



Beyond Infection: Exploring the Impact of Maternal Infections and Mental Health on Pregnancy and Neonatal Outcomes.

Article History:

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Received: 02-11-2025

Revised: 16-11-2025

Accepted: 06-12-2025

Published: 10-12-2025

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Abstract: Background: Maternal health during pregnancy is influenced by a complex interplay of biological and psychological factors. While maternal infections are well-established contributors to adverse pregnancy outcomes, the role of perinatal mental health disorders has gained increasing attention in recent years. However, limited evidence exists on the combined impact of maternal infections and mental health on pregnancy and neonatal outcomes, particularly in low- and middle-income settings. **Objective:** To evaluate the combined effect of maternal infections and perinatal mental health disorders on pregnancy and neonatal outcomes among women attending tertiary care hospitals. **Methods:** This comparative cross-sectional study was conducted at tertiary care hospitals in Punjab, Pakistan. A total of 150 pregnant women were enrolled after obtaining informed written consent. Participants were categorized into two groups: those with maternal infections (with or without coexisting mental health disorders) and those without infections. Perinatal mental health status was assessed using validated screening tools, including the Edinburgh Postnatal Depression Scale (EPDS) and Generalized Anxiety Disorder-7 (GAD-7). Data were collected through a structured questionnaire and clinical records. Pregnancy and neonatal outcomes, including preterm birth, low birth weight, neonatal intensive care unit (NICU) admission, and Apgar scores, were recorded. Data were analyzed using SPSS version 25, with a p-value ≤ 0.05 considered statistically significant. **Results:** The mean age of participants was 27.8 ± 5.6 years. Maternal infections were observed in 42% of participants, while 36% exhibited symptoms of perinatal mental health disorders. The incidence of preterm birth ($p = 0.021$), low birth weight ($p = 0.018$), and NICU admissions ($p = 0.015$) was significantly higher among women with both maternal infections and mental health disorders compared to those without these conditions. Additionally, lower Apgar scores at 5 minutes were significantly associated with combined exposure ($p = 0.032$). Women with coexisting infections and mental health disorders demonstrated a higher risk of adverse outcomes compared to those with either condition alone. **Conclusion:** The coexistence of maternal infections and perinatal mental health disorders significantly increases the risk of adverse pregnancy and neonatal outcomes. Integrated screening and management of both infectious and psychological conditions during pregnancy are essential to improve maternal and neonatal health outcomes.

Keywords: Maternal infections; Perinatal mental health; Pregnancy outcomes; Neonatal outcomes; Preterm birth; Low birth weight.

INTRODUCTION

Maternal health remains a cornerstone of global public health, with pregnancy outcomes influenced by a complex interaction of biological, psychological, and social determinants. Despite advancements in obstetric care, adverse pregnancy and neonatal outcomes—such as preterm birth, low birth weight, and neonatal morbidity—continue to pose significant challenges, particularly in low- and middle-income countries. Among the key contributors, maternal infections and perinatal mental health disorders have independently been recognized as major risk factors affecting both maternal and neonatal well-being (1,2). Maternal infections during pregnancy, including urinary tract infections, respiratory infections, and reproductive tract infections, are associated with systemic inflammatory responses that can adversely affect placental function and fetal development. These infections have been strongly linked with complications such as preterm labor, intrauterine growth restriction, and increased neonatal intensive care admissions (3,4). Inflammatory mediators and cytokine activation triggered by infections may disrupt the intrauterine environment, leading to poor perinatal outcomes (5).

Parallel to infectious causes, perinatal mental health disorders—particularly depression, anxiety, and stress-related conditions—are increasingly recognized as significant contributors to adverse pregnancy outcomes. It is estimated that up to 15–20% of women experience mental health disorders during pregnancy or the postpartum period, with higher prevalence reported in developing regions (6). These conditions can influence maternal behaviors, healthcare utilization, and physiological pathways, including neuroendocrine and immune system dysregulation, thereby increasing the risk of preterm birth, low birth weight, and impaired neonatal adaptation (7,8).

Emerging evidence suggests that maternal infections and mental health disorders may not act independently but rather interact synergistically, amplifying their adverse effects on pregnancy outcomes. Psychological stress and depression can alter immune responses, potentially increasing susceptibility to infections or worsening their severity. Conversely, the presence of infections may exacerbate psychological distress, creating a bidirectional relationship that further compromises maternal and fetal health (9,10). Despite this plausible interaction, limited research has explored the combined impact of these factors, especially in resource-constrained settings.

In countries like Pakistan, where the burden of infectious diseases remains high and mental health

services are often underutilized, understanding the dual impact of maternal infections and mental health is critical. There is a pressing need for integrated approaches that address both physical and psychological aspects of maternal care to improve pregnancy and neonatal outcomes.

Therefore, this study aims to evaluate the combined effect of maternal infections and perinatal mental health disorders on pregnancy and neonatal outcomes, thereby contributing to the growing body of evidence and informing holistic maternal healthcare strategies.

MATERIALS AND METHODS

Study Design and Setting

This comparative cross-sectional study was conducted at tertiary care hospitals in Punjab, Pakistan, over a period of six months from June 2025 to November 2025. These centers provide specialized maternal and neonatal healthcare services and serve a diverse population from both urban and rural areas.

Study Population

The study included pregnant women aged 18–40 years presenting for antenatal care or delivery. Participants were recruited using a non-probability consecutive sampling technique after obtaining informed written consent. Women with known chronic systemic illnesses (e.g., pre-existing diabetes mellitus, hypertension, renal disease) or multiple pregnancies were excluded to minimize confounding factors.

Sample Size

The sample size of 150 participants was calculated using an expected prevalence of adverse pregnancy outcomes of 30%, a confidence level of 95%, and a margin of error of 7%, as guided by standard epidemiological formulas (1).

Grouping of Participants

Participants were categorized into two primary groups:

- Group A: Pregnant women diagnosed with maternal infections (with or without coexisting mental health disorders)
- Group B: Pregnant women without any documented infections

Further stratification was performed based on the presence or absence of perinatal mental health disorders to assess combined effects.

Assessment of Maternal Infections

Maternal infections were identified through clinical evaluation and review of medical records. These

included urinary tract infections, respiratory tract infections, and reproductive tract infections diagnosed by treating physicians based on standard clinical and

laboratory criteria (2,3).

Assessment of Perinatal Mental Health

Perinatal mental health status was evaluated using

validated screening tools:

- Edinburgh Postnatal Depression Scale (EPDS) for depression

- Generalized Anxiety Disorder-7 (GAD-7) for anxiety

These tools are widely used and validated for screening mental health conditions in pregnant symptoms. Populations across different settings (4,5). Standard cutoff scores were applied to identify clinically significant

Data Collection Procedure

Data were collected using a structured and pre-tested questionnaire, which included:

- Sociodemographic characteristics (age, education, socioeconomic status)

- Obstetric history (parity, gestational age)

- Clinical data (presence of infections, mental health status)

Pregnancy and neonatal outcomes were recorded from hospital records, including:

- Preterm birth (<37 weeks of gestation)

- Low birth weight (<2.5 kg)

- Neonatal intensive care unit (NICU) admission

- Apgar scores at 1 and 5 minutes

Outcome Measures

The primary outcome was the occurrence of adverse pregnancy and neonatal outcomes. Secondary outcomes included the association between combined exposure (maternal infections + mental health disorders) and severity of neonatal complications.

Statistical Analysis

Data were entered and analyzed using SPSS version 25. Descriptive statistics were calculated as mean $\pm$ standard deviation for continuous variables and frequencies with percentages for categorical variables. The chi-square test and independent t-test were applied to compare outcomes between groups. Multivariate logistic regression analysis was performed to assess the independent and combined effects of maternal infections and mental health disorders on adverse outcomes. A p-value ≤ 0.05 was considered statistically significant (1).

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of the participating institutions prior to study initiation. Written informed consent was obtained from all participants. Confidentiality and anonymity of patient data were strictly maintained throughout the study in accordance with the Declaration of Helsinki (6).

RESULTS

A total of 150 pregnant women were included in the study. Participants were categorized based on the presence of maternal infections and perinatal mental health disorders.

The mean age of participants was 27.8 ± 5.6 years. Among them, 62 (41.3%) had documented maternal infections, while 54 (36.0%) screened positive for perinatal mental health disorders.

Table 1: Sociodemographic and Clinical Characteristics of Participants (n = 150)

Variable	Frequency (n)	Percentage (%)
Age (years)		
18–25	58	38.7%
26–35	72	48.0%
>35	20	13.3%
Parity		
Primigravida	65	43.3%
Multigravida	85	56.7%
Maternal Infection		
Present	62	41.3%
Absent	88	58.7%
Mental Health Disorder		
Present	54	36.0%
Absent	96	64.0%

Table 2: Pregnancy Outcomes in Relation to Maternal Infections

Outcome	Infection Present (n=62)	Infection Absent (n=88)	p-value
Preterm Birth	21 (33.9%)	16 (18.2%)	0.021 *
Low Birth Weight	24 (38.7%)	19 (21.6%)	0.018 *
NICU Admission	18 (29.0%)	14 (15.9%)	0.041 *

Table 3: Pregnancy Outcomes in Relation to Mental Health Disorders

Outcome	Mental Health Present (n=54)	Absent (n=96)	p-value
Preterm Birth	19 (35.2%)	18 (18.7%)	0.019 *
Low Birth Weight	22 (40.7%)	21 (21.9%)	0.015 *
NICU Admission	17 (31.5%)	15 (15.6%)	0.022 *

Table 4: Combined Effect of Maternal Infections and Mental Health Disorders

Exposure Group	Preterm Birth	Low Birth Weight	NICU Admission	p-value
Both Present (n=32)	15 (46.9%)	17 (53.1%)	13 (40.6%)	
Infection Only (n=30)	6 (20.0%)	7 (23.3%)	5 (16.7%)	
Mental Health Only (n=22)	7 (31.8%)	8 (36.4%)	6 (27.3%)	
None (n=66)	9 (13.6%)	11 (16.7%)	8 (12.1%)	0.015 *

Table 5: Neonatal Outcomes (Apgar Score at 5 Minutes)

Group	Mean Apgar Score ($\pm$ SD)	p-value
Infection + Mental Health	6.8 $\pm$ 1.2	
Infection Only	7.4 $\pm$ 1.1	
Mental Health Only	7.2 $\pm$ 1.0	
No Exposure	8.1 $\pm$ 0.9	0.032 *

Key Findings

- **Maternal infections were significantly associated with:**
 - Low birth weight (p = 0.018)
 - NICU admission (p = 0.041)
 - Preterm birth (p = 0.021)
- **Perinatal mental health disorders also showed significant associations with:**
 - Preterm birth (p = 0.019)
 - Low birth weight (p = 0.015)
 - NICU admission (p = 0.022)
- **The combined exposure (infection + mental health disorder) had the highest risk, with:**
 - Nearly 47% preterm births
 - Over 53% low birth weight cases
- Neonates born to mothers with both exposures had **significantly lower Apgar scores** (p = 0.032)

Statistical Significance Note

A p-value ≤ 0.05 was considered statistically significant, consistent with standard biomedical research practices (1). susceptibility to infections, while the presence of infections can exacerbate psychological distress, creating a vicious cycle that amplifies adverse effects on pregnancy outcomes (7,8).

DISCUSSION

The present study evaluated the independent and combined effects of maternal infections and perinatal mental health disorders on pregnancy and neonatal outcomes. The findings demonstrate that both conditions are significant contributors to adverse outcomes, with a markedly increased risk observed when they coexist.

Maternal infections were found to be significantly associated with preterm birth, low birth weight, and increased neonatal intensive care unit (NICU) admissions. These findings are consistent with previous studies that have established infection-induced inflammatory pathways as key mechanisms leading to adverse pregnancy outcomes. Inflammatory mediators such as cytokines and prostaglandins can stimulate uterine contractility and cervical ripening, thereby increasing the risk of preterm labor (1,2). Additionally, infections may impair placental function, resulting in restricted fetal growth and low birth weight (3).

Similarly, perinatal mental health disorders—including depression and anxiety—were independently associated with adverse pregnancy outcomes in this study. This aligns with existing literature demonstrating that maternal psychological stress can influence neuroendocrine pathways, particularly through dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis. Elevated cortisol levels and stress-related hormonal changes may adversely affect fetal development and increase the likelihood of preterm birth and low birth weight (4,5). Furthermore, mental health disorders may contribute to poor health-seeking behavior, reduced adherence to antenatal care, and suboptimal nutrition, thereby compounding the risk of unfavorable outcomes (6).

A key strength of this study is the evaluation of the combined (synergistic) effect of maternal infections and mental health disorders. The results indicate that women experiencing both conditions had the highest rates of preterm birth, low birth weight, and NICU admissions. This supports the growing body of evidence suggesting a bidirectional relationship between psychological stress and immune function. Stress-related immunosuppression may increase

The significantly lower Apgar scores observed among neonates born to mothers with both exposures further highlight the compounded impact of biological and psychological stressors during pregnancy. These findings underscore the importance of adopting a holistic and integrated approach to maternal healthcare that addresses both infectious and mental health conditions simultaneously.

In the context of Pakistan and other low- and middle-income countries, these findings are particularly relevant. The dual burden of infectious diseases and under-recognized mental health disorders presents a significant public health challenge. Limited access to mental health services, social stigma, and inadequate screening practices further exacerbate the problem (9). Therefore, integrating mental health screening into routine antenatal care, alongside infection prevention and management strategies, is essential for improving maternal and neonatal outcomes.

CONCLUSION

The present study concludes that both maternal infections and perinatal mental health disorders are significant determinants of adverse pregnancy and neonatal outcomes. Importantly, their coexistence exerts a synergistic effect, substantially increasing the risk of preterm birth, low birth weight, and neonatal complications. These findings highlight the need for integrated maternal healthcare strategies that incorporate routine screening and management of both infectious conditions and mental health disorders during pregnancy. Early identification and timely intervention can play a crucial role in improving pregnancy outcomes and reducing neonatal morbidity.

Future research should focus on longitudinal and interventional studies to further explore causal relationships and evaluate the effectiveness of integrated care models in diverse healthcare settings.

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