1.207	1.632	.107	-.438	4.376

a. Interaction Term: Difficulty Paying Expenses x Health Professional Shortage Area for Mental Health. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.024	4.085	1	70	.047

a. Interaction Term: Difficulty Paying Expenses x Health Professional Shortage Area for Mental Health Residence. Outcome: EPDS Score

Conditional Effects[a]

mhHPSA	Coeff	se	t	p	LLCI	ULCI
0	1.782	.904	1.971	.0526	-.021	3.585
1	.518	.749	-.691	.492	-2.012	.976

a. Conditional effects of the focal predictor at values of the moderator

Table L13

MSPSS Score on EPDS Score, Primary Care HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.841a	.707	14.218	28.151	6	70	<.001

a. Predictors: (Constant), Multidimensional Scale of Perceived Social Support Score, Health Professional Shortage Area for Primary Care Residence, Interaction Term (Multidimensional Scale of Perceived Social Support Score x Health Professional Shortage Area for Primary Care Residence), History of Depression Symptoms, Perinatal Anxiety Screening Scale Score, Perceived Stress Scale-14 item Score. Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	-3.330	1.901	-1.712	.084	-7.120	.461
Multidimensional Scale of Perceived Social Support Score	-.899	.394	-2.281	.026	-1.686	-.113
HPSA Primary Care	.141	2.231	.063	.950	-4.308	-.113
Interaction Term[a]	-.099	.531	-.186	.853	-1.158	.960
History of Depression Symptoms	-1.057	1.066	-.991	.325	-3.182	1.069
Perinatal Anxiety Screening Scale Score	.169	.033	5.150	.000	.104	.235
Perceived Stress Scale-14 item Score	.203	.086	2.344	.022	.030	.375

a. Interaction Term: Multidimensional Scale of Perceived Social Support Score x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.000	.035	1	70	.853

a. Interaction Term: Multidimensional Scale of Perceived Social Support Score x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Table L14

MSPSS Score on EPDS Score, Mental Health HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.845a	.713	13.921	29.000	6	70	<.001

a. Predictors: (Constant), Multidimensional Scale of Perceived Social Support Score, Health Professional Shortage Area for Mental Health Residence, Interaction Term (Difficulty Paying Expenses x Health Professional Shortage Area for Mental Health Residence), History of Depression Symptoms, Perinatal Anxiety Screening Scale Score, Perceived Stress Scale-14 item Score. Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	-7.764	1.754	-2.717	.008	-8.261	-1.267
Multidimensional Scale of Perceived Social Support Score	-1.179	.359	-3.285	.002	-1.895	-.463
HPSA Mental Health	2.921	2.146	1.361	.178	-1.360	7.201
Interaction Term[a]	.607	.507	1.198	.235	-.404	1.618
History of Depression Symptoms	-.956	1.053	-.908	.367	-3.056	1.144
Perinatal Anxiety Screening Scale Score	.156	.032	4.931	.000	.093	.220
Perceived Stress Scale-14 item Score	.232	.082	2.814	.006	.067	.396

a. Interaction Term: Multidimensional Scale of Perceived Social Support Score x Health Professional Shortage Area for Mental Health. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.006	1.434	1	70	.235

a. Interaction Term: Multidimensional Scale of Perceived Social Support Score x Health Professional Shortage Area for Mental Health Residence. Outcome: EPDS Score

Table L15

Cumulative SDH on EPDS Score, Primary Care HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.826a	.681	15.685	21.081	7	69	<.001

a. Predictors: (Constant), Cumulative Social Determinants of Health, Health Professional Shortage Area for Primary Care Residence, Interaction Term (Cumulative Social Determinants of Health x Health Professional Shortage Area for Primary Care Residence), History of Depressive Symptoms, Formal Depression Diagnosis, Perinatal Anxiety Screening Scale Score, Perceived Stress Scale-14 item Score. Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	-3.075	1.931	-1.592	.116	-6.928	.778
Cumulative Social Determinants of Health	-.366	.755	-.485	.629	-1.871	1.139
HPSA Primary Care	.554	1.914	.289	.773	-3.265	4.372
Interaction Terma	.311	1.023	.304	.762	-1.730	2.353
History of Depression Symptoms	-1.551	1.202	-1.290	.762	-1.730	2.352
Formal Diagnosis of Depression	1.563	1.035	1.509	.201	-3.950	.848
Perinatal Anxiety Screening Scale Score	.167	.033	5.082	.000	.102	.233
Perceived Stress Scale-14 item Score	.333	.075	4.432	.000	.183	.483

a. Interaction Term: Cumulative Social Determinants of Health x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Terma	.000	.093	1	69	.762

a. Interaction Term: Cumulative Social Determinants of Health x Health Professional Shortage Area for Primary Care Residence. Outcome: EPDS Score

Table L16

Cumulative SDH on EPDS Score, Mental Health HPSA Status Moderating

Model Summary

R	R-sq	MSE	F	df1	df2	p
.825a	.680	15.750	20.953	7	69	<.001

a. Predictors: (Constant), Cumulative Social Determinants of Health, Health Professional Shortage Area for Primary Care Residence, Interaction Term (Cumulative Social Determinants of Health x Health Professional Shortage Area for Mental Health Residence), History of Depressive Symptoms, Formal Depression Diagnosis, Perinatal Anxiety Screening Scale Score, Perceived Stress Scale-14 item Score. Outcome: EPDS Score

Model

					95.0% CI	
	Coeff	se	t	p	LLCI	ULCI
(Constant)	-2.805	2.077	-1.351	.181	-6.949	1.339
Cumulative Social Determinants of Health	-.576	.835	-.90	.492	-2.241	1.089
HPSA Primary Care	.007	1.954	.004	.997	-3.890	3.905
Interaction Term[a]	.537	1.084	.495	.622	-1.626	2.700
History of Depression Symptoms	-1.582	1.236	-1.280	.205	-4.048	.883
Formal Diagnosis of Depression	1.533	1.038	1.477	.144	-.537	3.604
Perinatal Anxiety Screening Scale Score	.167	.033	5.037	.000	.101	.233
Perceived Stress Scale-14 item Score	.338	.075	4.549	.000	.190	4.87

a. Interaction Term: Cumulative Social Determinants of Health x Health Professional Shortage Area for Mental Health. Outcome: EPDS Score

Interaction

	R2-change	F	df1	df2	p
Interaction Term[a]	.001	.245	1	69	.622

a. Interaction Term: Cumulative Social Determinants of Health x Health Professional Shortage Area for Mental Health Residence. Outcome: EPDS Score

Appendix M

Benjamini-Hochberg Adjustment Tables

Table M1

Type 1 Error Correction: pcHPSA Status Moderating

Predictor	Observed p-value	Rank	Adjusted Alpha	Statistically Significant
Difficulty Paying Expenses	0.000	1	0.017	Yes
Household Gross Income	0.517	2	0.033	No
Personal Gross Income	0.634	3	0.050	No

Note. Benjamini-Hochberg adjustment table for Residence in a Health Professional Shortage Area for Primary Care moderating the relationship between the predictor variable and depressive symptoms.

Table M2

Type 1 Error Correction: mhHPSA Status Moderating

Predictor	Observed p-value	Rank	Adjusted Alpha	Statistically Significant
Difficulty Paying Expenses	0.000	1	0.017	Yes
Household Gross Income	0.317	2	0.033	No
Personal Gross Income	0.615	3	0.050	No

Note. Benjamini-Hochberg adjustment table for Residence in a Health Professional Shortage Area for Mental Health moderating the relationship between the predictor variable and depressive symptoms.