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Relationships of Race and Socioeconomic Status to Postpartum Depressive Symptoms in Rural African American and Non-Hispanic White Women

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Abstract This study examines the potential racial disparity in postpartum depression (PPD) symptoms among a cohort of non-Hispanic white and African American women after taking into consideration the influence of socioeconomic status (SES). Participants ($N = 299$) were recruited from maternity clinics serving rural counties, with oversampling of low SES and African Americans. The Edinburgh Postnatal Depression Scale (EPDS) was administered 1 and 6 months postpartum, and subjective SES scale at 6 months postpartum. Demographic information was collected during enrollment and 1 month postpartum, with updates at 6 months postpartum. Separate logistic regressions were conducted for 1 and 6 month time points for minor-major PPD (EPDS ≥ 10) and major PPD (EPDS > 12); with marital status, poverty, education, subjective SES, and race predictors entered in block sequence. After including all other predictors, race was not a significant predictor of minor-major or major PPD at 1 or 6 months postpartum. Subjective SES was the most consistent predictor of PPD, being significantly associated with minor-major PPD and major PPD at 6 months postpartum, with higher subjective SES indicating lower odds of PPD, even after accounting for all other predictors. This study shows that significant racial disparities were not observed for minor-major or major PPD criteria at 1 or 6 months postpartum. The most consistent and significant predictor of PPD was subjective SES. Implications of these findings for future research, as well as PPD screening and intervention are discussed.

Keywords Postpartum depression · Race · Subjective socioeconomic status · Health disparity · Objective socioeconomic status

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Introduction

For women, the postnatal period is the most vulnerable time for depression than any other time in their lives [1]. In research on this topic, postpartum depression (PPD) is commonly characterized as major and minor depressive symptom levels occurring within the months following childbirth, with major PPD referring to a diagnosis of or symptom level related to a form of clinical depression and minor PPD to a less severe yet still impairing form [1]. Estimates of the prevalence of PPD range from 5 to 25 % or more depending on whether major and/or minor PPD are assessed, the population studied, as well as the method and timing of assessment [1]. Given there are approximately four million live births annually in the United States (US) [2], this equates to a minimum of roughly two hundred thousand women suffering from PPD annually. This maternal suffering translates into an estimated economic burden of $44 billion annually in the US [3], and deleterious effects associated with mother's health [4, 5], infant health and development [6], and mother-infant attachment [7].

While racial disparities have been documented in a variety of physical and mental health conditions, studies on

the prevalence of racial disparity in PPD have provided mixed results. Some studies report African American women have higher rates of PPD than non-Hispanic whites [8–10], while others have reported no racial differences [11–13]. These conflicting results may be due to the difficulty of differentiating the confounding effects of race versus socioeconomic status (SES) since African Americans are over-represented in low SES, and a lack of consistency in the method and timing of assessing PPD.

Research on traditional objective indicators of SES (income, education, occupational status) indicates these inter-linking factors can influence the development of PPD [14]. For instance, mothers with lower income, education, and employment status have a greater likelihood of developing PPD, perhaps because they commonly are younger, have lower social support, and are more likely to be single parents [15]. Given the strong relationship of SES with physical and mental health, researchers have begun to explore possible mechanisms for this relationship. For instance, psychosocial processes related to feelings of relative deprivation and social anxiety may at least partly explain the SES-health relationship [16]. One such process is subjective SES, one's perceived position in the social hierarchy [17]. Subjective SES is associated with physical and mental health, and in some cases, is a stronger predictor than objective indicators of SES [17–19]. Thus, subjective SES seems to contribute something unique in the prediction of health outcomes. However, subjective SES has not been studied in relation to PPD.

An understudied factor often related to race and SES that may also relate to PPD is the type of area in which people live (e.g., rural, suburban, urban). Most PPD research has focused on urban, suburban, and national (mixed) samples, while the specific challenges of rural settings (e.g., low community support, low access to appropriate services, limited transportation, isolated conditions) may influence PPD [20]. Thus, PPD may affect rural women to a greater extent [20], a finding supported by a recent study of low income rural women [12].

The purpose of the current study is to determine whether disparities in PPD symptoms exist between African American and non-Hispanic white rural women, and whether these differences are accounted for by objective and subjective SES, as well as marital status (a noted PPD risk factor) [21]. To address inconsistencies in the method and timing of PPD assessment, one of the most valid and widely tested instruments for PPD assessment, the Edinburgh Postnatal Depression Scale (EPDS), was used at 1 and 6 months postpartum. The EPDS has been used with diverse racial and SES populations, and has a significant level of sensitivity (proportion of depressed women correctly identified) and specificity (proportion of non-depressed women correctly identified) based on cut-off scores [22, 23].

Methods

This study is part of a larger study, the first being conducted by the Community Child Health Network (CCHN), a group of community organizations and universities partnering with the Eunice Kennedy Shriver National Institute of Child Health and Human Development and the National Institute of Nursing Research to gain new insights into reasons for disparities in maternal health and child development. The goals of the network's first study are to examine the factors associated with maternal allostatic load (a possible factor in adverse pregnancy outcomes), and to evaluate the usefulness of community-partnered participatory research for conducting research on health disparities. These goals are being achieved through a community-academic partnered, multisite observational study examining how stress and resilience factors interact with biological factors to result in racial disparities in birth outcomes The CCHN study sites include three urban (Baltimore, Los Angeles, Washington, DC), one mixed urban-suburban (Lake County, IL), and one rural (Eastern North Carolina, ENC). The analyses included here are based on the ENC site.

Participants

The sample was an availability sample obtained from a seven-county geographical catchment area in ENC (Bertie, Edgecombe, Greene, Martin, Pitt, Tyrrell and Washington counties). Women were recruited prenatally from maternity clinics and through perinatal community outreach by the research team and Eastern Baby Love Plus Maternity Care Coordinators and Community Health Advocates.

Participants met the following inclusion criteria: (1) 18–40 years old; (2) African American or non-Hispanic white; (3) resided in the catchment area for at least 6 months at time of delivery; and (4) live birth of greater than or equal to 20 weeks of gestation. Exclusion criteria included: (1) unable to give informed consent; (2) unable to fully understand requirements of the study in English; (3) four or more children; (4) incarcerated or otherwise unable to participate in the study in a home, community or clinical setting; and (5) surgically sterile or desired to be surgically sterilized following the birth. The ENC site oversampled low SES and African American women to help ensure the majority of the CCHN total sample was comprised of low SES and minority women.

At the time of this analysis, 433 participants were enrolled in the study. Only participants who had completed both the 1 and 6 months postpartum interviews were included in the analyses. This excluded 86 (20 %) women who had missed the window for completing the 6 months postpartum interview, and 48 (11 %) for whom the window was still open but who had yet to complete the interview.

Overall demographics of the ENC sample ($N = 299$, 69 %) are shown in Table 1. The majority of the sample were African American (69 %), categorized as having household income at or below the federal poverty threshold (60 %), and were not employed at 1 month (63 %) or 6 months (57 %) postpartum. The largest percentage had more than a high school education (43 %), and was in a relationship (but not married) at enrollment (54 %), 1 month (48 %) and 6 months (47 %) postpartum.

Procedures

This study was conducted in accordance with ethical treatment of human research participants after approvals by the Institutional Review Boards at the participating institutions were obtained. Women were "pre-enrolled" prenatally or enrolled postnatally after completing an eligibility interview and contacted within 1 month postpartum to complete a birth interview (T0). A 90-min face-to-face interview was conducted during home visits at 1 month (T1, window 2–16 weeks) and 6 months (T2, window 24–39 weeks) postpartum. Interviewers resided in the catchment area, underwent extensive training, and were matched with participants based on race. Gift cards for completion of the T0 ($20), T1 ($25), and T2 ($25) interviews were provided.

Measures

Demographics

Race and ethnicity were determined using two self-identification questions included in the T0 eligibility interview that were recommended by the US Office of Management and Budget. First, individuals were asked to identify their ethnicity as "Hispanic or Latino" or "Not Hispanic or Latino." Individuals who identified as Hispanic or Latino were excluded from the analyses ($n = 2$). Then they were asked to select one or more racial designations. Individuals who answered yes to at least one of the two races of focus for the ENC site (African American, non-Hispanic white) were eligible for the study. Participants who indicated they were multi-racial ($n = 7$) were included using their primary race designation (4 African American, 3 non-Hispanic white). Marital status was categorized as being married, in a relationship, or not in a relationship, and was determined using questions from the T0 interview about the participant's relationship with the father of the baby or other romantic interest, with updates requested during the T1 and T2 interviews. The T1 interview included education questions, specifically how many years of school completed and highest degree earned. The T1 interview also included employment questions, with updates requested during the T2 interview.

Poverty

The T1 interview also included questions regarding household income and number of people in the household. Using responses to these questions, the following three poverty categories were derived based on the US Census Bureau, Weighted Average Poverty Thresholds 2009 [24], which vary according to the size of the household without requiring information on the number of related children under 18 years: (1) ≤100 % federal poverty level (FPL) (indicating income at or less than poverty threshold); (2) 101–200 % FPL; and (3) >200 % FPL. When a participant did not know or refused to report household income ($n = 53$), poverty status was imputed based on her receipt of Medicaid and/or public assistance [food stamps; Women, Infants, and Children's Program (WIC); Temporary Assistance to Needy Families (TANF)]. If she did not receive any of these, she was categorized as >200 % FPL. If she only received WIC or Medicaid, she was categorized as 101–200 % FPL. If she received food stamps or TANF, she was categorized as ≤100 % FPL.

Subjective SES

The T2 interview included the MacArthur Scale of Subjective Social Status (SES version), designed to capture one's sense of relative social standing across the objective SES indicators [20]. Respondents view a picture of a ladder, with each rung labeled with a number from "1" at the bottom to "10" at the top. It is explained to them that the ladder represents where the people in the US stand, with those at the top being people who are the best off (with the most money, education, and respected jobs), and people at the bottom being people who are the worst off (with the least money, education, and respected jobs). Respondents indicate the number that corresponds to the rung where they think they stand compared to all the other people in the US. This measure has demonstrated adequate test–retest reliability and predictive validity [25].

Postpartum Depression Symptoms

The T1 and T2 interviews included the EPDS, which consists of 10 questions that ask about the experience of various symptoms of depression (e.g., felt sad or miserable, so unhappy that had difficulty sleeping) during the past 7 days [22]. Respondents answer each question on a 4-point scale indicating lower to higher levels of the particular symptom. Question 10 asks about thoughts of harming oneself. Cronbach's alpha for the T1 EPDS was 0.83 and for the T2 EPDS was 0.85. Cut-off scores on the EPDS were used to categorize participants as: (1) negative

Table 1 Descriptive Statistics of Study Variables Overall and by Race

Categorical Variables	Overall (N = 299) Frequency (percentage)	African American (n = 206) Frequency (percentage)	Non-Hispanic white (n = 93) Frequency (percentage)	*p*
PPD (1 month postpartum)[a]				
Minor PPD (scores 10–12)	19 (6.9)	16 (8.5)	3 (3.4)	0.124
Major PPD (scores 13 +)	29 (10.5)	23 (12.2)	6 (6.9)	0.180
Minor–major PPD (scores 10 +)	48 (17.5)	39 (20.7)	9 (10.3)	0.035
PPD (6 months postpartum)				
Minor PPD (scores 10–12)	25 (8.4)	17 (8.3)	8 (8.6)	0.540
Major PPD (scores 13 +)	27 (9.0)	21 (10.2)	6 (6.5)	0.206
Minor–major PPD (scores 10 +)	52 (17.4)	38 (18.4)	14 (15.1)	0.294
Race				
African American	206 (69)			
Non-Hispanic white	93 (31)			
Marital status (enrollment)[b]				
Not in a relationship	52 (17)	47 (23)	5 (5)	<0.0001
In a relationship	161 (54)	124 (60)	37 (40)	
Married	85 (29)	34 (17)	51 (55)	
Marital status (1 month postpartum)[c]				
Not in a relationship	71 (24)	65 (32)	6 (6)	<0.0001
In a relationship	141 (48)	104 (51)	37 (40)	
Married	84 (28)	34 (17)	50 (54)	
Marital status (6 months postpartum)				
Not in a relationship	75 (25)	66 (32)	9 (10)	<0.0001
In a relationship	142 (47)	108 (52)	34 (37)	
Married	82 (27)	32 (16)	50 (54)	
Poverty status (1 month postpartum)				
≤100 % FPL	179 (60)	136 (66)	43 (46)	<0.0001
101–200 % FPL	73 (24)	53 (26)	20 (22)	
>200 % FPL	47 (16)	17 (8)	30 (32)	
Employment status (1 month postpartum)				
Working	47 (16)	31 (15)	16 (17)	0.210
On leave	64 (21)	39 (19)	25 (27)	
Unemployed	188 (63)	136 (66)	52 (56)	
Employment status (6 months postpartum)				
Working	127 (42)	85 (41)	42 (45)	0.253
On leave	1 (< 1)	0 (0)	1 (1)	
Unemployed	171 (57)	121 (59)	50 (54)	
Highest degree (1 month postpartum)[d]				
Less than high school	47 (16)	35 (17)	12 (13)	0.007
High school	124 (42)	95 (46)	29 (31)	
More than high school	127 (43)	75 (37)	52 (56)	

Continuous variables	Overall (N = 299) Mean (standard deviation)	African American (n = 206) Mean (standard deviation)	Non-Hispanic white (n = 93) Mean (standard deviation)	*p*
EPDS (1 month postpartum)[a]	5.50 (±4.84)	5.75 (±5.08)	4.97 (±4.23)	0.211
EPDS (6 months postpartum)	4.76 (±4.86)	4.77 (±4.92)	4.72 (±4.74)	0.933
Subjective SES (6 months postpartum)	5.1 (±1.7)	5.1 (±1.8)	5.2 (±1.4)	0.612
Years of school (1 month postpartum)	13.2 (±2.2)	13.0 (±2.0)	13.6 (±2.7)	0.052

Table 1 continued

Continuous variables	Overall (N = 299) Mean (standard deviation)	African American (n = 206) Mean (standard deviation)	Non-Hispanic white (n = 93) Mean (standard deviation)	*p*
Age in years (enrollment)	23.6 (±4.7)	22.7 (±4.2)	25.6 (±5.3)	<0.0001

FPL federal poverty level, *EPDS* Edinburgh Postnatal Depression Scale

[a] 2 missing, 22 excluded who completed T1 at <2 weeks postpartum

[b] 1 missing

[c] 3 missing

[d] 1 missing

screen for PPD or non-symptomatic (scores of 0–9); (2) positive screen for minor PPD (scores of 10–12); or (3) positive screen for major PPD (scores of 13–30) or EPDS item 10 responded to affirmatively indicating any suicidal thoughts regardless of EPDS total score [22, 23]. The sensitivity and specificity of this measure at the 10-point cut-off are 83.6 and 88.3 %, respectively. The sensitivity and specificity at the 13-point cut-off are 58.5 and 97.5 %, respectively [26].

Statistical Analysis

Descriptive statistics were prepared for all variables including frequencies and percentages for categorical variables and means and standard deviations for continuous variables. Demographic and study variables were compared between African American and non-Hispanic white women using X^2 or Fisher's exact tests (when expected cell counts were too sparse for X^2 tests to be appropriate) for categorical variables and two-sample t tests, for quantitative variables. PPD was defined as a binary variable in two ways: (1) combining minor and major PPD for comparison with non-symptomatic (minor-major PPD), and (2) combining non-symptomatic and minor PPD for comparison with major PPD (major PPD). Logistic regression was used to examine the association between PPD and race after accounting for the relationships between PPD and poverty status, education, subjective SES, and marital status. Separate models were constructed for the 1 and 6 months postpartum time points for minor-major PPD and major PPD. Twenty-two mothers were excluded in the analyses for the 1 month postpartum time point, as the interview was completed at less than 2 weeks postpartum. Models were constructed in four steps, sequentially adding in the variables of interest with race as the primary predictor of interest being added in the final step: (1) current marital status; (2) current marital status, poverty status, and education; (3) current marital status, poverty status, education, and subjective SES; and (4) current marital status, poverty status, education, subjective SES, and race. Exact logistic regression methods were used when the number of PPD cases was too small for traditional logistic regression methods. Findings were considered statistically significant for $p < 0.05$. Analyses were conducted using SPSS (IBM Corporation, Somers, NY) and SAS (SAS Institute Inc., Cary, NC).

Results

Descriptive Statistics and Univariate Race Comparisons

Demographics of the sample by race are shown in Table 1. Compared to non-Hispanic white participants, African American participants were significantly younger ($t = -4.67$, $p < 0.0001$), poorer ($X^2 = 28.15$, $p < 0.0001$), less educated ($X^2 = 9.85$, $p = 0.01$), and less likely to be married at enrollment or one or 6 months postpartum ($X^2 = 49.19$, 49.93, and 50.32, respectively, all $p < 0.0001$). African American and non-Hispanic white participants did not differ with respect to subjective SES at 6 months postpartum ($t = -0.51$, $p = 0.61$) or employment status at 1 or 6 months postpartum ($X^2 = 3.12$, $p = 0.21$ and Fisher's exact table probability = 0.02, $p = 0.25$, respectively).

Descriptive statistics for the EPDS and minor, major, and minor-major PPD categories at 1 and 6 months postpartum for the overall sample and by race are shown in Table 1, along with univariate tests for differences by race. At 1 month postpartum the mean EPDS score for the overall sample was 5.5 (±4.8), with 6.9 % of participants having a positive screen for minor PPD, 10.5 % having a positive screen for major PPD, and 17.5 % having a positive screen for minor or major PPD. African American participants had a higher mean EPDS score 1 month postpartum compared to non-Hispanic white participants, but this was not a significant difference ($t = 1.25$, $p = 0.21$). A significantly greater percentage of African American participants fell in the minor-major PPD category (20.7 %) at 1 month postpartum compared to non-Hispanic white participants (10.3 %) ($X^2 = 4.46$, $p = 0.03$). A similar pattern was observed for minor PPD (African American 8.5 %, non-Hispanic white 3.4 %) and major PPD (African American

12.2 %, non-Hispanic white 6.9 %) at 1 month postpartum, but were not significant ($X^2 = 2.37$, $p = 0.12$; $X^2 = 1.80$, $p = 0.18$, respectively).

At 6 months postpartum, the mean EPDS score for the overall sample decreased to 4.8 (±4.9) with 8.4 % of participants having a positive screen for minor PPD, 9.0 % having a positive screen for major PPD, and 17.4 % having a positive screen for minor or major PPD. The mean EPDS scores decreased at 6 months postpartum for both African American and non-Hispanic white participants, with a greater decrease observed for African American participants; there was no significant difference in 6 month postpartum EPDS scores by race ($t = 0.09$, $p = 0.93$). The percentage of African American participants in the minor PPD category at 6 months postpartum decreased, while the percentage of non-Hispanic white participants in this category increased. This led to a change in the racial pattern for minor PPD at this time point, with a greater percentage of non-Hispanic white participants having a positive screen compared to African American participants, however, this difference was not significant (Fisher's exact table probability = 1.00, $p = 0.54$). The percentage of African American participants in the major PPD category at 6 months postpartum decreased and the percentage of non-Hispanic white participants in this category stayed the same; the overall pattern remained the same (greater percentage of African Americans than non-Hispanic whites), but was not significant (Fisher's exact table probability = 0.39, $p = 0.21$). For the minor-major PPD category at 6 months postpartum, the percentage of African American participants decreased, while the percentage of non-Hispanic whites increased; the overall pattern remained the same (greater percentage of African Americans than non-Hispanic whites), but was not significant (Fisher's exact table probability = 0.51, $p = 0.29$).

Multivariable Logistic Regressions

Results of the logistic regressions for minor-major PPD, modeled separately at 1 and 6 months postpartum are summarized in Table 2. At 1 month postpartum, education was a significant predictor of minor-major PPD until the inclusion of race in the model after which it became marginal. At 1 month postpartum, current marital status was a significant predictor of minor-major PPD until the inclusion of poverty and education in the model after which it became marginal, and then lost significance after the inclusion of race in the model. At 6 months postpartum, subjective SES was significantly associated with minor-major PPD, even after including all of the other predictors in the model, with higher subjective SES indicating lower odds of PPD. At 6 months postpartum, current marital status was significantly associated with minor-major PPD until accounting for poverty and education where it became marginal.

Results of the logistic regression modeling for major PPD are summarized in Table 3. At 1 month postpartum, current marital status approached significance as a predictor of major PPD; however, the significance was not maintained after adding poverty, education, subjective SES, and race to the model. Current marital status approached significance as a predictor of major PPD at 6 months postpartum, but lost significance after subjective SES and race were included in the model. Education approached significance as a predictor of major PPD at 6 months postpartum. At 6 months postpartum, only subjective SES was significantly associated with major PPD even with current marital status, poverty, education, and race in the model, with higher subjective SES indicating lower odds of PPD.

Discussion

In the current study of rural African American and non-Hispanic white women, the prevalence rates at 1 and 6 months postpartum of a positive screen for major PPD (11, 9 %, respectively) and minor-major PPD (18, 17 %, respectively) are within the range of those reported in previous research using varying assessment methods and time points (5–25 % or more) [1] and those reported in previous studies that assessed PPD using the EPDS at similar postpartum time points (6.5–34 %) [12, 14, 26–28]. Of comparable studies, only one focused on a rural, although low income, sample and reported higher rates of major PPD (15 %) and minor-major PPD (33 %) at 6–8 weeks postpartum [12], The inclusion of high income women in the current study may help to explain in part the lower rates of PPD observed. Comparable studies of urban samples reported slightly lower rates of major PPD (8 %) 6 months postpartum [28] and minor-major PPD (13 %) at 4–6 weeks postpartum [27]. It is possible that the oral administration of the EPDS in the current study led to under-reporting of depressive symptoms as has been observed in previous research [27]. In comparing the current study's results to those of previous comparable studies, it appears that rural women with varying levels of SES experience PPD symptoms to a greater extent than women in urban areas but not as high as those experienced by rural, low SES women, and that these rates persist up to 6 months postpartum.

Initial univariate analyses revealed that a significantly greater percentage of African American participants had scores that fell into the minor-major PPD category at 1 month postpartum compared to non-Hispanic white participants. However, after taking marital status, poverty,

Table 2 Logistic Regression Modeling of Minor–Major PPD at 1 and 6 months Postpartum

Variable	Step 1		Step 2		Step 3		Step 4	
	Odds Ratio (95 % CI)	*p*	Odds Ratio (95 % CI)	*p*	Odds Ratio (95 % CI)	*p*	Odds Ratio (95 % CI)	*p*
Minor–Major PPD 1 month postpartum								
Current marital status		0.046		0.066		0.075		0.185
Not in a relationship versus Married	3.272 (1.256–8.523)	0.015	3.500 (1.189–10.305)	0.023	3.322 (1.131–9.757)	0.029	2.601 (0.842–8.035)	0.097
In a relationship versus Married	2.556 (1.049–6.226)	0.039	2.897 (1.050–7.994)	0.040	2.884 (1.051–7.914)	0.040	2.525 (0.906–7.039)	0.077
Poverty status				0.175		0.169		0.167
≤100 % FPL versus >200 % FPL			0.394 (0.118–1.318)	0.131	0.402 (0.121–1.338)	0.137	0.389 (0.116–1.303)	0.126
101–200 % FPL versus >200 % FPL			0.722 (0.219–2.383)	0.593	0.756 (0.230–2.479)	0.644	0.725 (0.220–2.392)	0.597
Education				0.038		0.048		0.052
<High school versus >High school			3.397 (1.312–8.793)	0.012	3.239 (1.247–8.408)	0.016	3.230 (1.240–8.409)	0.016
High school versus >High school			2.147 (0.947–4.865)	0.067	2.114 (0.931–4.798)	0.074	2.032 (0.892–4.633)	0.092
Subjective SES					0.907 (0.751–1.095)	0.309	0.901 (0.747–1.088)	0.279
Race (African American versus non-Hispanic white)							1.736 (0.743–4.055)	0.202
Minor–Major PPD 6 months postpartum								
Current marital status		0.011		0.070		0.103		0.088
Not in a relationship versus Married	3.915 (1.346–11.385)	0.012	3.288 (1.048–10.316)	0.041	2.605 (0.823–8.249)	0.104	2.889 (0.869–9.604)	0.083
In a relationship versus Married	4.480 (1.671–12.014)	0.003	3.509 (1.193–10.320)	0.023	3.179 (1.096–9.221)	0.033	3.407 (1.146–10.129)	0.027
Poverty status				0.362		0.455		0.455
≤100 % FPL versus >200 % FPL			1.257 (0.362–4.360)	0.719	1.383 (0.398–4.809)	0.610	1.418 (0.407–4.944)	0.583
101–200 % FPL versus >200 % FPL			0.680 (0.175–2.638)	0.577	0.808 (0.209–3.125)	0.757	0.832 (0.214–3.229)	0.791
Education				0.425		0.537		0.506
<High school versus >High school			1.621 (0.640–4.106)	0.309	1.477 (0.577–3.784)	0.416	1.493 (0.582–3.831)	0.405
High school versus >High school			1.626 (0.758–3.487)	0.212	1.534 (0.708–3.321)	0.278	1.572 (0.723–3.419)	0.253
Subjective SES					0.766 (0.632–0.928)	0.006	0.766 (0.632–0.928)	0.007
Race (African American versus non-Hispanic white)							0.789 (0.373–1.670)	0.536

CI confidence interval, *FPL* federal poverty level; models were constructed in four steps, increasing the number of predictors at each step: Step 1—marital status; Step 2—marital status, poverty status, and education; Step 3—marital status, poverty status, education, and subjective SES; and Step 4—marital status, poverty status, education, subjective SES, and race

education, and subjective SES into consideration, there were no significant racial differences observed in symptoms of PPD at 1 or 6 months postpartum. These results indicate that when focusing on a rural sample such as this with varying levels of objective and subjective SES, PPD symptoms may not differ between African American and non-Hispanic white women at 1 and 6 months postpartum. These results are consistent with most of the other studies that assessed PPD using the EPDS at similar time points [12, 14, 27–29]. No significant racial differences in major or minor-major PPD were found in a rural, low income sample at 6–8 weeks postpartum [12], or a national sample within 6 months postpartum [14]. SES and marital status were not taken into consideration in the analyses of racial

Table 3 Logistic Regression Modeling of Major PPD at 1 and 6 months Postpartum

Variable	Step 1		Step 2		Step 3		Step 4	
	Odds Ratio (95 % CI)	*p*	Odds Ratio (95 % CI)	*p*	Odds Ratio (95 % CI)	*p*	Odds Ratio (95 % CI)	*p*
Major PPD 1 month postpartum								
Current marital status		0.057		0.265		0.221		0.245
Not in a relationship versus Married	2.994 (0.743–12.070)	0.123	1.793 (0.374–11.552)	0.642	1.767 (0.367–11.408)	0.659	1.530 (0.297–10.436)	0.847
In a relationship versus Married	4.515 (1.291–15.796)	0.018	2.664 (0.720–14.892)	0.184	2.709 (0.731–15.169)	0.174	2.521 (0.666–14.313)	0.231
Poverty status				0.172		0.173		0.173
≤100 % FPL versus >200 % FPL			4.108 (0.577–Infinity)	0.182	4.117 (0.582–Infinity)	0.179	4.007 (0.570–Infinity)	0.188
101–200 % FPL versus >200 % FPL			5.266 (0.726–Infinity)	0.110	5.379 (0.747–Infinity)	0.104	5.166 (0.720–Infinity)	0.113
Education				0.879		0.878		0.912
<High school versus >High school			1.357 (0.352–4.913)	0.805	1.301 (0.335–4.739)	0.864	1.304 (0.336–4.755)	0.861
High school versus >High school			1.189 (0.434–3.423)	0.897	1.177 (0.429–3.389)	0.916	1.156 (0.419–3.342)	0.948
Subjective SES					0.922 (0.731–1.154)	0.478	0.917 (0.727–1.146)	0.445
Race (African American versus non-Hispanic white)							1.380 (0.484–4.453)	0.556
Major PPD 6 months postpartum								
Current marital status		0.059		0.098		0.173		0.161
Not in a relationship versus Married	12.461 (1.555–99.885)	0.018	10.678 (1.239–92.008)	0.031	7.698 (0.891–66.491)	0.064	8.411 (0.931–76.014)	0.058
In a relationship versus Married	10.286 (1.338–79.061)	0.025	8.128 (0.977–67.637)	0.053	6.819 (0.836–55.614)	0.073	7.202 (0.867–59.809)	0.068
Poverty status				0.390		0.442		0.434
≤100 % FPL versus >200 % FPL			2.235 (0.253–19.736)	0.469	2.890 (0.324–25.797)	0.342	2.968 (0.333–26.493)	0.330
101–200 % FPL versus >200 % FPL			1.078 (0.105–11.032)	0.949	1.622 (0.156–16.831)	0.686	1.668 (0.160–17.344)	0.668
Education				0.078		0.079		0.076
<High school versus >High school			0.186 (0.022–1.575)	0.123	0.157 (0.018–1.358)	0.093	0.158 (0.018–1.362)	0.093
High school versus >High school			1.690 (0.658–4.341)	0.276	1.544 (0.592–4.025)	0.374	1.578 (0.602–4.133)	0.353
Subjective SES					0.726 (0.563–0.937)	0.014	0.725 (0.562–0.937)	0.014
Race (African American versus non-Hispanic white)							0.809 (0.286–2.287)	0.689

CI confidence interval, *FPL* federal poverty level; models were constructed in four steps, increasing the number of predictors at each step: Step 1—marital status; Step 2—marital status, poverty status, and education; Step 3—marital status, poverty status, education, and subjective SES; and Step 4—marital status, poverty status, education, subjective SES, and race

differences in PPD in either of these studies. In two studies of urban samples, initial racial differences in major PPD at 6 months postpartum [28] and minor-major PPD at 4–6 weeks postpartum [27] whereby African American women had higher rates than non-Hispanic white women were either accounted for by financial hardship [28] or not confirmed after a clinical interview confirmation of PPD [27]. Other studies identified in the literature as examining racial differences in PPD show mixed results [8–11, 13, 30, 31], however, are not comparable given different PPD assessment methods and assessment time points. Similar to other comparable studies, the results of the current study suggest that any initial racial differences in PPD that are observed do not appear to maintain significance once SES or confirmation of a clinical diagnosis is taken into account.

Subjective SES was the most consistent predictor of PPD symptoms, predicting major and minor-major PPD at 6 months postpartum. While one other identified study found a negative relationship between subjective SES and depression measured using items from the General Health Questionnaire 30 in male and female London civil service employees [32], the present study is the first we are aware of to examine the relationship between subjective SES and PPD symptoms. The present study's results suggest that women who see themselves as less well-off in terms of income, education, and occupation in comparison to others may be at a higher risk of developing PPD. This could be due to these women experiencing greater distress as a result of their perceived inferior circumstances. For instance, they may perceive themselves as having lower self-worth and self-efficacy than other women, feel unable to adequately provide for their families as well as themselves, and/or view their current life situations as unlikely to change, leaving them feeling hopeless and helpless (hallmark indicators of depression). That the relationship could be bidirectional (e.g., a woman experiencing depressive symptoms may be more likely to perceive her SES position as worse than others) raises the issue of a confounding effect of depressive symptoms on the appraisal of one's subjective SES. However, research has demonstrated that the appraisal of one's subjective SES is not significantly impacted by psychological biases [32] including negative affect [25], which has conceptual overlap with depressive symptoms. The observed relationship between subjective SES and negative affect is more likely the result of the influence of low subjective SES on negative affect rather than the reverse [25, 33]. This research supports the idea that low subjective SES increases the risk for PPD symptoms, perhaps in part by increasing negative affect in the ways described above.

The significance of subjective SES for positive screen for minor-major and major PPD at 6 months postpartum, and that its inclusion in the regression models often reduced the influence of indicators of objective SES suggests that one's perceived social status may provide predictive value that is not accounted for by the more commonly used objective indicators of SES when examining factors related to PPD. This finding is consistent with prior research relating SES to other health outcomes [19, 20, 22], but is the first report of an examination of subjective SES in relation to PPD. It would be prudent for future researchers to include both objective and subjective measures of SES when trying to understand relative contributions of race and SES in examining racial disparities in health, especially in rural populations where SES and race can be easily entangled.

Marital status was a significant predictor of PPD in our study, but only when entered by itself in the first step of the minor-major PPD regressions. When poverty status and education were included, marital status became non-significant, and in most cases became even more non-significant with the addition of subjective SES and race. This pattern suggests that the other predictors, particularly poverty status and education, may help to account for the initial observed relationship between marital status and PPD.

Limitations

There were several limitations inherent in this study. Although the use of established cut-offs using the EPDS for assessment of PPD is consistent with much PPD research, it only enables the determination of the likelihood of a clinical diagnosis of PPD, not an actual diagnosis. Another limitation is that subjective SES was only assessed at 6 months postpartum, so its relationship with PPD at 1 month postpartum should be interpreted with caution. However, the MacArthur Scale of Subjective Social Status has demonstrated adequate test–retest reliability, suggesting this may not be a major concern [25]. As indicated earlier, depressive symptoms could confound the appraisal of subjective SES, so assessing both variables prospectively will help elucidate how these variables affect one another. In addition, that the assessments of subjective SES and PPD were both via questionnaires, the strength of the relationship between these two variables may be overestimated given same source bias. However, previous research showing negative affect has similar relationships with both objective and subjective SES suggests that same-source bias may not be a large concern [25]. Also, a potential confound that was not included in these analyses due to over-fitting the regression models was the variable preterm birth (PTB). Racial disparities in PTB are well established in the literature, with African American women exhibiting significantly higher rates than non-Hispanic White women (one in five births and one in 8–9 births, respectively) [34]. PTB has been shown to be directly correlated with increased risk of PPD [35]; therefore future studies should take this variable into account. However, exploratory analyses that included PTB in the first step of the multivariable modeling showed that PTB did not affect the significance of the variables currently presented. A statistical limitation was that the number of cases of positive screens for major PPD was not large, and thus the level of power to detect significant effects in the logistic regression models may be limited. As evidenced by the large 95 % confidence intervals, the estimated odds ratios have low precision. It is important to note that poverty status was derived from household size, which was not asked directly, and household income, which was not always provided. Household size was estimated from a series of questions detailing if the participant lived with parents, children,

other family members, and non-family members, which could lead to an under-reporting of household size. As previously described, when a participant did not know or refused to report household income, poverty status was imputed based on her receipt of Medicaid and/or public assistance. Lastly, a small percentage of the sample (4 %) reported taking medication for depression during the 6 months postpartum interview. These participants were more likely to be non-Hispanic white, married, and unemployed.

Practical Implications

The prevalence rate of PPD up to 6 months postpartum in this study's sample of rural women being higher than that of urban women highlights the need for routine screening mechanisms for PPD detection in rural areas. This may be especially applicable to rural and low SES women, given their actual and/or perceived limited personal resources and few opportunities to seek help. Increased screening leads to increased diagnosis, referral, and treatment, signifying that screening is a crucial first step toward PPD treatment [36]. The feasibility of PPD screening has been demonstrated in pediatrician and obstetrician/gynecologist offices and health departments [36–38]. Additionally, screening could extend to community-based infant mortality prevention programs in order to more effectively reach rural populations. Given its established psychometric properties and clinical utility, we concur with others who recommend the EPDS be used as the standard screening measure for PPD [1, 27], which would further enable comparisons across studies.

That the most consistent predictor of PPD in this study was subjective SES focuses attention on it as a possible risk factor that may be modified through intervention services. However, before specific interventions can be developed, findings from this study need replication and further understanding of why given the same level of objective SES, rural women who perceive their SES to be lower are more likely to have PPD symptoms. With this being said, future avenues for exploration after the problem is more fully understood include facilitating women's awareness of potential resources at their disposal, so they may not feel as helpless to change their current situation and may help instill hope that their situations can change for the better; and enhancing problem-solving skills to help women learn how to access support and services as well as facilitate active coping towards presenting problems they are experiencing. Relatedly, given that subjective SES is considered an average appraisal of the combination of one's income, occupation, and education [16], designing interventions to target improvement on any of these three objective SES factors should also help improve one's subjective SES.

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