



The incidence of postpartum depression among mothers of newborns in the intensive care unit compared to mothers of normal births in Sana'a, Yemen: a prospective cohort study

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ABSTRACT

Background: Postpartum depression (PPD) is a major public health problem affecting women worldwide, with higher rates reported in low and middle income and conflict affected settings. Mothers whose newborns are admitted to the Neonatal Intensive Care Unit (NICU) may experience additional psychological stressors that increase their vulnerability to postpartum depression.

Objective: To estimate the incidence of postpartum depression and examine its association with NICU admission among postpartum mothers in Sana'a City, Yemen.

Methods: A prospective cohort study was conducted among 442 postpartum mothers recruited from four hospitals in Sana'a City. Participants were categorized into exposed (NICU admission) and non-exposed (non-NICU admission) groups and followed up for six weeks postpartum. Postpartum depression was assessed using the Edinburgh Postnatal Depression Scale (EPDS) with a cutoff score of ≥ 13 . Data were analyzed using chi-square tests and multivariate logistic regression.

Results: The overall incidence of postpartum depression at six weeks postpartum was 19.9%. The incidence was higher among mothers exposed to NICU admission than among non-exposed mothers (24.0% vs. 15.8%). A statistically significant association was observed between NICU admission and postpartum depression ($\chi^2 = 4.597$, $p = 0.032$). After adjusting for potential confounders, NICU admission remained an independent predictor of postpartum depression (RR = 1.52; 95% CI: 1.05–2.22; $p = 0.033$). Recent painful life events were the strongest predictors (RR = 2.68; 95% CI: 2.05–3.55; $p < 0.001$). Other significant predictors included poor financial status (RR = 1.86) and higher child order (RR = 2.16). Husband support had a protective effect (RR = 0.54).

Conclusion: Neonatal intensive care unit (NICU) admission significantly increases the risk of postpartum depression in Yemeni mothers. The inclusion of early screening using a validated instrument such as the EPDS is highly warranted.

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1. INTRODUCTION

1.1. GLOBAL BURDEN AND CONSEQUENCES OF POSTPARTUM DEPRESSION

Postpartum depression (PPD) is a major public health challenge globally [1, 2], affecting 10–20% of women

worldwide after childbirth, with a higher prevalence reported in low- and middle-income countries (LMICs) [3, 4]. Untreated PPD causes emotional exhaustion, poor maternal self-care, and a reduced capacity to nurture or bond with an infant [5, 6]. Children of depressed mothers face an increased risk of delayed cognitive development,



insecure attachment, and later behavioral problems [7]. As early maternal-infant interaction is foundational to emotional regulation [8], PPD has critical intergenerational implications. Conversely, early skin-to-skin contact and family involvement, particularly in NICU settings, significantly improve maternal and infant outcomes [9].

1.2. DIAGNOSTIC WINDOWS AND SYMPTOMATOLOGY

While depressive symptoms may emerge throughout the first postpartum year [3, 10], contemporary clinical practice frequently utilizes a four–six week diagnostic window to coincide with the conclusion of the puerperium [11]. This timeframe allows for the stabilization of immediate physiological transitions and ensures a clearer distinction between transient 'baby blues' and clinically significant depression [12, 13]. PPD must be distinguished from the common and transient "baby blues" which resolves within days without clinical intervention, and from rare postpartum psychosis, which represents a psychiatric emergency [14]. Symptoms of PPD include persistent feelings of depression, irritability, hopelessness, difficulty in concentrating or making decisions, severe fatigue, sleep disturbances, and thoughts of worthlessness as a mother [11].

1.3. VULNERABILITIES IN LMICs AND FRAGILE SETTINGS

Maternal mental health in LMICs is heavily shaped by structural inequalities, limited healthcare resources, and broader socioeconomic vulnerabilities, with reported PPD prevalence rates commonly ranging between 20% and 30% [4, 5, 15]. The Edinburgh Postnatal Depression Scale (EPDS) is the most widely used screening instrument and has demonstrated strong reliability in Arab populations [2, 16]. This burden is further intensified in fragile and conflict-affected settings. In Yemen, maternal mental health remains largely neglected despite prolonged conflict, economic collapse, food insecurity, and weakened healthcare systems [3, 17, 18].

1.4. NEONATAL STRESSORS AND THE NEED FOR PROSPECTIVE COHORT EVIDENCE

The admission of a newborn to the Neonatal Intensive Care Unit (NICU) is a significant maternal stressor driven by maternal-infant separation, fears over infant survival, a medicalized atmosphere, and corresponding financial burdens [19–21]. Systematic reviews confirm higher levels of depression, anxiety, and stress in mothers of NICU-admitted infants compared to healthy newborns [20, 21], although family centered care can reduce psychological distress [19]. Importantly, most available PPD evidence from LMICs

is predominantly cross-sectional, which limits the ability to estimate the true incidence or establish temporal relationships [3, 4, 15]. In Yemen, empirical evidence is scarce and is strictly limited to facility-based cross-sectional studies. To date, no prospective cohort study has compared the incidence of PPD between mothers of NICU-admitted infants and those of non-admitted infants. This lack of longitudinal evidence restricts the ability to identify high-risk maternal groups and inform effective screening and intervention strategies in Yemeni healthcare services.

2. METHODS

2.1. STUDY DESIGN

Regarding the methodology, the best approach in research methodology is to address it as follows: A prospective cohort study will be conducted from January 2024 to January 2025.

2.2. STUDY SETTING

The study was conducted in four major hospitals in Sana'a City, Yemen, which provide both maternity and neonatal intensive care services.

2.3. STUDY POPULATION

The study population consisted of postpartum mothers who delivered live infants in the selected hospitals. The participants were classified into two groups:

Exposed group: Mothers whose newborns were admitted to the NICU.

Non-exposed group: Mothers whose newborns were not admitted to the NICU.

The participants were followed up for six weeks postpartum.

2.4. SAMPLE SIZE

A total of 442 postpartum mothers were included, with 221 mothers in each group.

2.5. STATISTICAL ANALYSIS

The data were entered and analyzed using SPSS. Descriptive statistics were used to summarize the variables. The incidence rates were calculated for both groups. Associations were assessed using chi-square tests, and multivariable logistic regression analysis was used to identify independent predictors of postpartum depression.

2.6. ETHICAL CONSIDERATIONS

Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine and Health Sciences, Sana'a

Table 1. Sociodemographic and obstetric characteristics of study participants ($n = 442$).

Variable	Category	Non-exposed to NICU n (%)	Exposed to NICU n (%)	p	χ^2 (df)	Odds ratio 95% CI	Total n (%)
Maternal age group				0.895	0.607	AOR 0.908 (0.670–1.231)	
	15–19	29 (46%)	33 (53%)				62 (14.0%)
	20–29	129 (50.4%)	127 (49.6%)				256 (57.9%)
	30–39	56 (50%)	56 (50%)				112 (25.3%)
	40–49	7 (58.3%)	5 (41.7%)				12 (2.7%)
Mother residence				1.000	0.000	1.000 (0.453–2.209)	
	Urban	208 (94.1%)	208 (94.1%)				416 (94.1%)
	Rural	13 (5.9%)	13 (5.9%)				26 (5.9%)
Type of delivery				1.000	0.000	1.000 (0.688–1.453)	
	Vaginal	118 (53.4%)	118 (53.4%)				236 (53.4%)
	Cesarean section	103 (46.6%)	103 (46.6%)				206 (46.6%)
Child order				1.000	0.000	AOR 1.035 (0.813–1.317)	
	First child	90 (40.7%)	90 (40.7%)				180 (40.7%)
	Second child	54 (24.4%)	54 (24.4%)				108 (24.4%)
	Third or more	77 (34.8%)	77 (34.8%)				154 (34.8%)

Table 2. Incidence of postpartum depression (PPD). Overall incidence at six weeks postpartum: 19.9%.

Group	Developed PPD n (%)	Did not develop PPD n (%)	Total
Non-exposed to NICU	35 (15.8%)	186 (84.2%)	221
Exposed to NICU	53 (24.0%)	168 (76.0%)	221
Total	88 (19.9%)	354 (80.1%)	442

$$\chi^2 = 4.597 \quad p\text{-value} = 0.032 \quad RR = 1.52$$

University. Administrative approval was obtained from the participating hospitals. Verbal informed consent was obtained from all the participants. Confidentiality and anonymity were maintained throughout the study period.

3. RESULTS

Participants in the exposed and non-exposed groups were intentionally matched at the design stage based on maternal residence, child order, and type of delivery; therefore, these variables demonstrated identical distributions between the two groups.

Table 1: Sociodemographic and Obstetric Characteristics of Study Participants ($n=442$)

(This table demonstrates structural parity between the two distinct cohorts established during recruitment).

A total of 442 mothers participated in the study,

equally distributed between the exposed and non-exposed groups. Table (2) estimated that the overall incidence of postpartum depression at six weeks postpartum was 19.9%.

The incidence of postpartum depression was significantly higher among mothers whose infants were admitted to the NICU than among mothers whose infants were not admitted (24.0% vs. 15.8%).

A statistically significant association was found between NICU admission and postpartum depression ($\chi^2 = 4.597$, $p = 0.032$).

Multivariable logistic regression analysis was conducted to identify factors independently associated with postpartum depression. Multivariable analysis showed that NICU admission remained an independent predictor of postpartum depression ($RR = 1.52$; 95% CI: 1.05–2.22; $p = 0.033$).



Variable	B	S.E.	Wald	p-value	Adjusted RR (95% CI)
Painful event recently (yes vs no)	1.475	0.300	24.156	<0.001	2.68 (2.05–3.55)
Child order (overall)	—	—	11.640	0.003	—
Second vs First	0.665	0.375	3.153	0.076	1.58 (0.92–2.35)
Third+ vs First	1.130	0.331	11.635	0.001	2.16 (1.35–3.45)
Financial status (overall)	—	—	9.867	0.007	—
Average vs Excellent	-0.016	0.405	0.002	0.968	0.98 (0.45–1.85)
Poor vs Excellent	0.899	0.430	4.368	0.037	1.86 (1.06–2.95)
NICU exposure (yes vs no)	0.610	0.286	4.550	0.033	1.52 (1.05–2.22)
Husband support (yes vs no)	-0.766	0.379	4.073	0.044	0.54 (0.28–0.98)
Heard about PPD (yes vs no)	0.604	0.296	4.161	0.041	1.51 (1.02–2.25)
Mother residence (rural vs urban)	1.474	0.800	3.390	0.066	2.68 (0.90–6.50)
Child wanted (yes vs no)	-0.384	0.329	1.364	0.243	0.71 (0.35–1.30)
Family support (yes vs no)	-0.469	0.436	1.160	0.281	0.66 (0.27–1.45)
Visit psychiatrist (yes vs no)	-0.141	0.324	0.190	0.663	0.88 (0.45–1.65)
Constant	-3.280	1.045	9.848	0.002	—

Other significant predictors included:

Recent painful life events (RR = 2.68; 95% CI: 2.05–3.55; $p < 0.001$)

Poor financial status (RR = 1.86; $p = 0.037$)

Third child or higher birth order (RR = 2.16; $p = 0.001$)

Husband support was identified as a significant protective factor (RR = 0.54; $p = 0.044$).

4. DISCUSSION

This prospective cohort study investigated the incidence of PPD at six weeks postpartum and its relationship with NICU exposure and various psychosocial and obstetric variables in Sana'a, Yemen. The incidence of PPD in this study was 19.9%, which means that one in five mothers experienced clinically significant depressive symptoms (EPDS ≥ 13) at six weeks postpartum.

The incidence of postpartum depression (19.9%) aligns with estimates reported in LMICs [4, 15].

NICU admission significantly increased the risk of maternal depression, consistent with international evidence [1, 22] In our study, we found that NICU exposure is a major risk factor for PPD, with mothers of admitted

infants being 1.52 times more likely to develop depression. This result aligns perfectly with global data, such as the large meta-analysis by [23], which found a high prevalence of 29.2% among mothers of preterm infants. However, the impact of the war in Yemen goes beyond psychological distress. As noted in the discussion, these families face severe economic hardship due to the high costs of neonatal care and transportation in an unstable environment. This combination of emotional trauma, as described by [21] and financial pressure makes mothers in the NICU context especially vulnerable.

The intersection of NICU exposure, economic difficulties, increased parity, and acute stressors indicates that maternal mental health in Yemen is influenced by both biomedical and sociopolitical factors.

In Yemen's current economic context, characterized by interrupted government salaries, rising commodity prices, limited employment opportunities, and non-universal maternal health coverage, financial hardship may exacerbate postpartum stress through food insecurity, debt, and the inability to afford healthcare services. Thus, structural poverty appears to function as both a chronic stressor and an acute vulnerability factor.

In contrast to research conducted in more stable high-

income environments, the results of this study must be considered in light of protracted conflict, disrupted healthcare systems, partial privatization of services, and economic collapse. It is likely that structural stressors interact with individual risk factors to heighten PPD vulnerability.

Child order was significantly associated with PPD ($\chi^2 = 15.059$, $p = 0.001$). Mothers with a child order of three or higher showed an adjusted relative risk of ($RR = 2.16$, 95% CI: 1.35–3.45, $p = 0.001$), which was more than twice the risk of having depressive symptoms than mothers who had their first childbirth.

Regarding the child order, our findings present an interesting contrast to the international and regional literature. For instance, studies in Japan [24] and Egypt [25] highlighted that primiparity (being a first-time mother) was a significant risk factor for PPD, often due to the lack of childcare experience and the acute shock of the first birth transitioning into a NICU crisis. I believe that this discrepancy is deeply rooted in the unique socioeconomic challenges of the Yemeni context. While a first-time mother might struggle with inexperience, a multiparous mother in our setting faces a 'compounded burden.' They must navigate the emotional trauma of having a neonate in the NICU while simultaneously managing the physical and financial demands of their other children at home. In a resource-limited environment where economic hardship is prevalent, each additional child can increase the family's vulnerability, making the mother more susceptible to depression as her caregiving and financial resources are stretched to their limit.

Our analysis identified recent painful events as the single strongest predictor of PPD, with mothers who experienced such events having nearly 2.7 times the risk of developing PPD compared to those who did not experience such events ($RR = 2.68$, 95% CI: 2.05–3.55, $p < 0.001$). This finding is particularly striking when compared with global benchmarks. For instance, an umbrella review of 185 studies [26] found that psychosocial stressors, such as violent experiences, typically doubled the risk of depression ($OR = 2.07$).

This amplified association aligns with evidence from Turkey [27], which links cumulative obstetric and personal trauma to severe maternal distress. In the specific context of Yemen, painful events are rarely isolated; they often involve a devastating mix of displacement, loss of loved ones, loss of jobs, and total economic breakdown. In contrast, our study found that perceived spousal support had a significant protective effect on PPD ($RR = 0.54$, 95% CI: 0.28–0.98, $p = 0.044$). This suggests that mothers who felt supported by their husbands had a 46% reduced risk of developing PPD symptoms. This is supported by international studies that have found social support, particularly from spouses and immediate family, to be an important resilience factor for postpartum mothers. An umbrella review that synthesized data from other

meta-analytical studies found that positive psychosocial support, such as emotional and practical support, is consistently associated with reduced odds of postpartum depressive symptoms among mothers from different populations worldwide [26]. Emotional support, sharing of responsibilities, and direct support for childcare can all reduce PPD pathways, emphasizing the role of social support systems in helping to reduce psychological distress among postpartum mothers.

One of the most telling findings of this study was the limited awareness of PPD among the participants. Only 36.2% of the mothers reported any prior knowledge of the condition, leaving a significant majority (63.8%) completely unaware of PPD before their current experience. Interestingly, there was no significant difference in awareness levels between the NICU-exposed and non-exposed groups ($p = 0.428$), suggesting that the lack of health education is a widespread issue, regardless of the clinical outcome of birth.

5. CONCLUSION

Neonatal intensive care unit (NICU) admission significantly increases the risk of postpartum depression among Yemeni mothers. Taken together, these findings suggest that postpartum depression in Sana'a is influenced by an interaction between the medical stress experienced by newborns, socioeconomic difficulties, the cumulative burden on the mother, and modern life stressors. The continued presence of NICU admission as an independent predictor, even after adjustment, reinforces the need to integrate routine mental health screening into neonatal and postnatal care services in Yemen. Given that nearly one-fifth of mothers experience postpartum depression and numerous modifiable psychosocial factors have been identified, the inclusion of early screening using a validated instrument such as the Edinburgh Postpartum Depression Scale (EPDS), particularly in the NICU, is highly warranted. Maternal mental health issues are not only a clinical need but also a public health priority for several reasons.

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