Polycystic ovary syndrome and postpartum depression among Hispanics and non-Hispanics: a population-based study

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BACKGROUND: Women with polycystic ovary syndrome experience increased health complications during and after pregnancy, including a higher prevalence of postpartum depression. Although previous research has found that Hispanic women with polycystic ovary syndrome experience heightened hyperandrogenism and metabolic effects compared with non-Hispanic women, it is unknown whether they experience other polycystic ovary syndrome–related comorbidities, such as postpartum depression, to a greater degree than their non-Hispanic counterparts.

OBJECTIVE: This study aimed to determine the associations among a self-reported prepregnancy diagnosis of polycystic ovary syndrome, polycystic ovary syndrome symptoms (irregular menstruation, hirsutism, and acne), and postpartum depression among a national sample of at-risk women and evaluated the potential effect modification by Hispanic ethnicity.

STUDY DESIGN: The study population included 52,267 postpartum (2–6 months) women who completed the US Pregnancy Risk Assessment Monitoring System Phase 8 questionnaire (2016–2018). Data from US states that captured self-reported polycystic ovary syndrome symptoms in the 3 months before pregnancy (n=17 states) were used. Moreover, we performed a subanalysis restricted to data from the Utah Pregnancy Risk Assessment Monitoring System Phase 8 questionnaire (2016–2019; n=5814), as it was the only state that considered self-reported polycystic ovary syndrome symptoms during this period. Postpartum depressed mood and anhedonia, the postpartum depression outcome measurements, were assessed via the following questions, respectively: (1) “Since your new baby was born, how often have you felt down, depressed, or hopeless?” and (2) “Since your new baby was born, how often have you had little interest or little pleasure in doing things you usually enjoyed?” In addition, postpartum depressed mood and anhedonia were assessed separately and as a combined variable. Here, weighted adjusted prevalence ratios and 95% confidence intervals were used to assess the association between polycystic ovary syndrome and postpartum depressed mood and anhedonia among Hispanic women and non-Hispanic women while taking into account preconception sociodemographics, lifestyle, and health history confounding factors.

RESULTS: The national study population was composed of 16.8% of Hispanic ethnicity, with 11.4% Hispanic women and 17.1% non-Hispanic women reporting prepregnancy polycystic ovary syndrome symptoms. The study found no association between women reporting prepregnancy polycystic ovary syndrome vs women without polycystic ovary syndrome and the prevalence of postpartum depressed mood and/or anhedonia. Moreover, the results were null when we stratified by Hispanic ethnicity. The Utah study population was composed of 15.5% of women of Hispanic ethnicity, with 5.8% of Hispanic women and 7.4% of non-Hispanic women reporting prepregnancy polycystic ovary syndrome. Symptom-based polycystic ovary syndrome (having irregular menstruation with hirsutism or irregular menstruation with acne), compared with having regular menstruation in the Utah sample, was associated with a 1.54 higher adjusted prevalence ratio (95% confidence interval, 1.14–2.09) for postpartum depressed mood and anhedonia. Stratified analyses by ethnicity indicated a 2- to 5-fold higher prevalence of postpartum depression with symptom-based polycystic ovary syndrome for Hispanic women and a 1.5-fold higher prevalence for non-Hispanic women.
Introduction
Polycystic ovary syndrome (PCOS) is the most common endocrine disorder among women of reproductive age, affecting 8% to 13% of all women worldwide and 15% to 20% of women seeking pregnancy.1-4 In the United States alone, it is estimated that PCOS affects approximately 5 million women of reproductive age, resulting in almost $4 billion yearly in direct medical costs.5 Much of the existing literature on PCOS has focused primarily on reproductive effects. An estimated 70% to 80% of women with PCOS have treatable infertility.6 Even after successful conception, women with PCOS experience higher pregnancy complications, including miscarriage, preterm birth, gestational diabetes mellitus, preeclampsia, and other hypertensive disorders than the general population.7 Outside of pregnancy, women with PCOS vs women without PCOS are known to be more likely to suffer from depression (27.3% vs 18.8%) and anxiety (50% vs 39.2%)8; and a history of depression is one of the most substantial risk factors for postpartum depression (PPD) in various international communities.9-11 Although prepregnancy depression predicting PPD is well established, limited research has assessed the relationship between PCOS and PPD among certain demographic groups known to experience greater severity of PCOS symptoms.12 Hispanic women, in particular, are a population in need of further investigation, as previous research has found that Hispanic women with PCOS have the most severe phenotype for both hyperandrogenism and metabolic effects.12,13 This results in Hispanic women not only experiencing a higher prevalence of hirsutism and acne but also having a higher tendency to be more insulin resistant,12-14 a higher proportion of abnormal fasting insulin and glucose levels, and a higher prevalence of metabolic syndrome than non-Hispanic Whites and non-Hispanic Blacks with PCOS.12,13

We sought to address the current research gap by (1) evaluating the associations among a self-reported prepregnancy diagnosis of PCOS, PCOS symptoms (irregular menstruation, hirsutism, and acne), and PPD among a national sample of at-risk women and (2) evaluating potential effect modification by Hispanic ethnicity.

Materials and Methods

Study participants and questionnaire
National Pregnancy Risk Assessment Monitoring System. We used data from the US national Pregnancy Risk Assessment Monitoring System (PRAMS) Phase 8 questionnaire (2016–2018). PRAMS is conducted by the Center for Disease Control and Prevention in conjunction with state health departments. A detailed description of the PRAMS surveillance system methodology and protocols can be found elsewhere.15,16 Stratification variables vary by state and may include Medicaid status, birthweight, maternal race and ethnicity, geographic area, and smoking status. Each participating site draws a stratified random sample of 100 to 250 new mothers (2–6 months after delivery) every month from a frame of eligible birth certificates. New mothers are contacted via mailed questionnaire (available in English and Spanish) multiple times and telephone follow-up. An informed consent document is included within each survey packet. Consent is implied if the survey is completed.15,16 Of note, 17 participating states (AK, CT, DE, HI, MD, ME, MI, MO, NJ, NY, OK, PA, UT, WI, WV, and Puerto Rico) included questions on the

CONCLUSION: In this US population-based study, a self-reported prepregnancy diagnosis of polycystic ovary syndrome was not associated with postpartum depression. However, self-reported polycystic ovary syndrome symptoms, including irregular menstruation and acne and/or hirsutism, were associated with a higher probability of postpartum depression, most prominently for Hispanic women. Our findings suggested that capturing polycystic ovary syndrome symptoms among at-risk women may be important for identifying associations with postpartum depression and potentially other comorbidities.

Keywords: depression, Hispanic women, polycystic ovary syndrome, postpartum depression, pregnancy, Pregnancy Risk Assessment Monitoring System
prepregnancy diagnosis of PCOS and postpartum depressive mood and anhedonia. A total of 52,267 women, reflecting an estimated population of 2,586,406 women, completed the PRAMS questionnaires 2016–2018 and were included in the current study.

Utah Pregnancy Risk Assessment Monitoring System. We performed a subanalysis on the Utah PRAMS data as Utah is the only PRAMS-participating state in 2016–2019, among those noted that also included self-reported PCOS symptoms. A total of 5814 women, reflecting an estimated population of 188,770 women, completed the Utah PRAMS Phase 8 from 2016 to 2019 and were included in the current study.

Exposure: polycystic ovary syndrome

National Pregnancy Risk Assessment Monitoring System. For the national survey, the assessment of self-reported prepregnancy PCOS was based on responses to the following question: “During the 3 months before you got pregnant with your new baby, did you have any of the following health conditions?,” including “PCOS” with “yes” or “no” response options.

Utah Pregnancy Risk Assessment Monitoring System. In addition to the same PCOS question asked in all states, the Utah survey included the following questions: (1) “Have you ever been told that you have polycystic ovarian syndrome or PCOS by a doctor, nurse, or other healthcare workers?” with “yes,” “no,” or “I do not know” response options (clinically diagnosed PCOS), (2) “Have you ever experienced any of the following health problems?” — with the following choices—“irregular periods (menstruation);” “skin condition that causes pimples (acne);” “increased hair growth on the face, chest, or other parts of the body (hirsutism);” and “being overweight or obese” with “yes” or “no” response options (symptom-based PCOS). In our analysis, PCOS symptomology was primarily defined as having at least 2 symptoms: irregular periods and hirsutism or irregular periods and acne. A secondary analysis defined PCOS symptomology as having all 3 symptoms: irregular periods, acne, and hirsutism.17,18 The reference group was women with regular menstruation.

Outcomes: postpartum depressed mood and anhedonia

PPD was defined as having answered “always” or “often” to either of the following 2 questions that captured PPD or a postpartum depressed mood and anhedonia: (1) “Since your new baby was born, how often have you felt down, depressed, or hopeless?” and (2) “Since your new baby was born, how often have you had little interest or little pleasure in doing things you usually enjoyed?” PPD variables were created for those who had both postpartum depressed mood and anhedonia and either postpartum depressed mood or anhedonia.

Covariates

Variables obtained from the linked birth certificates included maternal age, race and ethnicity, education, and marital status. Maternal age included 7 categories (≤17, 18–19, 20–24, 25–29, 30–34, 35–39, and ≥40 years). Maternal education included 5 categories (0–8, 9–11, 12, 13–15, and ≥16 years). Race was dichotomized to White or non-White, ethnicity to Hispanic or non-Hispanic, and marital status to ever married (yes or no).

Variables obtained from the PRAMS questionnaire included prepregnancy body mass index (BMI), depression, high blood pressure, type 1 or 2 diabetes mellitus, and smoking or drinking alcohol. Women were asked their current height and weight right before pregnancy, which was converted to BMI (kg/m²) and assessed continuously and categorically (underweight, <18.5; normal, 18.5–24.9; overweight, 25.0–29.9; obese, ≥30.0). In addition, women were asked in the 3 months before getting pregnant whether they had any of the following health conditions (yes or no): depression, high blood pressure, or type 1 or 2 diabetes mellitus. Moreover, women were asked whether they had smoked or drank alcohol in the past 2 years (yes or no).

Statistical analysis

Descriptive analyses were used to explore the characteristics of the study population by prepregnancy PCOS status. Moreover, we also compared prepregnancy PCOS vs clinically diagnosed PCOS vs symptom-based PCOS reporting via percent agreement and kappa statistics for the Utah sample. Relationships among PCOS, postpartum depressed mood, and anhedonia were assessed using robust Poisson distribution models to generate prevalence ratios (PRs) and 95% confidence intervals (CIs).

We reported unadjusted and adjusted models. Key confounders were selected on the basis of previous knowledge as documented in the literature.9,19,20 They included age, race, Hispanic ethnicity, maternal education, prepregnancy BMI, depression before pregnancy, high blood pressure, drinking and smoking status in the last 2 years, and type 1 or 2 diabetes mellitus. The effect modification by Hispanic ethnicity was tested using interaction terms within Poisson models (with Wald chi-square test for significance), with stratified results presented. SAS software (version 9.4; SAS Institute, Cary, NC) and Stata (StataCorp, College Station, TX) were used for the analyses.

Ethics approval

The University of Utah Institutional Review Board classified this research as nonhuman subject research.

Results

Descriptive characteristics

National Pregnancy Risk Assessment Monitoring System. After removing 639 women (1.2%) who did not answer the question on prepregnancy PCOS, there were 51,628 women in our primary analyses representing an estimated population size of 2,553,730 women. Missing data for sociodemographic, health history, and lifestyle potential confounding factors were low (Table 1).

In the final weighted sample, 16.8% of women reported prepregnancy PCOS (11.4% for Hispanic women vs 17.1%
| Characteristics                              | Total N=51,628 | PCOS Yes n=3280 (6.3) | PCOS No n=48,348 (93.7) |
|---------------------------------------------|----------------|-----------------------|--------------------------|
| Maternal age group (y)                     |                |                       |                          |
| <17                                         | 1.1            | 0.4                   | 1.1                      |
| 18–19                                       | 2.9            | 1.8                   | 3.0                      |
| 20–24                                       | 17.7           | 11.2                  | 18.1                     |
| 25–29                                       | 29.3           | 30.1                  | 29.2                     |
| 30–34                                       | 30.1           | 34.5                  | 29.8                     |
| 35–39                                       | 15.4           | 17.7                  | 15.2                     |
| ≥40                                         | 3.5            | 4.3                   | 3.4                      |
| Prepregnancy BMI (kg/m²), mean(SE)          |                |                       |                          |
| <18                                         | 3.3            | 1.9                   | 3.4                      |
| 18–24                                       | 44.2           | 35.0                  | 44.8                     |
| 25–29                                       | 26.4           | 25.6                  | 26.5                     |
| ≥30                                         | 26.1           | 37.6                  | 25.3                     |
| Hispanic ethnicity                          | 16.8           | 11.4                  | 17.1                     |
| Race                                        |                |                       |                          |
| White                                       | 70.3           | 77.3                  | 69.8                     |
| Black                                       | 15.9           | 10.4                  | 16.2                     |
| Other                                       | 13.8           | 12.2                  | 14.0                     |
| Education level (y)                         |                |                       |                          |
| 0–8                                         | 3.1            | 0.8                   | 3.3                      |
| 9–11                                        | 8.7            | 4.4                   | 9.0                      |
| 12                                          | 24.1           | 18.8                  | 24.5                     |
| 13–15                                       | 26.5           | 30.0                  | 26.2                     |
| ≥16                                         | 37.9           | 46.2                  | 37.0                     |
| Married (%)                                 | 62.1           | 74.0                  | 61.3                     |
| Depression before pregnancy                 | 13.4           | 40.0                  | 11.7                     |
| High blood pressure before pregnancy        | 5.5            | 36.0                  | 3.4                      |
| Type 1 or 2 diabetes mellitus before pregnancy | 3.6           | 34.6                  | 1.5                      |
| Prenatal depression                         | 12.2           | 13.7                  | 12.1                     |
| Prenatal anxiety                            | 18.4           | 22.4                  | 18.1                     |
| Postpartum depressed mood                   | 6.3            | 6.9                   | 6.3                      |
| Postpartum anhedonia                        | 10.0           | 9.9                   | 10.0                     |
| Postpartum depressed mood and anhedonia     | 3.3            | 3.7                   | 3.3                      |
| Mother consumed alcohol in the past 2 y      | 65.8           | 71.8                  | 65.4                     |
| Mother smoked in the past 2 y               | 19.9           | 20.5                  | 19.8                     |

Data are presented as weighted percentages, unless otherwise specified. Missing frequencies for characteristics among women who are not missing PCOS (N=51,628): age=0 (0%); BMI=1193 (2.6%); Hispanic ethnicity=244 (0.5%); race=0 (0%); education=430 (0.6%); married=51 (0.6%); depression before pregnancy=110 (0.2%); high blood pressure before pregnancy=94 (0.2%); prenatal depression=911 (1.8%); prenatal anxiety=36,945 (36,452 [79.8%] women from state that did not ask about prenatal anxiety and 222 [0.3%] women from state that did ask but participant left blank); postpartum depressed mood=1375 (2.3%); postpartum anhedonia=1369 (2.4%); postpartum depressed mood and anhedonia=1669 (2.9%); postpartum depressed mood or anhedonia=1591 (2.9%); consumed alcoholic drinks in the last 2 years=852 (1.5%); smoked cigarettes in the last 2 years=733 (1.3%); type 1 or 2 diabetes mellitus=209 (0.5%); and gestational diabetes mellitus=747 (1.5%).

BMI, body mass index; PCOS, polycystic ovary syndrome; SE, standard error.

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non-Hispanic women). Women with prepregnancy PCOS vs women without prepregnancy PCOS were more likely to be older, have higher BMI, be White and non-Hispanic, obtain higher education, and be married (Table 1). Moreover, women with PCOS had a higher prevalence of prepregnancy depression, high blood pressure, and type 1 or 2 diabetes mellitus than women without PCOS.

Regarding PPD in the national sample, 6.3% of women reported postpartum depressed mood, 10.0% of women reported anhedonia, 3.3% of women report postpartum depressed mood and anhedonia, and 13.0% of women reported postpartum depressed mood or anhedonia.

Utah Pregnancy Risk Assessment Monitoring System. After the removal of 94 women who did not answer the question on prepregnancy PCOS, there were 5720 women included in the analysis representing 185,925 women. The prevalence of prepregnancy PCOS was 7.1% overall (6.7% for Hispanic women vs 8.2% for non-Hispanic women). When considering symptom-based PCOS, 24.4% of women had 2 symptoms (irregular periods and hirsutism or irregular periods and acne), and 6.7% of women had all 3 symptoms (irregular period, hirsutism, and acne). Hispanic women had a slightly higher prevalence of irregular menstruation and a lower prevalence of acne and hirsutism (Figure 1) than non-Hispanic women. PCOS symptomology between Hispanic women and non-Hispanic women for 2 (25.0% vs 22.6%) and 3 (7.0% vs 4.9%) symptoms were similar (Figure 2).

Regarding PPD in the Utah sample, 9.6% of women reported postpartum depressed mood, 10.4% of women reported anhedonia, 5.1% of women reported postpartum depressed mood and anhedonia, and 15.0% of women reported postpartum depressed mood or anhedonia.

Utah Pregnancy Risk Assessment Monitoring System: agreement between prepregnancy polycystic ovary syndrome, clinically diagnosed polycystic ovary syndrome, symptom-based polycystic ovary syndrome

Within the Utah sample, 60.6% and 27.6% of women with prepregnancy PCOS had 2 and 3 symptoms, respectively. 

**FIGURE 1**
Polycystic ovary syndrome symptoms by ethnicity: UT-PRAMS (2016–2019)

**FIGURE 2**
Polycystic ovary syndrome symptoms by symptomology: UT-PRAMS (2016–2019)
PCOS reported 2 or all 3 symptoms, respectively, compared with 4.6% and 2.1% of women without prepregnancy PCOS (Figure 3). The agreement was fair with $\kappa=0.20$ (95% CI, 0.17−0.22) for 2 symptoms and $\kappa=0.24$ (95% CI, 0.20−0.29) for all 3 symptoms. Within the Utah sample, 60.9% and 27.3% of women with clinically diagnosed PCOS reported 2 or all 3 symptoms, respectively, compared with 4.6% and 2.1% of women without clinically diagnosed PCOS (Figure 4). The agreement was fair with $\kappa=0.22$ (95% CI, 0.19−0.25) for 2 symptoms and $\kappa=0.25$ (95% CI, 0.21−0.30) for all 3 symptoms. The agreement between women reporting
prepregnancy PCOS and clinically diagnosed PCOS was high, with 96% agreement (κ=0.73; 95% CI, 0.70–0.77).

**National Pregnancy Risk Assessment Monitoring System: clinically diagnosed polycystic ovary syndrome and postpartum depression**

In the unadjusted and adjusted models, we found no relationship between prepregnancy PCOS and postpartum depressed mood (adjusted PR [aPR], 0.84; 95% CI, 0.68–1.05), anhedonia (aPR, 0.91; 95% CI, 0.76–1.09), depressed mood and anhedonia (aPR, 0.82; 95% CI, 0.60–1.13) or depressed mood or anhedonia (aPR, 0.90; 95% CI, 0.77–1.05) (Table 2). We found no indication for effect modification by Hispanic ethnicity and prepregnancy PCOS for any PPD outcomes (all P> .49).

**Utah Pregnancy Risk Assessment Monitoring System: clinically diagnosed polycystic ovary syndrome, symptoms of polycystic ovary syndrome, and postpartum depression**

Unadjusted PRs and aPRs for prepregnancy PCOS were similarly null in the Utah PRAMS cohort compared with the national PRAMS cohort (Table 3). However, reporting having ever been told by a doctor, nurse, or healthcare worker of having PCOS (total) was associated with increased odds of postpartum depressed mood and anhedonia (aPR, 2.06; 95% CI, 1.35–3.15) compared with those reporting PCOS in 3 months before getting pregnant (aPR, 1.52; 95% CI, 0.97–2.41).

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### Table 2

| Variable                  | Postpartum depressed mood and anhedonia | Postpartum depressed mood or anhedonia | Postpartum depressed mood | Postpartum anhedonia |
|---------------------------|----------------------------------------|---------------------------------------|---------------------------|----------------------|
|                           | PR (95% CI)                            | PR (95% CI)                           | PR (95% CI)               | PR (95% CI)          |
| Total                     |                                        |                                       |                           |                      |
| Unadjusted                | 1.10 (0.86–1.40)                       | 1.02 (0.90–1.15)                      | 1.11 (0.94–1.32)          | 0.99 (0.86–1.15)     |
| Adjusted                  | 0.82 (0.60–1.13)                       | 0.90 (0.77–1.05)                      | 0.84 (0.68–1.05)          | 0.91 (0.76–1.09)     |

Models were adjusted for age, race, Hispanic ethnicity, maternal education, prepregnancy depression, body mass index, high blood pressure, type 1 or 2 diabetes mellitus, marital status, and ever smoked or consumed alcohol in the past 2 years.

CI, confidence interval; PR, prevalence ratio.

Fugal. Polycystic ovary syndrome and postpartum depression. Am J Obstet Gynecol Glob Rep 2022.

### Table 3

| Variable                  | Postpartum depressed mood and anhedonia | Postpartum depressed mood or anhedonia | Postpartum depressed mood | Postpartum anhedonia |
|---------------------------|----------------------------------------|---------------------------------------|---------------------------|----------------------|
|                           | PR (95% CI)                            | PR (95% CI)                           | PR (95% CI)               | PR (95% CI)          |
|                           |                                        |                                       |                           |                      |
| PCOS in 3 mo before getting pregnant (total) |                                        |                                       |                           |                      |
| Unadjusted                | 1.52 (0.97–2.41)                       | 1.06 (0.80–1.40)                      | 1.30 (0.93–1.81)          | 1.06 (0.74–1.51)     |
| Adjusted                  | 1.39 (0.74–2.64)                       | 1.05 (0.73–1.51)                      | 1.20 (0.78–1.86)          | 1.07 (0.67–1.72)     |
| Ever having been told by a doctor, nurse, or other healthcare worker of having PCOS (total) |                                        |                                       |                           |                      |
| Unadjusted                | 2.11 (1.44–3.10)                       | 1.30 (1.01–1.67)                      | 1.52 (1.13–2.05)          | 1.47 (1.10–1.99)     |
| Adjusted                  | 2.06 (1.35–3.15)                       | 1.40 (1.07–1.83)                      | 1.54 (1.12–2.12)          | 1.60 (1.16–2.22)     |

Models were adjusted for age, maternal education, prepregnancy body mass index, high blood pressure, type 1 or 2 diabetes mellitus, depression before pregnancy, and smoking and drinking status in the past 2 years. Of 5614 women, data are missing for the following: 97 for postpartum anhedonia, 113 for postpartum depressed mood, 129 for postpartum depressed mood and anhedonia, and 123 for postpartum depressed mood or anhedonia.

CI, confidence interval; PCOS, polycystic ovary syndrome; PR, prevalence ratio.

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worker of having PCOS was significantly associated with a higher adjusted prevalence for postpartum depressed mood (aPR, 2.06; 95% CI, 1.35–3.15), anhedonia (aPR, 1.40; 95% CI, 1.07–1.83), depressed mood and anhedonia (aPR, 1.54; 95% CI, 1.12–2.12), or depressed mood or anhedonia (aPR, 1.60; 95% CI, 1.16–2.22) (Table 3). Utah women reporting symptom-based PCOS (having irregular menstruation with hirsutism or irregular menstruation with acne), compared with those having regular menstruation, also had a higher prevalence of postpartum depressed mood (aPR, 1.27; 95% CI, 1.03–1.58) and depressed mood and anhedonia (aPR, 1.54; 95% CI, 1.14–2.09) (Table 4). The results were similar, but with wider CIs, for symptom-based PCOS defined as having all 3 symptoms (irregular menstruation, hirsutism, and acne) (Table 5). The effect modification by Hispanic ethnicity for the relationship between symptom-based PCOS and PPD was suggestive for all outcomes (all P < .20). We observed the most substantial effect modification for symptom-based PCOS, defined as having all 3 symptoms (Table 5), with Hispanic women having a 5-fold (95% CI, 1.41–17.42) higher adjusted prevalence of depressed mood and anhedonia compared with non-Hispanic women having a 1.4-fold (95% CI, 0.82–2.49) higher adjusted prevalence.

**Comment**

**Principal findings**

In this large US national sample, we found no relationship between self-reported prepregnancy PCOS and postpartum depressed mood and/or anhedonia when comparing Hispanic women with non-Hispanic women. In contrast, in a subanalysis within 1 state that asked additional questions on PCOS symptoms and ever being told of having PCOS by a healthcare worker, we found both to be associated with a 1.5- to 2-fold higher prevalence of PPD. Moreover, we observed that Hispanic women with PCOS symptoms are at higher risk of PPD than non-Hispanic women with PCOS symptoms. Finally, we found relatively poor agreement between women reporting a diagnosis of PCOS and women reporting PCOS symptoms.

Our findings suggested that women at higher risk of health problems, as per the PRAMS targeted sampling scheme, may experience consensus-based symptoms for PCOS, including menstrual irregularity and hyperandrogenism, but never receive a formal diagnosis of PCOS. In addition, women with PCOS symptoms, notably Hispanic women with PCOS symptoms, may be at increased risk of PPD even after accounting for several prepregnancy sociodemographic, lifestyle, and health history factors. Future population-based research wishing to assess comorbidities associated with PCOS should consider expanding PCOS classification beyond a clinical diagnosis to include symptom reporting by participants.

**Clinical implications**

Previous systematic reviews and meta-analyses have well documented that women with PCOS are 3 times more likely to experience depression and anxiety than women without PCOS. Hypothesized explanations for the increased depression risk among women with PCOS are multifactorial. They include hormonal (eg, increased circulating testosterone), chemical (eg, lowered serotonin), and metabolic

**TABLE 4**

Unadjusted and adjusted prevalence ratios (95% confidence intervals) on the relationship between PCOS and postpartum depressed mood and anhedonia for 2-symptom polycystic ovary syndrome from the Utah Pregnancy Risk Assessment Monitoring System 2016–2019.

| Variable      | Postpartum depressed mood and anhedonia | Postpartum depressed mood or anhedonia | Postpartum depressed mood | Postpartum anhedonia |
|---------------|-----------------------------------------|----------------------------------------|---------------------------|----------------------|
| **Overall**   |                                         |                                        |                           |                      |
| Unadjusted    | 1.77 (1.32–2.36)                         | 1.14 (0.95–1.36)                       | 1.46 (1.18–1.80)          | 1.14 (0.92–1.40)     |
| Adjusted      | 1.54 (1.14–2.09)                         | 1.06 (0.89–1.27)                       | 1.27 (1.03–1.58)          | 1.09 (0.88–1.36)     |
| **Hispanics** |                                         |                                        |                           |                      |
| Unadjusted    | 1.99 (0.85–4.65)                         | 1.13 (0.72–2.77)                       | 1.47 (0.79–2.76)          | 1.13 (0.66–1.92)     |
| Adjusted      | 2.33 (1.06–5.37)                         | 1.21 (0.77–1.90)                       | 1.73 (0.97–3.09)          | 1.15 (0.66–2.03)     |
| **Non-Hispanics** |                                        |                                        |                           |                      |
| Unadjusted    | 1.73 (1.27–2.36)                         | 1.14 (0.95–1.38)                       | 1.45 (1.16–1.82)          | 1.14 (0.90–1.44)     |
| Adjusted      | 1.50 (1.09–2.06)                         | 1.06 (0.87–1.28)                       | 1.25 (0.99–1.58)          | 1.09 (0.86–1.38)     |

Models were adjusted for age, race, Hispanic ethnicity, maternal education, prepregnancy depression, body mass index, high blood pressure, type 1 or 2 diabetes mellitus, marital status, and ever smoked or consumed alcohol in the past 2 years. The reference for no PCOS was report of regular menstruation.

CI, confidence interval; PCOS, polycystic ovary syndrome; PR, prevalence ratio.

Fugl. Polycystic ovary syndrome and postpartum depression. Am J Obstet Gynecol Glob Rep 2022.
TABLE 5
Unadjusted and adjusted prevalence ratios (95% confidence intervals) on the relationship between polycystic ovary syndrome and postpartum depressed mood and anhedonia for 3-symptom polycystic ovary syndrome from Utah Pregnancy Risk Assessment Monitoring System 2016—2019

| Variable                      | Postpartum depressed mood and anhedonia | Postpartum depressed mood or anhedonia | Postpartum depressed mood | Postpartum anhedonia |
|-------------------------------|----------------------------------------|----------------------------------------|----------------------------|----------------------|
| Overall                       |                                        |                                        |                            |                      |
| Unadjusted                    | 1.73 (1.07—2.78)                       | 1.09 (0.81—1.48)                      | 1.11 (0.76—1.64)          | 1.38 (0.98—1.94)     |
| Adjusted                      | 1.62 (0.97—2.71)                       | 1.08 (0.78—1.51)                      | 1.04 (0.68—1.58)          | 1.42 (0.98—2.06)     |
| Hispanics                     |                                        |                                        |                            |                      |
| Unadjusted                    | 3.54 (0.98—12.81)                      | 1.86 (0.96—3.61)                      | 1.66 (0.57—4.87)          | 2.53 (1.24—5.18)     |
| Adjusted                      | 4.96 (1.41—17.42)                      | 2.39 (1.17—4.86)                      | 2.30 (0.76—6.98)          | 3.31 (1.58—6.95)     |
| Non-Hispanics                 |                                        |                                        |                            |                      |
| Unadjusted                    | 1.56 (0.94—2.61)                       | 1.00 (0.71—1.40)                      | 1.05 (0.69—1.59)          | 1.24 (0.84—1.82)     |
| Adjusted                      | 1.43 (0.82—2.49)                       | 0.95 (0.66—1.37)                      | 0.95 (0.60—1.50)          | 1.22 (0.80—1.85)     |

Models were adjusted for age, race, Hispanic ethnicity, maternal education, prepregnancy depression, body mass index, high blood pressure, type 1 or 2 diabetes mellitus, marital status, and ever smoked or consumed alcohol in the past 2 years.
CI, confidence interval; PR, prevalence ratio.

Fugul. Polycystic ovary syndrome and postpartum depression. Am J Obstet Gynecol Glob Rep 2022.

(eg, insulin resistance) imbalances in addition to clinical manifestations of the disease (eg, infertility, obesity, hirsutism, or acne). Although Hispanic women with PCOS are genetically more predisposed to develop insulin resistance than non-Hispanic Whites with PCOS, social determinants of health that lead to health disparities in access to care may also contribute to the disparity. Recent data showed that 19% of Hispanic women do not have health insurance, compared with 8% of non-Hispanic Whites. Moreover, Hispanic women face barriers to primary care access, including language barriers, immigration status, and transportation barriers to healthcare. Medical systems should be aware of the implications of diagnosing and treating individuals from different races and ethnicities, as diseases manifest in different populations in different ways and severity because of genetic makeup and social, environmental, and economic factors.

As there is no single biomarker for PCOS and no test to definitively diagnose PCOS, underdiagnosed PCOS among women with limited access to care, as our study suggests, is problematic as it impacts appropriate and timely interventions that can mitigate associated metabolic and cardiovascular disease risks. Previous research has reported that among a large international sample, it takes an average of 2 years and 3 different healthcare professionals before making a correct diagnosis of PCOS. Underrepresented minorities, especially in countries that lack universal healthcare, are likely to experience even longer delays in diagnosis and appropriate treatment. Additional research on diagnosis delay among underrepresented minorities and how capturing menstrual cycle information and PCOS symptoms by health workers can shorten the delay and lead to improved health outcomes is needed before targeted interventions are implemented.

Research implications
Although this study was conducted using US data, the results were still relevant to women outside the United States, as they may serve to increase discussions between women and their healthcare providers about the importance of menstrual health concerning overall health. Results from this study may also help researchers in other countries investigate risk differences in the relationship between PCOS and PPD among specific populations. For example, in a recent study, White women with PCOS had higher anxiety odds than Black women with PCOS but no difference in adjusted odds of depression. Similar research evaluating differences by Hispanic ethnicity and other race and ethnicity groups is warranted for tailored surveillance, screening, and treatments.

Strengths and limitations
The strengths of our study included the assessment of the relationship between clinical and symptom-based PCOS and PPD among Hispanic and non-Hispanic women. Another strength included the large representative sample of women from across the United States, purposively sampled to include women at greatest risk of pregnancy-related health problems, increasing generalizability.

Our study has important limitations in the context of its strengths. Because of being a cross-sectional study, the
data were vulnerable to recall bias. Compared with women without PPD, women with PPD may systematically differ in how they remember events or omit details in their answers. Another major limitation was that we could not infer causality between PPD and PCOS because of the cross-sectional nature of the data. Lastly, this study was limited in self-reporting data for PCOS symptoms (irregular menstruation, hirsutism, and inflammatory acne). Therefore, we created our indications for PCOS that should be validated against gold standard diagnoses. A clinical diagnosis of PCOS poses its limitation because of the lack of a biomarker and evolving diagnostic criteria. To diagnose women with PCOS, clinicians rely on 3 criteria, including the National Institutes of Health (NIH), Rotterdam 2003, and Androgen Excess-PCOS Society. The lack of a gold standard for the diagnosis of PCOS is problematic. Different criteria can lead to different disease prevalence, such as 9% for the NIH criteria and 18% for the Rotterdam consensus. Finally, we only looked at PCOS symptoms for 1 US state. Our results showed fewer PCOS symptoms for Hispanic women than non-Hispanic women, which contradicts the findings of a previous study. Whether this contradiction is owing to Hispanic women in Utah being nongeneralizable to Hispanic women in other states or simply owing to different assessment manners between studies is unclear and warrants further research.

**Conclusion**

In this US population-based study, a self-reported prepregnancy diagnosis of PCOS was not associated with PPD. However, self-reported PCOS symptoms, including irregular menstruation and acne and/or hirsutism, were associated with a higher probability of PPD, especially among Hispanic women. Our findings suggested that determining PCOS symptoms among at-risk women may be important for identifying associations with PPD and potentially other comorbidities.

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