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***Title***

**The association between anemia and postpartum depression in Bedouin mothers in southern Israel**

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**Abstract (up to 250 words)**

**Introduction:** Anemia and postpartum depression (PPD) are common morbidities during the perinatal period. Recognizing postpartum anemia as a major risk factor for PPD is crucial for postpartum maternal health. This study aimed to examine the association between anemia and PPD in indigenous Bedouin mothers in southern Israel who have higher rates of these conditions compared to other Israeli women.

**Methods:** A cross-sectional study that included 332 women aged 18 to 45 years who were 2-4 months postpartum during follow-up at two clinics from October 2017-July 2018. Postpartum anemia was measured based on hemoglobin levels <12 mg/dl collected from the women’s medical records. . PPD was measured by the Edinburgh Postnatal Depression Scale (EPDS) with a cutoff point ≥ 10 based on face-to-face interviews.

**Results**: PPD prevalence was 23.2% and 69% of mothers had anemia. Multivariate analysis showed that anemia was associated with nearly threefold increased risk of PPD (odds ratio, 95% CI= 2.8, add 95%CI here) while considering other risk factors (living in unrecognized villages, experiencing one or more miscarriages, , and being 1-2 months postpartum compared to 2-4 months postpartum.

 **Conclusions:** Our research suggests an association between anemia and PPD in Bedouin women in southern Israel. Women with anemia require closer monitoring for PPD and referral to treatment. Interventions for enhancing nutrition for perinatal women might help prevent anemia and reduce PPD risk.

**Keywords:** Anemia, postpartum depression, Edinburgh Postpartum Depression Scale, hemoglobin, Bedouin women, indigenous women.

For primary research articles, the maximum length up to 5000 words, 50 references, and 6 tables or figures. The word count refers to the main body of text, excluding the title page, abstract, references etc.

**Introduction**

**Postpartum depression (PPD) is** a significant public health concern with adverse implications for physical and mental health of mothers, their partners. mother-child relationships, and child developmental outcomes (Slomian et al., 2019; Kassier & Madlala, 2018; Ip et al., 2018; Badr et al., 2018). PPD is one of the most common non-obstetric complications associated with childbearing age or childbirth (Werner et al., 2015), affecting an estimated 14% (range 5%-26%) of mothers worldwide and varies by country, cultural background, and economic status (Liu et al., 2022; Anokye et al., 2018). The fifth DSM-5 Edition expanded the definition of PPD to include major depressive episodes with a perinatal onset as those beginning in either pregnancy or within the first four weeks postpartum (APA, 2013). PPD symptoms can range from mild to severe and might include feelings of sadness, hopelessness, or emptiness, sleep and appetite disturbance, impaired concentration, anhedonia, feelings of worthlessness or guilt, and anxiety (Bernstein et al., 2008; Fonseca et al., 2020).

Anemia during pregnancy and postpartum is also a serious public health issue as it affects almost half a billion women of reproductive age worldwide (WHO, 2014). Anemia is a medical condition characterized by a reduction in hemoglobin concentration below a certain threshold and can result from various factors, including micronutrient deficiencies, inherited hemoglobinopathies, chronic infection, parasitic infection and blood loss (WHO, 2023; Rubio-Álvarez et al., 2018). Although WHO's thresholds to define anemia across many populations are currently under review WHO, 2023), as of now, it is still defined as having a hemoglobin concentration of less than 12.0 g/L for non-pregnant and lactating women and less than 11.0 g/L for pregnant women (Garcia‐Casal et al., 2019; WHO, 2023). Half the cases are due to iron deficiency, iron is vital for the production of hemoglobin by erythroblasts. If the iron supply is inadequate, the hemoglobin production fails, and the number of red blood cells decreases (Tairo & Munyogwa, 2022) . Postpartum anemia is mainly caused by untreated antenatal iron deficiency and excessive blood loss during or after childbirth, and its prevalence in women after delivery remains unacceptably high in both developed (22–50%) and developing (50–80%) countries (Infante-Torres et al., 2018; Milman, 2012). Anemia is one of the significant symptoms that are often observed in women with PPD, anemia is an important concern because both conditions share common features, ranging from fatigue, weakness, dizziness, and shortness of breath to irritability (Weckmann et al., 2023 ; WHO, 2023).

Anemia impairs the health and well-being of women and increases the risk of maternal and neonatal adverse outcomes (Drukker et al., 2015). A recent meta-analysis showed that perinatal anemia significantly increases the risk of PPD (Azami et al., 2019). Iron deficiency can affect neurophysiological mechanisms, cognition, social behavior and over time, a diverse set of neuro-pathologies  (Ferreira et al., 2019). Studies found that consuming Iron supplement results in lower depression and stress in previously iron-deficient mothers (Balarajan et al., 2011; Mitra & Khoury, 2012).

Postpartum anemia can lead to cognitive challenges and emotional issues. Mood is strongly affected by brain iron levels, especially iron deficiency (Kim & Wessling-Resnick, 2014) . A review of the literature reported that eight of ten studies found a higher risk for PPD in women with anemia (Wassef et al., 2019). A recent study reported that mothers with iron deficiency were three times more likely to have PPD (Hameed et al., 2022).

Anemia in perinatal women is much more common in low and middle-income countries, reaching 60% of prevalence (Du et al., 2022). Moreover, women belonging to a minority or ethnic group can elevate the risk of anemia(Kang et al., 2021)**.** As for minority women, postpartum anemia can increase and posing a public health concern for women of reproductive age (Drukker et al., 2015; Mitra & Khoury, 2012). Ethnic minority women sometimes live in remote areas with low socioeconomic status, low education, and unique dietary habits. Moreover, some may lack the knowledge of prenatal healthcare (Zhang et al., 2017) . Ethnic minority background has been identified as a risk factor postpartum anemia (Bergmann et al., 2010; Bodnar et al., 2005). However, a study conducted on a Norwegian population-based cohort by (Næss-Andresen et al., 2022) found that the prevalence of postpartum anemia in minority groups was slightly lower than reported in the US (Miller, 2014).

Among Bedouin women in Israel, Anemia was higher than that in women in other population groups. A recent study reported that severe anemia (HB < 8 mg/dl) is more prevalent among Bedouin women compared to Jewish women in Israel (8.1% vs. 6.3%) (Treister-Goltzman et al., 2020). Several factors might explain the disparity in anemia rates between Bedouin and Jewish women in Israel, including socioeconomic challenges, limited access to health services in particular in unrecognized villages, and a lack of nutritional and anemia prevention awareness. Bedouin society is a unique social group within Arab minority in Israel and comprise 27.4% of the Negev region’s population (CBS, 2014). Most (60%) live in eight Bedouin towns, and the rest (40%) live in unrecognized villages. The standard of living among the Bedouin population, particularly those residing in the unrecognized villages, is considerably lower than the average standard of living in other areas in Israel. Bedouin local authorities mostly lack basic welfare, educational, and health services (Rudnitzky et al., 2012). Bedouin women's low socioeconomic resources were associated with the high prevalence of PPD (Alfayumi-Zeadna et al., 2022). The prevalence of PPD among Bedouin women was 31%, of which 19.1% were assessed as having moderate to severe symptoms (EPDS ≥ 13) (Alfayumi‐Zeadna et al., 2015). Despite the high PPD rates and high prevalence of postpartum anemia in Bedouin women, empirical evidence in these regards is mainly lacking. Recognizing postpartum anemia as a major risk factor for PPD is crucial for postpartum maternal health. Iron deficiency is the most common cause of maternal anemia because of insufficient maternal iron stores at conception, increased pregnancy‐related iron requirements, and iron losses due to blood loss during childbirth (Uduwana & Nemerofsky, 2023). Anemia is associated with PPD, fatigue, impaired cognition, impeding maternal‐infant bonding (Butwick & McDonnell, 2021). Additionally, Infants born to mothers with anemia are more vulnerable to anemia in the first year of life (Scholl, 2011), also mothers with anemia might have reduced iron levels in their breast milk, potentially leading to their babies receiving insufficient mineral content for optimal growth and development (Marin et al., 2012). It's important to emphasize that breastfeeding has many benefits for infants beyond just nutrition. It provides essential antibodies, promotes bonding, and offers protection against many illnesses. The recommendation for exclusive breastfeeding for the first six months of life is based on these myriad benefits (Kristiansen et al., 2023). This study aimed to examine the association between anemia and PPD in indigenous Bedouin mothers in southern Israel who have higher rates of these conditions than other Israeli women.

**Methods**

***Study design and*** ***Participants***

This cross-sectional study that includes a convenience sample of 332 women between 18 to 45 years of age who were recruited during their visits to women’s health clinics. Participants were individually interviewed 2-4 months postpartum as part of a larger cohort study (Alfayumi-Zeadna et al., 2022). Those excluded were younger than 18 years and unable to speak Arabic.

***Study Procedures and Data Collection***

Data collection was conducted in two women’s health clinics in southern Israel. Women were approached by a physician or nurse who requested their participation after providing a short description of the study. Those who agreed and met the inclusion criteria received written information in Arabic and signed a consent form.

Participants completed a structured questionnaire administered by a female nurse or trained research assistant in a separate clinic room. Clinical history and chart data were drawn from medical records.

***Study Measures***

***Dependent Variable:*** The Edinburgh Postnatal Depression Scale (EPDS) was used to measure PPD symptoms. We used the Arabic version of the EPDS (Cox et al., 1987; Ghubash, R. et al., 1997), which asks women to report the frequency of various depressive symptoms over the past week. This Arabic version of the EPDS has been widely used in the Middle East including Bedouin women in Israel (Alfayumi‐Zeadna et al., 2015; Ghubash, Rafia & Abou-Saleh, 1997). The EPDS is a 10-item self-report scale with the frequency of symptoms reported along a Likert scale ranging from *not at all* (0) to *yes, all the time* (3), with higher scores indicating a higher level of PPD symptoms. The total score ranges from 0 to 30, with higher scores indicating a higher likelihood of PPD. In this study, internal consistency of EPDS responses was in ideal parameters during pregnancy and postpartum (Cronbach’s α = 0.80). We used the EPDS score ≥ 10 are suggestive of clinically significant symptomology (Cox et al., 1987). Women with EPDS responses greater than 10 and all reporting thoughts of self-harm (item #10) were referred to the clinic nurse for more thorough assessment and treatment.

***Independent variables***

Anemia was estimated based on hemoglobin levels measured two to four months after delivery. Postpartum anemia is defined as a hemoglobin level below 12 g/dl WHO, 2023; Ruiz de Viñaspre‐Hernández et al., 2021). We used the dichotomous variable of anemia with cutoff 12 g/dl, and another variable with five categories (< 0.8 g/dl (*severe anemia*), 0.8-10.9 g/dl (*moderate anemia*), 11.0-11.9 g/dl (*mild anemia*), 12.0-13.0 g/dl, 13.10-15 gr/dl) WHO, 2023). For the data analysis, a dichotomous anemia variable was used.

**Sociodemographic Characteristics**

We asked women about their age (categories: 15–24, 25–34, and ≥ 35), residence type (recognized / unrecognized), number of children (0–1, 2–3, and ≥ 4).

**Socioeconomic Status**

Woman’s education ( non-academic/ academic degree), Woman’s employment status (currently employed/unemployed,), husband’s employment status (currently employed/unemployed), and family income (lower than monthly average (< ILS 15,149 /month), similar to, or higher than average.

**Reproductive Health Variables**

Women reported number of miscarriages a continuous variable (i.e., "How many miscarriages have you had in the past?"). The World Health Organization (WHO, 1977) defines miscarriage as the premature loss of a fetus up to 23 weeks of pregnancy and weighing up to 500 grams.

Planned pregnancy (yes/no),mode of delivery (spontaneous/ cesarian section), number of months postpartum, using iron supplements postpartum (yes/no), history of general depression (yes/no), and history of PPD (yes/no).

***Statistical Methods***

Data were analyzed using descriptive statistics to summarize the participants characteristics and the prevalence of PPD symptoms and anemia. A univariate analysis between independent variables and PPD using the chi-square test and t-test. In addition, a multivariate logistic regression analysis was conducted to examine the relationship between anemia and PPD symptoms, adjusting for potential confounding variables that were significantly (p < 0.05) associated with EPDS ≥ 10 in the univariate analysis. Two models were utilized: an unadjusted model (Model 1) and an adjusted model (Model 2) that included variables significantly associated with PPD in the univariate analysis. Odds ratios (OR) and 95% confidence intervals (CI) were calculated to estimate the strength of associations.

***Ethical considerations***

This study was approved by the Ethics Review Committees at Ben-Gurion University of the Negev (BGU) and Clalit Health Services (COM-004-16). Further ethical approval (COM-0107-21) was received for data collection from the participants' medical record (Alfayumi-Zeadna et al., 2022).

**Results**

Figure 1 shows that the prevalence of Anemia in the total study population of 332 Bedouin women in southern Israel based on their hemoglobin levels was 69.0%.

**31.0%**

**69.0%**

**Figure 1: Prevalence of Anemia (HB < 12) among total study sample (N = 332)**

Figure 2. shows the distribution of anemia level. Of the 332 women, 69% were found with anemia (had hemoglobin levels ≤ 12 g/l). 115 (34.6%) women were classified as having mild anemia (a level of hemoglobin concentrated between 11-11.9 g/l), 108 (32.5%) women were classified as having moderate anemia (hemoglobin levels between 8-10.9 g/l), and 6 (1.8%) women were classified having severe anemia (hemoglobin levels below 8 g/L). (Figure 3).

**Figure 2.** **Frequency distribution of anemia levels in study participants (N=332)**

Figure 3 shows that the prevalence of PPD symptoms (EPDS ≥ 10) in the total study population was 23.2%.

**Figure 3: Prevalence of PPD (EPDS ≥ 10) among total study sample (N = 332)**

Table 1 summarizes the study sample characteristics and their association with PPD, as measured by EPDS scores. Key findings include that half of participants (53.9%) were aged 25-34, with an average age of 28.5 (6.0) years and age range of 18-45. Many lived in unrecognized villages (26%) and had 1-3 children (45.5%). 76.6% had an education level of high school diploma or below. The majority of women were unemployed (82.8%), while their husbands were mostly employed (87.0%). Notably, 87.7% reported family incomes below the national average, indicating potential economic challenges. About a third did not plan their pregnancies, and most births were spontaneous (81.9%). 33.7% participants had experienced miscarriages, and only 47.3% took postpartum iron supplements. 9.6% had a history of general depression (9.6%), and a similar percentage reported a history of PPD (9.0%).

Results of univariate analysis indicate significant associations with PPD (EPDS ≥ 10). Women with anemia had a double rate (28.4%) of PPD compared to mothers without anemia (11.7%). Additionally, residence in unrecognized villages (p = 0.005) was associated with higher PPD rates. History of depression significantly increase PPD risk (around 40% vs. 21% without). Miscarriages showed a borderline relation (p = 0.053), with about a third of affected women reporting PPD, while several other variables, including age, education, employment, planned pregnancy, delivery mode, and postpartum iron intake, did not show significant PPD associations.

**Table 1: Characteristics of study sample and univariate associations between study characteristics and PPD (N=332)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Total Sample****N = 332** | **EPDS < 10****N=255 (76.8%)** | **EPDS ≥ 10****N=77 (23.2%)** | **P-Value**  |
|  | N (%) | N (%) | N (%) |  |
| **Anemia status** |  |  |  | <0.001 |
| HB ≥ 12 | 103 (31.0) | 91 (88.3) | 12 (11.7) |  |
| HB < 12 | 69 (229) | 164 (71.6) | 65 (28.4) |  |
| **Maternal Age (**Mean (SD), range) | 28.5 (6.0), 18-45 |  |  | 0.754 |
| 18-24 | 93 (28.0) | 73 (78.5) | 20 (21.5) |  |
| 25-34 | 179 (53.9) | 138 (77.1) | 41 (22.9) |  |
| 35-45 | 60 (18.1) | 44 (73.3) | 16 (26.7) |  |
| **Residence type**  |  |  |  | 0.005 |
| Recognized village | 244 (73.5) | 197 (80.7) | 47 (19.3) |  |
| Unrecognized village | 88 (26.5) | 58 (65.9) | 30 (34.1) |  |
| **Number of children** |  |  |  | 0.400 |
| 0 | 97 (29.2) | 76 (78.4) | 21 (21.6) |  |
| 1-3 | 151 (45.5) | 119 (78.8) | 32 (21.2) |  |
| 4-12  | 84 (25.3) | 60 (71.4) | 24 (28.6) |  |
| **Woman’s education**  |  |  |  | 0.581 |
| ≤ High school  | 252 (76.6) | 192 (76.2) | 60 (23.8) |  |
| > Secondary and highereducation | 77 (23.4) | 61 (58.4) | 16 (18.2) |  |
| **Woman's employment status** |  |  |  | 0.444 |
| Employed  | 57 (17.2) | 46 (80.7) | 11 (19.3) |  |
| Unemployed | 275 (82.8) | 209 (76.0) | 66 (24.0) |  |
| **Husband's employment status**  |  |  |  | 0.691 |
| Employed  | 289 (87.0) | 223 (77.2) | 66 (22.8) |  |
| Unemployed | 43 (13.0) | 32 (67.2) | 11 (25.6) |  |
| **Family income**  |  |  |  | 0.806 |
| Below the national average  | 291 (87.7) | 145 (76.3) | 45 (23.7) |  |
| Above/similar to the national average  | 41 (12.3) | 110 (77.5) | 32 (22.5) |  |
| **Number of Miscarriages**  |  |  |  | 0.053 |
| 0 | 220 (66.3) | 176 (80.0) | 44 (20.0) |  |
| ≥1 | 112 (33.7) | 79 (70.5) | 33 (29.5) |  |
| **Planned pregnancy**  |  |  |  | 0.071 |
| Yes | 206 (62.0) | 168 (80.0) | 42 (20.0) |  |
| No | 126 (38.0) | 87 (71.3) | 35 (28.7) |  |
| **Mode of delivery** |  |  |  | 0.757 |
| Spontaneous  | 272 (81.9) | 208 (76.5) | 64 (23.5) |  |
| Cesarean section | 60 (18.1) | 47 (78.3) | 13 (21.7) |  |
| **Number of months postpartum** |  |  |  | 0.044 |
| 2 months | 118 (35.5) | 83 (70.3) | 35 (29.7) |  |
| 3-4 months  | 207 (62.3) | 166 (80.2) | 41 (19.8) |  |
| **Using iron postpartum**  |  |  |  | 0.713 |
| Yes | 157 (47.3) | 122 (77.7) | 35 (22.3) |  |
| No | 175 (52.7) | 133 (76.0) | 42 (24.0) |  |
| **History of general depression** |  |  |  | 0.014 |
| No | 32 (9.6) | 236 (78.7) | 64 (21.3) |  |
| Yes | 300 (90.4) | 19 (59.4) | 13 (40.6) |  |
| **History of PPD** |  |  |  | 0.022 |
| No | 30 (9.0) | 237 (78.5) | 65 (21.5) |  |
| Yes  | 302 (91.0) | 18 (60.0) | 12 (40.0) |  |

Table 2 presents the results of a multivariate logistic regression model comparing women with EPDS scores ≥ 10 to women who scored lower than 10. All variables significantly associated with PPD (p-value < 0.01) in the bivariate analysis were included as independent variables in the multivariate analysis. Across both models, women with anemia have a substantially higher risk of PPD symptoms compared to those with HB of 12 or higher (i.e., without anemia). The odds ratios (OR) range from 2.8 to 3.0 (95%, confidence intervals (CI) = 1.4 – 5.7)., indicating that women who suffer from postpartum anemia are three times more at risk of developing PPD symptoms compared to women without anemia. Furthermore, the likelihood of experiencing PPD was found to be more than 2.1 times greater for women who live in unrecognized village (OR = 2.1, 95%, CI = 1.4–5.7), nearly twice greater for those who experienced one or more miscarriages (OR = 1.9, 95% CI = 1.0–3.4), and 1.8 times greater for those who were 2 months postpartum (OR = 1.8, 95% CI = 1.1–3.1), compared to those who 2-4 months postpartum.

**Table 2. Unadjusted and adjusted regression models for the association between anemia and PPD (EPDS ≥ 10) among the total study sample (N=332)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **\*Model 1** | **\*Model 3** |  |
| **Variables** | **OR (90% CI)** | **PV** | **OR (90% CI)** |  |
| **Anemia status** |  |  |  |  |
| HB ≥ 12 | 1 |  | 1 |  |
| HB < 12 | 3.0 (1.5-5.8)  | <0.001 | 2.8 (1.4 – 5.6) | 0.003 |
| **Residence type** |  |  |  |
| Recognized village | 1 |  |
| Unrecognized village | 2.1 (1.2-3.8)  | 0.010 |
| **Number of miscarriages** |  |  |
| 0 | 1 |  |
| ≥1 | 1.9 (1.0 – 3.3)  | 0.029 |
| **History of general depression** |  |  |
| No  | 1 |  |
| Yes  | 1.6 (0.6 – 3.7) | 0.309 |
| **History of PPD** |  |  |
| No  | 1 |  |
| Yes  | 2.1 (0.9 – 5.1) | 0.078 |
| **Number of months postpartum**  |  |  |
| 2 months | 1.8 (1.1 – 3.3)  | 0.026 |
| 3-4 months | 1 |  |

**Discussion**

The current study set out to examine the association between anemia and PPD in Bedouin mothers in southern Israel who have higher rates of these conditions than other Israeli women. The study found a 23.2% prevalence of PPD, and a rate of anemia of 69%. The results showed that anemia was significantly associated with increased risk of PPD. Mothers who have anemia had a nearly threefold increased risk of PPD. Other factors increasing PPD risk included living in unrecognized villages, experiencing one or more miscarriages, and being 2 months postpartum compared to 2-4 months.

In our study, 23.2% of women reported clinically elevated PPD symptoms 2-4 months after giving birth, indicating potential clinical symptomology. Previous research showed 31.1% of Bedouin women in southern Israel reported PPD symptoms (Alfayumi‐Zeadna et al., 2015). These findings are higher than the 19.0% to 20.8% observed among other Arab women in Israel (Shwartz et al., 2019) and the 10.3% to 11.9% among Jewish women (Shwartz et al., 2019; Glasser et al., 2016). A comprehensive systematic review and meta-analysis encompassing 33 studies revealed that PPD prevalence fluctuates by country, spanning 5% to 26% including developing countries which exhibit particularly high rates (Liu et al., 2022). PPD rates found in the current study are higher than the depression rates reported in global studies which indicate that the global prevalence of PPD of 17.22% in the world's population (Wang et al., 2021). The rate of PPD in minority women is higher (approximately 24%) in the US (Lau & Adams, 2023), in women in southwest minority areas in China the total prevalence of PPD (score > 12) was 16.46%, and that of mild PPD (9-12 score) was 22.03% (Qin et al., 2022). Another study examined prevalence of PPD (EPDS ≥ 10) among mothers in Canada, women from minority populations (e.g., immigrant and Indigenous) the prevalence was significantly higher (12.2% and 11.1%, respectively) compared to Canadian-born non-Indigenous mothers (5.6%) (Daoud et al., 2019).

The main goal of the current study is to examine the association between anemia (Hemoglobin < 12) and PPD in Bedouin mothers, two to four months after birth. The findings indicated that the anemia rate among the participants was about 69% (had hemoglobin levels < 12 g/l). Of these, 34.6% had mild anemia, 32.5% moderate anemia and 1.8% sever. Similar to our findings, a study conducted among women in the US reported a higher prevalence of anemia (48%), among women from minority groups, compared to 27% among women not belonging to ethnic minority groups (Mitra & Khoury, 2012). Another study that discusses the multiple causes of anemia among women of reproductive age, which examined explanatory pathways for anemia, found that low socio-economic status and belonging to an ethnic minority group are directly related to postpartum anemia (Nguyen et al., 2015).

We found an association between low hemoglobin and PPD, the findings indicated that anemia is a risk factor for PPD, women with postpartum anemia were 2.7 times more likely to experience PPD symptoms than those without anemia. To our knowledge, this is the first study in Israel, specifically among Bedouin mothers, examining the association between postpartum anemia and PPD. To date, two studies have been conducted in Israel to examine the prevalence of anemia among women in general (including both Arab and Jewish populations), without specifically targeting postpartum anemia.(Treister-Goltzman et al., 2020; Treister-Goltzman et al., 2015). A recent meta-analysis showed that postpartum anemia is significantly increases PPD risk (Azami et al., 2019; Maeda et al., 2020). In addition, several studies worldwide have explored the association between anemia and PPD among women from minority and low-income groups (Mitra & Khoury, 2012; Nguyen et al., 2015; Balarajan et al., 2011). Xu et al. (2018) reported that women with anemia were more likely to be admitted to hospital for depression than those without. Interventions needed to emphasize the importance of a well-balanced diet rich in iron and other essential nutrients during pregnancy and the postpartum period. Good dietary sources of iron and Iron supplementation should be combined with other appropriate interventions, such as emotional support, counseling, and lifestyle adjustments.

This study also suggests that women who have experienced a miscarriage may be at an increased risk of developing PPD. About a third of women who had miscarriages reported PPD symptoms compared to 20% of women who had never had a miscarriage and nearly twice greater for those who experienced one or more miscarriages. Miscarriage can be a traumatic event for many women, both physically and emotionally. Similar findings were obtained in studies conducted among women in Israel. A positive correlation was found between EPDS score and number of spontaneous abortions and elective pregnancy terminations (Soltsman et al., 2021) . Also, in women from other countries, for example a recent study conducted in Kenia reported that pregnancy loss was 5-fold higher among large cohort of perinatal women with moderate to severe depression (Larsen et al., 2023).

Another important finding related to the number of months after birth, The postpartum period is typically defined as the time immediately after childbirth to the following year. However, the onset and duration of PPD symptoms can vary among women (APA, 2013). Our study shows that the point in time when a mother is assessed can influence PPD rates, mothers who were 2 months postpartum had a higher rate of PPD (29.7%) compared to those 3-4 months postpartum (19.8%). Furthermore, the likelihood of experiencing PPD was found to be more than 1.8 times greater for those who were two months postpartum compared to those who 3-4 months postpartum. Other studies also reported a high prevalence of PPD during the 2-3 months after birth. For example, in a previous study reported an average prevalence of about 16.7% of PPD was reported during the first three months postpartum (O'Hara & McCabe, 2013). A possible explanation for this finding refers to the combination of other factors that influence this report, in particular social support. Social support has been described in many studies as having a positive effect on mother’s mental health (Alfayumi-Zeadna et al., 2022); (Ayoub et al., 2020) and these findings also emphasize the need for screening at this critical time.

Another finding from this study related to PPD is residence type. women from unrecognized villages had a higher rate (34.1%) of PPD compared to those from recognized villages (19.3%). The likelihood of experiencing PPD was found to be more than 2.1 times greater for women who live in unrecognized village. This significant difference suggests that place of residence, which reflecting socio-economic and structural factors, is significantly associated with PPD. A study that examined general depression in Bedouin women in southern Israel reported a higher prevalence of deprissive symptoms among women who live in unrecognized villages compared to women who live in recognized villages (57.9% and 41.9% respectively) (Daoud & Jabareen, 2014). The results of this study align with global research showing that women in rural areas have a higher risk of PPD compared to those in urban areas (Azad et al., 2019; Ross et al., 2011). The higher prevalence of PPD in women who live in unrecognized villages compared to women in recognized villages may be attributed to several factors such as lack of basic services, economic disparities , limited access to healthcare, cultural stigma and political and legal uncertainty (Living in such conditions can create a sense of insecurity and anxiety, which may contribute to PPD) (Alfayumi‐Zeadna et al., 2019). Addressing the high prevalence of depressive symptoms in unrecognized villages requires a multifaceted approach that includes improving access to essential services, reducing economic disparities, addressing social isolation, and increasing awareness about mental health issues and available support services.

**Study Limitations**

The study has various limitations. Findings cannot be generalized to all Bedouin women as participants were recruited from just two clinical settings in the south of Israel. However, these clinics primary serve Bedouin women. Moreover, clinical interviews by a psychiatrist or other licensed clinician would have enabled us to corroborate self-reported PPD responses. Another limitation is the use of an observational design and inability to establish causality between anemia and PPD because other unobserved variables may be influencing the relationship (i.e., the extent of bleeding at birth, the type of iron supplementation, or nutritional factors) which are account for changes over time. Despite this limitation, observational studies remain important in various fields, as they can provide valuable insights and generate hypotheses for further investigation. Reliance on self-report to screen for assessing PPD and the possibility of socially desirable responding (i.e., impression management) may have led to underreporting of symptoms. These limitations should be taken into account when interpreting the study's findings and considering their implications for clinical practice and future research.

**Conclusions**

This is the first study to identify the association between anemia and PPD in Bedouin women in southern Israel. The findings reveal a significant relationship between anemia and an increased risk of PPD, underscoring the importance of recognizing postpartum anemia as a potential risk factor for maternal mental health issues. Our sample has unique characteristics such as high rates of anemia and PPD, low education, low socioeconomic status, and restricted access to health services. The findings highlight the need for closer monitoring and potential treatment of mothers with anemia to mitigate the risk of PPD. Additionally, interventions aimed at improving perinatal nutrition may play a crucial role in preventing anemia and reducing the incidence of PPD in this vulnerable population. Future research should consider longitudinal designs, a broader participants base, and a thorough evaluation of confounding factors to better understand the relationship between anemia and PPD. Such studies will provide a more robust foundation for developing effective strategies to support the mental health and well-being of perinatal women, particularly those in underserved communities.

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