

Postpartum Depression among African-American and Latina Mothers Living in Small Cities, Towns, and Rural Communities

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Abstract

Background The presence of postpartum depression can lead to poor maternal-child attachment, failure to thrive, and even infant death. Postpartum depression affects 13–19 % of parturients. However, among racial and ethnic minority parturients, postpartum depression rates have been shown to reach up to 35–67 % (as reported by O’Hara and McCabe, *Annu Rev Clin Psychol* 9:379–407, 2013; Boury et al., *Women Health*. 39(3):19–34, 2004; Ramos-Marcuse et al., *J Affect Disord*. 122(1–2):68–75, 2010; Lucero et al., *J Am Acad Nurse Pract*. 24(12):726–34, 2012). This is more concerning when considering the fact that these mothers are also hardest to reach because they are usually marginalized and displaced within mainstream US society. The current study assesses potential risk factors that contribute to postpartum depression among African-American and Latina mothers.

Methods We analyze data from 3317 Healthy Start participants living in small cities, towns, and rural areas in Pennsylvania using a logistic regression analysis controlling for known contributing risk factors, including maternal health,

family life, social support, socioeconomic and demographic characteristics, and community of residence. We use a multiple imputation multivariate analysis to account for the potential effects of missing data.

Results The results show that the odds of a risk of postpartum depression is nearly 80 and 40 % greater for African-American (OR = 1.80, $p < .001$) and Latina mothers (OR = 1.41, $p < .01$), respectively, as compared to white mothers. While the higher risks of postpartum depression for Latinas is explained in part by socioeconomic status, community of residence, and immigrant status, the significantly higher risk among African-American mothers cannot be completely ameliorated by the controlled variables. Our study highlights the need for further research into the impact of social and environmental stressors on postpartum depression among racial and ethnic minority populations living in small cities, towns, and rural areas.

Keywords Postpartum depression · Maternal health · Mental health · Health disparities · Race and ethnicity · African-American · Latino

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Introduction

Postpartum depression is a severe mood disorder that occurs within 4 weeks of giving birth and as late as 30 weeks postpartum [1–3]. Untreated maternal depression has been shown to impact infant well-being in the areas of behavioral and cognitive development as well as physical and mental health [1, 4–7]. Prevalence of postpartum depression among new mothers in the USA ranges from 13 to 19 % [1]. This prevalence varies by region, population, and method of measurement of postpartum depression and has been found in one study to be as high as 82 % [8, 9]. In fact, 49 % of

African-American mothers and 54 % of Latina mothers have experienced depressive symptoms after the birth of a child [10, 11]. According to the 2004–2005 Pregnancy Risk Assessment Monitoring System (PRAMS), a Center for Disease Control and Prevention survey showed self-reported postpartum depression in 10 to 15 % of mothers in the 17 states recorded [12]. Although the PRAMS survey in 2004–2005 found that African-Americans and Latinas had higher rates of self-reported postpartum depressive symptoms than whites [12], more recent PRAMS data reveals the prevalence of postpartum depression was higher for African-Americans in 2009 and 2010, and lower for Latinas in 2011, as compared to whites [13]. Given these inconsistencies in rates of postpartum depression for racial and ethnic minority mothers, there are surprisingly few studies that attempt to explain these differentials. The research that does exist has shown conflicting results.

Findings in contemporary research on the risk of postpartum depression among low-income, racial and ethnic mothers across social, demographic, and contextual factors [11, 14] have been inconsistent. Wang et al. [15] found no significant difference in maternal depression between the races when controlling for social, economic, health, and support factors. Yonkers and colleagues [16], in a study of inner city, Latina and African-American mothers receiving care from a publicly funded maternal health system, found no difference in postpartum depression as compared to whites. Furthermore, Hobfoll et al. [17] found postpartum depression to be significantly higher among women living in the inner city as compared to those living in middle-class areas, but no significant difference by race. Still, other research finds no difference in the rates of maternal depression by race or ethnicity once controlling for sociodemographic, health, and individual characteristics [18–20]. In fact, one study by Segre et al. [21] found Latinas to have a lower risk of postpartum depression as compared to white mothers. While these studies found no racial-ethnic linked increase in rates of postpartum depression, other studies highlight disturbing statistics.

Several studies have found African-American and Latina mothers to have significantly higher rates of postpartum depression as compared to white mothers [21–23]. Ramos-Marcuse et al. found prevalence rates as high as 49 % among African-American adolescent mothers immediately following the birth of their child with a decrease to 37 % after 6 months [10]. A study of rural African-American women by Dolbier et al. found postpartum depression rates of approximately 38 % at 1 to 6 months after giving birth [18]. The evidence that the highest prevalence of postpartum depression is found among low-income, minority, and immigrant women [24, 11, 16, 25–28] highlights the fact that postpartum depression is a multifactorial process that needs to be examined from several angles.

Rates of postpartum depression among mothers with education beyond 12 years of schooling are lower than in mothers with less than 12 years of education. Moreover, postpartum

depression was consistently lower among mothers with at least 16 years of schooling compared to mothers holding less than a 4-year degree. In fact, lower rates of postpartum depression among mothers of high social economic status are consistent across 30 states [13]. The literature suggests that postpartum depression rates by race and ethnicity is less clear than rates based on socioeconomic status [23, 29].

Although a compelling argument could be made that social economic status is associated with rates of postpartum depression net effect of race and ethnicity, this may not hold true in certain demographics, such as small towns. Place of residence and access to support services could pose an even greater health risk for immigrant and African-American mothers who are marginalized from mainstream society as well as immediate maternal health outreach and education services. These discrepancies are a cause for alarming concern because mothers located on the outskirts of big cities and towns could be overlooked, which further exacerbates this important health issue in this population. Racial and ethnic minority mothers experience higher rates of poverty and maternal health disparities, which, in turn, interferes with family and child health outcomes over the life course [30]. Failing to consider other explanations such as the location of residence of racial and ethnic mothers could also grossly under represent the undiagnosed condition of “postpartum blues” due in part to limits in health care utilization and access, family and community cultural values, gaps in testing for postpartum depression during pre- and postnatal visits, and measurement techniques that do not adequately capture the early onset symptoms of postpartum depression [11, 14, 25].

Socioeconomic status alone does not adequately explain discrepancies in rates of postpartum depression and depressive symptoms for African-American and Latina mothers. Researchers indicate that culture influences how African-American and Latina mothers identify with mental health, which makes it more difficult for this group to recognize the signs and symptoms of postpartum depression and seek medical treatment [31]. There is very limited data on how the interplay of family and cultural values influence maternal health and medical treatment. Furthermore, a comprehensive understanding of complex psychosocial outcomes, like postpartum depression, requires the evaluation of a myriad of behavioral and cultural variables which include, but are not limited to health care utilization and access to prenatal services, periodic screenings that capture cultural differences in mood and affect during pregnancy and postpartum, maternal social support networks and resources needed to provide a stable family life, prenatal depression screening, compliance with health care and follow-up, and maternal education to ensure accurate reporting of symptoms. Additionally, family and cultural values as it relates to mistrust in medicine and the stigma of mental health disorders may significantly hinder racial and ethnic minority low-income mothers from seeking care.

Moreover, methodologies that do not incorporate a community health intervention component in the prenatal and postnatal periods may miss capturing perinatal depression in mothers who show lower rates of compliance as expressed by missed health care appointments and clinical visits [11, 4, 18, 22, 30, 32–37]. This also refers to measurement techniques that are culturally sensitive to the sociocultural dynamics that impact racial and ethnic mothers who most often live in urban racial-ethnic enclaves that make mothering and family life a daily stressful social condition. The importance of location of residence on rates of postpartum depression across racial-ethnic demographics is under-addressed, especially among low-income minority mothers.

This project investigates the risk of postpartum depression among African-American and Latina mothers participating in Pennsylvania's Healthy Start program. The purpose of this study is to improve our understanding of the mechanisms that cause maternal health disparities among African-American and Latina mothers who live in small towns and rural areas located on the outskirts of major cities, an understudied maternal population.

The Study

This study is based on information collected on low-income pregnant mothers who participate in a Healthy Start program located in a relatively affluent Pennsylvania county that has a mixture of small cities, towns, and rural communities in the exurbs, the urban-rural periphery beyond the suburbs of a large metropolitan city [38]. Thus, these impoverished mothers and their families live among a racially, ethnically, and socioeconomically diverse population. It is this type of regional heterogeneity that makes this population of mothers important for studying the risk of postpartum depression by race and ethnicity.

Healthy Start is a prenatal home visiting program that has the goal of reducing social and economic barriers for women, children, and families accessing health care and early education. Healthy Start connects new pregnant mothers with health care services and necessary resources to enable their infants to be born healthy and achieve developmental milestones. The program is part of a national initiative to improve maternal and infant birth outcomes in high-risk communities throughout the USA [39]. The Healthy Start program collects information on the participants and their children, including data on birth outcomes (prematurity, low birth weight, and infant mortality); maternal health behaviors (smoking and drinking); program interventions (health education, depression screening, resource linkages such as health insurance, medical care, education and emotional support); and socioeconomic and demographic characteristics.

Data and Methods

The data for this study contain information on all enrollees of a Healthy Start program in a Pennsylvania county. The study includes data collected over an 11-year time frame (from 2003 to 2013) and includes a total of 3317 women and their children who received services. The program participants are low-income and were pregnant upon enrolling in the program. They remain in the program for up to 2 years after completion of the pregnancy and may re-enroll for subsequent pregnancies. This analysis is limited to the participants' first enrollment in order to focus on outcomes of a single pregnancy.

The data to be analyzed include those participants who completed their pregnancies with the Healthy Start program and also completed an Edinburgh Postnatal Depression Scale screening survey (EPDS) as part of their enrollment. The EPDS has been validated for use cross-culturally and in multiple languages [40, 41]. The program utilized a screening survey based on the Cox, Holden, and Sagovsky 10-item EPDS scale [42]. To address the cultural needs of the large immigrant and Latino population they service, the program translates the survey into Spanish for Spanish-speaking mothers. For this analysis, we base the measure of postpartum depression on studies that recommend an EPDS score ranging between 9 and 13 to indicate the mother is at risk of postpartum depression and a score of 13 or greater to indicate the mother has a high likelihood of postpartum depression and is in need of a follow-up evaluation [43, 44]. The dependent variable for this analysis indicates that the mother is "at risk" of postpartum depression (1 = EPDS score is greater than 9, 0 = otherwise) after the birth of the child. All participants complete the EPDS screening survey during pregnancy as part of the enrollment process and again within the first year of the birth of their child, the time varying between 1 and 8 months after the delivery. The number of cases with an EPDS score of 13 or greater at postpartum in these data is too small for this analysis as a dependent variable; thus, we use a score greater than 9 as the cutoff point.

Independent variables include the participant's self-identification of race or ethnicity: Latino, African-American (non-Latino), and white (non-Latino). This analysis includes only these three groups as less than 1.5 % of the enrollees identified as some other race or ethnicity. In order to capture problems unrelated to maternal depression and pregnancy, we use the score of the EPDS screening questionnaire taken during pregnancy as an independent variable measuring prenatal depression (1 = if EPDS \geq 13; 0 = otherwise). Risk factors related to postpartum depression include postnatal maternal health risks, maternal age, marital conflict, breastfeeding, social support, and familial stress [2–4, 17, 29, 45, 46]. Mother's health is measured using a composite variable of postnatal maternal risk factors. This is a dichotomous variable including at least one maternal risk during or immediately after delivery.

Questions include whether the mother or baby spent over 3 days in the hospital after delivery, the mother experienced problems during delivery, or the mother or baby was in intensive care (1 = at least one risk factor present, 0 = no risk factors present). Breastfeeding is associated with a low risk of postpartum depression [3]. During follow-up after the delivery, mothers are asked if they breastfeed their infant (1 = breastfeeds, 0 = does not). Maternal age is also a risk factor for postpartum depression: teenage mothers are at a higher risk of postpartum depression, thus the age variable is a dichotomous indicator (1 = less than 20 years old, 0 = 20 years and older). Nulliparity, fear of childbirth, and familial stress are associated with postpartum depression. These are measured by whether this is the mother's first child (1 = first child, 0 = second or greater child), prior to mother's current delivery as a Healthy Start participant.

In addition, familial stress and social support are measured by whether the mother lives with family (1 = lives with a family member, 0 = does not live with a family member), and whether there is conflict in the home. Enrollees were asked if they had experienced any conflict in their home during the pregnancy (1 = yes, 0 = no). The participants of this study receive services at five sites located in small cities, towns, and rural communities situated in the exurbs of a large metropolitan city. These sites serve residents living in these and the surrounding communities. The program staff report that most of the Healthy Start participants live in the nearby communities. Thus, this variable will represent the participants' place of residence (1 = predominant racial-ethnic minority community, 0 = otherwise).

Measures of socioeconomic status include the type of health insurance the enrollee has access to (1 = private health insurance, 0 = other health insurance or none); employment status (1 = mother is employed, 0 = mother not employed); and education (1 = 12 years or more of schooling, 0 = less than 12 years of schooling). This analysis also controls for mother's legal status in the USA (1 = documented legal status or US citizen, 0 = undocumented).

These data include participants who have enrolled in the Healthy Start program over an 11-year period, from 2003 to 2013. Over this period, the level of postpartum depression among these participants has ranged from over 39 % in 2007 to under 22 % in 2005. A variable measuring the year of enrollment is included in the analysis to determine if the risk of postpartum depression by race and ethnic group varies over time. The measure is a continuous variable ranging from 3 to 13, and the numbers represent the year the participant first enrolled in the program, for example 2003 = 3, 2004 = 4, etc.

Because of the potential effect of missing data, we use a multiple imputation method for this analysis. A multiple imputation logistic regression analysis of missing data of these and other variables was conducted using the Stata 14 command for multiple imputation for chained equations (MICE) with a missing at random assumption [47, 48]. In

these data, over 25 % of the cases contain missing values, most of which are found among three variables: EPDS prenatal score, home conflict, and education. Other variables containing missing values include first child, breast feeding, lives with family, unemployed, and private health insurance. Preliminary analysis of missing data indicates that the most common pattern among the cases with missing values is found with the former three variables. The results of this analysis also show that these three variables and the variables: living with family, breast feeding, and having private health insurance, are significantly associated with the racial-ethnic background of the respondents. In order to reduce the possibility of bias due to missing values, we conduct a multiple imputation analysis of the data.

Results

These data contain information only from the participants' first-time enrollment. That is, only the first pregnancy enrollment is included in this analysis regardless of multiple enrollments for different pregnancies. This avoids duplication of women with multiple enrollments in the analysis. The distribution by race and ethnicity of the participants is 14 % African-American, 71 % Latina, and 15 % white (see descriptive statistics in Table 1). Twenty-nine percent of these mothers are at risk of postpartum depression (EPDS >9) and 16 % showed high likelihood of depression during pregnancy, with an EPDS score at or above 13 (see Table 1).

Nineteen percent of the mothers experienced at least one postnatal risk, 27 % breastfeed their infants, and 19 % are under 20 years of age. For half of the mothers (52 %), this is their first birth; most of them live with their families (89 %) and 19 % experience some conflict at home. Although the criteria for enrollment in Healthy Start include living at or near poverty levels, there is variation in the socioeconomic backgrounds of these mothers: 64 % are unemployed, 58 % of these mothers have private health insurance, and 44 % have a 12th grade education or higher. The participants live in small cities, towns, and rural communities located in the exurbs of a large metropolitan city. Twenty-seven percent live in a community that is predominantly African-American and Latino with poverty twice that of the state poverty rate [49, 50]. Slightly less than one half (48 %) of the participants are documented immigrants or US citizens. The number of enrollees in the program is relatively evenly distributed over the years, slightly declining from 12 % in 2003 to 7.5 % in 2013.

Table 2 presents the results of a bivariate analysis of the relationship between race-ethnicity, the risk of postpartum depression, and the independent variables associated with postpartum depression. The analysis shows that African-American and Latina mothers are significantly more likely to be at risk of

Table 1 Descriptive statistics

| Variable | Obs | Mean |
|---------------------------------------|------|------|
| EPDS ≥9 at postpartum | 3096 | 0.29 |
| EPDS ≥13 at prenatal | 2988 | 0.16 |
| African-American | 3317 | 0.14 |
| Latina | 3317 | 0.71 |
| White | 3317 | 0.15 |
| Postnatal risks ^a | 3317 | 0.19 |
| Breastfeeding | 3298 | 0.27 |
| Age <20 | 3317 | 0.19 |
| First child | 3307 | 0.52 |
| Lives with family | 3174 | 0.89 |
| Conflicts at home | 2834 | 0.19 |
| Community predominantly minority | 3317 | 0.27 |
| Private health insurance | 3163 | 0.58 |
| Unemployed | 3279 | 0.64 |
| Schooling ≥12th grade | 2904 | 0.44 |
| Documented status | 3317 | 0.48 |
| Year enrolled in program ^b | 3317 | 7.63 |

^a Postnatal risks includes at least one of the following: the respondent experienced problems during delivery, the respondent or her baby spent over 3 days in the hospital after the delivery, or the respondent or her baby was in intensive care

^b Standard deviation = 3.18

postpartum depression than white mothers 29 and 24 % as compared to 18 %, respectively. This is a 47 % ($p < .001$)

difference for African-American mothers as compared to white mothers. For Latinas, there is a 23 % percent difference ($p < .01$). These levels are higher than prevalence rates of postpartum depression reported for Pennsylvania in the PRAMS survey between 2009 and 2011 [13], which reported a prevalence ranging from 9.8 to 11.5 % for African-American, 10.1 to 15.6 % for Latina, and 8.5 to 10.1 % for white mothers. Explanations for these differences vary by group. There are important differences in the variables that are associated with higher rates of postpartum depression for African-Americans relative to whites including a higher likelihood of prenatal depression (31 % difference, $p < .05$) being a teenage mother (24 %, $p < .05$), not being able to breastfeed (-21 %, although only marginally, $p < .10$), living with a family member (-8 %, $p < .05$), and having at least 12 years of schooling (-11 %, $p < .01$). Notably, African-Americans are significantly more likely to live in a community with a population predominantly African-American and Latino (83 %, $p < .001$). On the other hand, Latinas are significantly more likely than whites to be unemployed (22 %, $p < .001$) which may explain why they are significantly less likely to have private health insurance (-71 %, $p < .001$). Latinas are also less likely to have at least 12 years of schooling (94 %, $p < .001$) and to be documented (113 %, $p < .001$). Thus, place of residence is the greatest difference between African-Americans and whites while the greatest differences for Latinas is the lack of private health insurance, education, and documented status.

Table 2 Bivariate analysis of variables by race and ethnicity

| | African-American | | | Latina | | | White | |
|----------------------------------|-------------------|----------|--------------|---------|----------|--------------|-------|----------|
| | Mean | <i>n</i> | % difference | Mean | <i>n</i> | % difference | Mean | <i>n</i> |
| EPDS ≥9 at postpartum | 0.29*** | 418 | 46.5 | 0.24** | 2228 | 22.6 | 0.18 | 450 |
| EPDS ≥13 at prenatal | 0.19* | 393 | 31.0 | 0.16 | 2151 | 11.2 | 0.14 | 444 |
| Postnatal risks | 0.28 | 466 | 6.6 | 0.15*** | 2342 | -53.2 | 0.27 | 509 |
| Breastfeeding | 0.23 [†] | 463 | -21.4 | 0.28 | 2332 | -0.9 | 0.28 | 503 |
| Age <20 | 0.24* | 466 | 24.4 | 0.18 | 2342 | -5.4 | 0.19 | 509 |
| First child | 0.54*** | 465 | -19.0 | 0.49*** | 2336 | -28.2 | 0.65 | 506 |
| Lives with family | 0.73* | 440 | -8.2 | 0.93*** | 2256 | 15.8 | 0.80 | 478 |
| Conflicts at home | 0.24 | 368 | -14.1 | 0.16*** | 2045 | -54.3 | 0.28 | 421 |
| Community predominantly minority | 0.54*** | 466 | 83.2 | 0.23 | 2342 | 0.7 | 0.22 | 509 |
| Private health insurance | 0.92 | 441 | 0.4 | 0.44*** | 2226 | -71.2 | 0.92 | 496 |
| Unemployed | 0.58 | 459 | 6.6 | 0.67*** | 2315 | 21.5 | 0.54 | 505 |
| Schooling ≥12th grade | 0.74** | 382 | -11.1 | 0.30*** | 2085 | -94.4 | 0.83 | 437 |
| Documented status | 0.98 | 466 | 0.3 | 0.27*** | 2342 | -113.3 | 0.98 | 509 |
| Year enrolled ^a | 8.32*** | 466 | 9.0 | 7.50 | 2342 | -1.4 | 7.60 | 509 |

[†] $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$ (differences relative to white category)

^a Standard deviations for year enrolled = 3.36 (African-American), 3.09 (Latina), 3.31 (white)

Table 3 Odds ratio of the risk of postpartum depression by race and ethnicity, health, behavioral, socioeconomic, and demographic variables—multiple imputation

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|-----------------------------------|-----------------------------------|-----------------------------------|---|-----------------------------------|-----------------------------------|
| African-American | 1.80*** (0.29) [1.31, 2.48] | 1.71** (0.29) [1.23, 2.40] | 1.72** (0.30) [1.23, 2.41] | 1.70** (0.29) [1.21, 2.38] | 1.61** (0.28) [1.14, 2.28] |
| Latina (white omitted) | 1.41** (0.19) [1.09, 1.82] | 1.42* (0.19) [1.08, 1.85] | 1.44** (0.20) [1.10, 1.89] | 1.45** (0.21) [1.09, 1.91] | 1.45** (0.21) [1.10, 1.92] |
| Prenatal depression | | 4.85*** (0.53) [3.91, 6.01] | 4.70*** (0.52) [3.79, 5.84] | 4.26*** (0.49) [3.40, 5.33] | 4.24*** (0.49) [3.39, 5.31] |
| Postnatal risks | | | 1.11 (0.13) [0.89, 1.39] | 1.12 (0.13) [0.89, 1.40] | 1.12 (0.13) [0.90, 1.40] |
| Breastfeeding | | | 0.74** (0.08) [0.60, 0.91] | 0.75** (0.08) [0.61, 0.92] | 0.75** (0.08) [0.61, 0.92] |
| Age <20 years | | | 0.81 [†] (0.10) [0.64, 1.03] | 0.88 (0.12) [0.68, 1.14] | 0.88 (0.12) [0.68, 1.14] |
| First child | | | | 0.76** (0.07) [0.63, 0.92] | 0.76** (0.07) [0.63, 0.92] |
| Lives with family | | | | 1.00 (0.15) [0.75, 1.34] | 0.99 (0.15) [0.74, 1.32] |
| Conflicts at home | | | | 1.49*** (0.18) [1.17, 1.88] | 1.47** (0.18) [1.16, 1.86] |
| Community: predominantly minority | | | | | 1.18* (0.12) [0.96, 1.44] |
| Constant | 0.23*** (0.03) [.18, .29] | 0.16*** (0.02) [0.13, 0.21] | 0.18*** (0.02) [0.14, 0.24] | 0.19*** (0.04) [0.13, 0.27] | 0.18*** (0.03) [0.13, 0.27] |
| N | 3096 | 3096 | 3096 | 3096 | 3096 |
| Average RVI | 0 | 0.04 | 0.03 | 0.05 | 0.04 |
| Largest FMI | 0 | 0.10 | 0.10 | 0.14 | 0.14 |
| F statistic | 6.57*** | 76.75*** | 40.48*** | 27.96*** | 25.42*** |

Standard errors in parentheses; 95 % confidence intervals in brackets

RVI relative increase in variance, FMI fraction of missing information

[†] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Tables 3 and 4 presents the results of the multiple imputation multivariate logistic regression analysis with the coefficients of odds ratios, standard errors (in parentheses), and confidence intervals (in brackets). This analysis focuses on the relationship between race and ethnicity, and postpartum depression while accounting for the effects of relevant covariates, including prenatal depression, pre- and postnatal health

risks, maternal age, social support, home conflict, and socioeconomic and demographic characteristics.

In model 1, the risk of postpartum depression is regressed on race and ethnicity with white mothers as the omitted category. That is, the coefficients of African-American and Latina mothers are each compared to white mothers. The odds ratio coefficients in model 1 indicate that the odds of African-

American and Latina mothers being at risk of postpartum depression are 80 % (OR = 1.80, $p < .001$) and 41 % (OR = 1.41, $p < .01$) higher than white mothers, respectively. Model 2 controls for mothers who may experience depression prior to delivery using an EPDS survey score greater than or equal to a score of 13. In this model, prenatal depression is statistically significant and positively predicts the risk of postpartum depression. Mothers with prenatal depression are nearly five times more likely to be at risk of postpartum depression (OR = 4.9, $p < .001$). This serves as a proxy for mothers who may have a mental health condition prior to pregnancy, such as depression or bipolar disorder. The results show that the risk of postpartum depression for African-Americans is partially mediated by prenatal depression. The odds ratio declines to 1.71. However, the effect remains significant ($p < .01$). For Latinas prenatal depression does not significantly change the effect of the risk of postpartum depression (OR = 1.42, $p < .05$).

In subsequent models, we add variables representing different risk factors explaining postpartum depression. We expected the risk of postpartum depression for African-Americans and Latinas to be mediated by those factors that explain this association once included in the model.

Model 3 adds three maternal/infant health risk factors of postpartum depression: postnatal risk, breast feeding, and maternal age (less than 20 years of age). The results are consistent with the literature on breastfeeding which show a lower risk of postpartum depression among women who breastfeed [1, 3]. The odds of postpartum depression for mothers who breastfeed is 26 % lower than for mothers who did not breastfeed (OR = .74, $p < .01$). On the other hand, postnatal risks and age are not significantly associated with postpartum depression in this model. When adding these variables, the risk of postpartum depression among African-American and Latina mothers, relative to whites remain virtually unchanged (African-American: OR = 1.72, $p < .01$; Latina: OR = 1.44, $p < .01$), suggesting that health risks, breastfeeding, and maternal age do not explain the higher risk of postpartum depression among African-American and Latina mothers.

Variables measuring the number of children (having a first child), social support (lives with family), and marital discord (conflicts at home) are added to model 4. In this model, having a first child is significantly related to a lower risk of postpartum depression (OR = .76, $p < .01$). This is consistent with research showing a higher risk of postpartum depression for mothers with higher parity [51, 52]. The odds of the risk of postpartum depression are nearly 50 % greater for those mothers experiencing conflict at home as compared to those who do not (OR = 1.49, $p < .001$). There is little effect on the racial-ethnic differential. The odds of the risk of postpartum depression among African-American and Latina mothers remain significantly higher than whites (African-American: OR = 1.70, $p < .01$; Latina: OR = 1.45, $p < .01$). The change

in these odds ratios as compared to model 3 is very slight indicating that these covariates do not explain the higher risk of postpartum depression among African-American and Latina mothers in the data.

Model 5 adds the community residence variable, as African-Americans are significantly more likely to live in residentially segregated communities: there is an 83 % difference (Table 2) in the proportion of African-American mothers living in a community with a population that is predominantly African-American and Latino as compared to white mothers ($p < .001$). In this model the community residence variable is not statistically significant, yet adding this variable reduces the odds ratio coefficient for African-Americans to 1.61 ($p < .01$). Thus, this suggests that, whereas community of residence may mediate the risk of postpartum depression among African-American mothers, it does not fully explain the difference between African-Americans and whites.

Model 6 adds variables measuring socioeconomic status, including whether the mother is unemployed, receives private health insurance, and has at least 12 years of schooling. In the bivariate analysis, compared to white mothers, Latinas are more likely to be unemployed (22 % difference, $p < .001$), to lack private health insurance (71 % difference, $p < .001$), and have less than 12 years of schooling (94 % difference, $p < .001$). African-Americans are also more likely to have less than 12 years of schooling compared to whites (11 % difference, $p < .01$). While none of these variables are statistically significant in the multivariate model, their inclusion does result in eliminating the risk of postpartum depression for Latinas relative to whites. Each variable was added individually to the model (results not shown here), without any effect on the risk of postpartum depression for Latinas or African-Americans. This suggests that these variables in combination may mediate the relationship of postpartum depression and race-ethnicity in Latinas. The interaction of these variables is analyzed below. Thus, unemployment, lack of private health insurance, and lower levels of education explain the higher rate of postpartum depression of Latinas as compared to whites. However, these variables do not explain the higher rates of postpartum depression among African-American mothers as the odds ratio remains nearly unchanged (OR = 1.60, $p < .01$).

Model 7 compares the results in model 4 by adding the documented status variable separately, defined as a mother who is a US citizen or documented immigrant, to evaluate its effect as a measure of acculturation into the US society for Latina mothers. The results show that while the documented status variable is not statistically significant, its inclusion into model 7 results in the elimination of the effect of the risk of postpartum depression among Latina mothers as compared to model 4. This suggests that immigration status and acculturation may contribute to a higher risk of postpartum depression for Latinas. Latina immigrants may be experiencing stress related to being undocumented and

Table 4 Odds ratio of the risk of postpartum depression by race and ethnicity, health, behavioral, and behavioral, socioeconomic, and demographic variables—multiple imputation

| | Model 6 | Model 7 | Model 8 | Model 9 |
|--|-----------------------------------|-----------------------------------|---|---|
| African-American | 1.60** (0.28) [1.13, 2.26] | 1.70** (0.29) [1.21, 2.38] | 1.56* (0.28) [1.11, 2.21] | 1.57* (0.28) [1.11, 2.22] |
| Latina (white omitted) | 1.22 (0.20) [0.89, 1.67] | 1.27 (0.21) [0.91, 1.76] | 1.13 (0.20) [0.80, 1.59] | 1.11 (0.20) [0.78, 1.57] |
| Prenatal depression | 4.17*** (0.48) [3.33, 5.23] | 4.22*** (0.48) [3.37, 5.29] | 4.17*** (0.48) [3.33, 5.23] | 4.15*** (0.48) [3.31, 5.20] |
| Postnatal risks | 1.13 (0.13) [0.90, 1.41] | 1.12 (0.13) [0.90, 1.40] | 1.13 (0.13) [0.90, 1.41] | 1.12 (0.13) [0.89, 1.40] |
| Breastfeeding | 0.75** (0.08) [0.61, 0.93] | 0.74** (0.08) [0.60, 0.91] | 0.74** (0.08) [0.60, 0.91] | 0.74** (0.08) [0.60, 0.92] |
| Age <20 years | 0.84 (0.11) [0.64, 1.09] | 0.89 (0.12) [0.69, 1.16] | 0.85 (0.11) [0.65, 1.11] | 0.85 (0.11) [0.65, 1.11] |
| First child | 0.80* (0.08) [0.66, 0.97] | 0.76** (0.07) [0.63, 0.92] | 0.79* (0.08) [0.65, 0.96] | 0.79* (0.08) [0.65, 0.96] |
| Lives with family | 0.96 (0.14) [0.72, 1.29] | 1.00 (0.15) [0.75, 1.34] | 0.96 (0.14) [0.71, 1.29] | 0.97 (0.15) [0.72, 1.31] |
| Conflicts at home | 1.50*** (0.18) [1.18, 1.90] | 1.50*** (0.18) [1.18, 1.90] | 1.50*** (0.18) [1.18, 1.90] | 1.50*** (0.18) [1.18, 1.90] |
| Community: predominantly minority | 1.18* (0.12) [0.96, 1.44] | | 1.16 (0.12) [0.95, 1.42] | 1.15 (0.12) [0.94, 1.41] |
| Private health insurance | 0.85 (0.09) [0.69, 1.05] | | 0.82 [†] (0.09) [0.65, 1.02] | 0.79 (0.15) [0.54, 1.15] |
| Unemployed | 1.15 (0.11) [0.95, 1.39] | | 1.15 (0.11) [0.95, 1.39] | 0.93 (0.15) [0.68, 1.27] |
| Schooling: ≥12th grade | 0.84 (0.10) [0.67, 1.06] | | 0.85 (0.10) [0.67, 1.06] | 0.67 [†] (0.15) [0.43, 1.04] |
| Documented | | 0.84 (0.10) [0.66, 1.06] | 0.92 (0.12) [0.71, 1.19] | 0.92 (0.12) [0.71, 1.19] |
| Year enrolled | | | 1.03* (0.02) [1.00, 1.06] | 1.03 [†] (0.02) [1.00, 1.06] |
| Interaction: Schooling X Private health insurance | | | | 0.94 (0.21) [0.61, 1.45] |

Table 4 (continued)

| | Model 6 | Model 7 | Model 8 | Model 9 |
|---|-----------------------------------|-----------------------------------|-----------------------------------|---|
| Interaction: Schooling X Unemployed | | | | 1.50 [†] (0.32) [0.98, 2.28] |
| Interaction: Unemployed X Private health insurance | | | | 1.08 (0.22) [0.72, 1.62] |
| Constant | 0.23*** (0.05) [0.14, 0.36] | 0.23*** (0.05) [0.15, 0.35] | 0.20*** (0.05) [0.12, 0.34] | 0.24*** (0.07) [0.14, 0.41] |
| <i>N</i> | 3096 | 3096 | 3096 | 3096 |
| Average RVI | 0.05 | 0.04 | 0.05 | 0.06 |
| Largest FMI | 0.14 | 0.14 | 0.15 | 0.15 |
| <i>F</i> statistic | 19.8*** | 25.4*** | 17.44*** | 14.52*** |

Standard errors in parentheses; 95 % confidence intervals in brackets

RVI relative increase in variance, *FMI* fraction of missing information

[†] $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

adjusting to a new culture. For African-American mothers, this variable has no effect on their risk of postpartum depression.

Model 8 adds year of enrollment to the variables in models 6 and 7. Year of enrollment is statistically significant (OR = 1.03, $p < .05$), however, it does not explain the higher risk of postpartum depression among African-American mothers; the coefficient only slightly changes and remains statistically significant (OR = 1.56, $p < .05$).

Finally, in Model 9, we evaluate the interaction of the socioeconomic variables: education, unemployment, and private health insurance. The results indicate that an interaction between schooling and unemployment is the only interaction that is statistically significant, but only marginally (OR = 1.50, $p < .10$). Those mothers with at least 12 years of schooling and who are unemployed are 50 % more likely to be at risk of postpartum depression relative to those mothers who are not. However, there is no significant effect on the risk of postpartum depression for African-Americans. Thus, as in model 6, the socioeconomic variables do not explain the higher risk of postpartum depression among African-Americans.

These results suggest that there are important differences and similarities as to what explains the association between race-ethnicity and the risk of postpartum depression. Documented status, which may be a proxy for acculturative stress, private health insurance, unemployment, and education, help explain the higher risk of postpartum depression for Latina mothers. For African-American mothers, community of residence, while not statistically significant, appears to mediate the risk of postpartum depression by a slight to moderate level, as the risk of postpartum depression remains significantly higher for

African-American mothers. This suggests that the higher risk of postpartum depression among Latinas as compared to whites, is due, in part, to these socioeconomic and community characteristics. On the other hand, this is not the case for African-American mothers, suggesting that there may be other factors that are unaccounted for in this model.

Discussion and Conclusion

Studies investigating racial and ethnic health disparities in postpartum depression show mixed results. These include findings that African-American and Latina mothers have higher rates of postpartum depression as compared to white mothers. While some studies find lower rates of postpartum depression among these groups, still, others find no differences once controlling for important covariates. In this study of healthy start participants in Pennsylvania, we found that African-American and Latina mothers were significantly more likely to be at risk of postpartum depression than white mothers. We also found that socioeconomic factors serve to mediate the risk of postpartum depression for Latina mothers. Living in a predominantly racial and ethnic minority community, being unemployed, having less than 12 years of schooling, and having private health insurance are important factors in explaining the higher risks of postpartum depression for Latina mothers compared to white mothers. The psychological well-being of mothers who live in impoverished communities with limited social resources is burdensome and stressful, especially for mothers with newborns [46, 53, 54]. Acculturative stress, as measured by immigrant status, appears to explain the higher risk of postpartum depression, perhaps

due to language barriers and adjustment to a new culture and environment in the USA that may be perceived as unwelcoming and discriminatory for Latino immigrants.

However, these variables did not mediate the risk of postpartum depression for African-American mothers. After controlling for unemployment, education, private health insurance, and community of residence, the odds of African-American mothers being at risk of postpartum depression was reduced; nevertheless, this group's risk of postpartum depression remained significantly higher than that of whites. This suggests that, although both African-Americans and Latinas in the general population share similar socioeconomic and demographic characteristics, this study population may experience different exposures to social and environmental risks and protective factors for postpartum depression. In particular, Latinas in this study are largely immigrant (73 %), with very low levels of education (58 % have 9 years of schooling or less), and a much lower usage and access to public assistance (8 %).

These results are consistent with other studies showing socioeconomic status mediating the risk of postpartum depression [32, 35, 55, 56]. However, in this case, socioeconomic risk factors, along with the community variable, affect each group differently. While the socioeconomic and community variables do not mediate postpartum depression differentials for African-Americans, they do mediate the risk of postpartum depression for Latinas. Furthermore, immigration status, independent of the socioeconomic and community variables, also explains the higher risk of postpartum depression for Latinas.

Limitations of this study include the omission of behavioral risk factors such as smoking, alcohol and substance abuse, detailed pregnancy history and birth outcomes, maternal and family health history, emotional support, and other stressors in the mother's life. Such factors have been found to be important in predicting postpartum depression [1, 2, 3]. We also do not include a measure of perceived racial discrimination by which low-income, racial-ethnic mothers are especially vulnerable. Perceived racial discrimination has been hypothesized to have deleterious effects on maternal health especially among low socioeconomic status populations. There is a need to acquire measures of discrimination for determining its effect on maternal stress, health, and well-being particularly within this racial and ethnic demographic [46, 55, 57, 58].

Implications

Researchers who study Latino maternal and infant health have found that length of duration in the USA has a deleterious effect on birth outcomes for Latino immigrants, both between and within generations [59–62]. Thus, longitudinal studies of Latina immigrant mothers' mental health could address

underlying mechanisms and processes related to immigration and acculturation that increase this groups' risk of postpartum depression. The implications of this work along with previous research calls for postpartum depression to be recognized as a serious public health concern because of its impact on mothers, families, and communities well beyond the condition itself.

Future Research

Based on the above implications, we offer several recommendations for future research. First, we recommend that social environment be further examined with specific attention to the interplay between social, cultural, and environmental influences in precipitating and contributing to risk of postpartum depression among racial-ethnic, low-income mothers. Second, the separate effect of immigration status on the risk of postpartum depression for Latina mothers require further study on the impact of immigration and acculturation on maternal mental health. Finally, further study of postpartum depression among African-Americans living in rural, small town, and small city exurbs and socioeconomically heterogeneous regions is paramount to understanding how this condition affects racial and ethnic mothers across demographic regions. Mothers' experiences with living in more isolated rural areas of the country may be significantly different than mother's experiences residing in racial and ethnically homogeneous communities, large urban centers, or heterogeneous metropolitan regions of the USA.

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Compliance with Ethical Standards

Conflicts of Interest The authors declare that they have no conflict of interest.

Research Involving Human Participants This study was approved by the West Chester University of Pennsylvania Institutional Review Board.

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