Research Square

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Maternal Depression During Pregnancy and Low Birth Weight in a Population Based Retrospective Cohort

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Abstract

Background:

Depression during pregnancy is a major global health concern that can adversely affect both maternal and neonatal outcomes. Low birth weight (LBW) is among the most serious complications, as it is associated with increased infant morbidity and mortality. This study aimed to assess the association between antenatal maternal depression and the risk of LBW in a large population-based cohort.

Methods:

This population-based retrospective cohort study included 108043 pregnant women who received prenatal care at health centers affiliated with Mashhad University of Medical Sciences between March 1, 2017, to June 20, 2025. Data were obtained from the Sina Health Information System. Women diagnosed with depression during pregnancy (n = 35934) were compared with those without depression (n = 72109). LBW was defined as birth weight < 2500 g. Multivariate logistic regression analysis was performed to estimate adjusted odds ratios (AORs) and 95% confidence intervals (CIs), controlling for demographic, obstetric, psychological, and clinical factors.

Results:

Of the 108043 pregnancies analyzed, 33.3% of mothers had a diagnosis of depression during pregnancy. The prevalence of low birth weight was higher among infants born to mothers with depression than among those born to mothers without depression (11.3% vs. 8.8%). In unadjusted analysis, maternal depression was associated with increased odds of LBW (OR = 1.32; 95% CI: 1.27 − 1.38). After adjustment for obstetric factors, the association remained significant (AOR = 1.42; 95% CI: 1.36 − 1.49). In the fully adjusted model, maternal depression continued to be significantly associated with LBW (AOR = 1.27; 95% CI: 1.22 − 1.33).

Conclusion:

Maternal depression during pregnancy was associated with increased odds of LBW. These findings underscore the importance of integrating mental health screening and interventions into routine prenatal care to improve maternal and neonatal outcomes.

1. Introduction

During pregnancy, depression can be a hidden but influential factor that contributes to adverse birth outcomes and even increases the severity of complications and the risk of neonatal mortality. It has been found that depression or worsening of depressive symptoms during this period is associated with

an increased risk of hospitalization and death in the first year of life(1). Depression during pregnancy can lead to adverse outcomes during the delivery process by creating unfavorable conditions such as premature birth, low birth weight, and restricted fetal growth(2). Low birth weight is defined as a baby weighing less than 2,500 grams at birth. Estimates suggest that about 20 out of every 100 babies worldwide are born with this condition. More than 20 million babies are born with low birth weight each year, and nearly 95 out of every 100 of these births occur in developing countries. Given the significant health and economic burden associated with low birth weight(3), the World Health Organization has prioritized reducing the prevalence of low birth weight as a major public health goal, with a goal of reducing the prevalence of low birth weight by 30% worldwide between 2012 and 2025(4).

Several factors are associated with an increased risk of low birth weight, including household food insecurity, younger maternal age, lower education, exposure to secondhand smoke, and cesarean delivery(5). In addition, the mother's mental health during pregnancy also plays an important role and can increase the risk of low birth weight(6, 7). The physical and social changes of pregnancy sometimes create pressures that can affect the mother's psyche and lead her to problems such as anxiety or depression. Such disorders during this sensitive period, especially anxiety and depression, are known to be factors that may increase the risk of having a low birth weight baby(8).

Prenatal depression is usually defined as a state in which a mother experiences some degree of sadness or low mood during pregnancy or in the months following delivery, with the severity ranging from mild to severe. It is estimated that antenatal depression affects about 7–15 out of every 100 women in high income countries, while this figure is reported to be between 19–25 out of every 100 women in low- and middle-income countries(9). Pregnancy is a period of hope and expectation for many women, but this same period can be accompanied by psychological stress; stress that, if severe, takes the mother away from her normal routine and even affects the development of the fetus. The mental health of a pregnant mother does not depend on just one factor; rather, it is shaped by a set of conditions. The level of education can determine her level of awareness and decision making ability during this period. Experiences such as a history of miscarriage may revive hidden concerns. The family's economic situation has a direct impact on her sense of security and peace. The mother's age also plays a role in this; some pregnancy ages are associated with more worry and some with more strength and confidence. The mother's physical condition and her body mass index can affect her mood. An unwanted pregnancy may also present the mother with contradictory and heavy feelings. Most importantly, the presence of domestic violence can multiply psychological stress and reinforce feelings of loneliness and helplessness(10, 11). Findings from community health assessment projects in different regions of Iran show that low birth weight neonates are one of the major health challenges in different regions of Iran(5, 12).

Given that low birth weight is one of the most important public health challenges and can have lasting physical and psychological effects on the child's life, addressing its determinants, especially maternal mental health, seems essential. Investigating the role of depression and other mental health problems during pregnancy can provide a more accurate picture of why this problem occurs and provide the basis

for designing preventive programs. The results of such research not only help to better understand the situation of pregnant mothers but can also be a practical guide for policymakers and health service providers to develop and implement more targeted and effective interventions to reduce low birth weight and improve maternal mental health.

2. Methods

2.1 Participants and Study Design:

Pregnant women receiving routine prenatal care at health centers affiliated with Mashhad University of Medical Sciences were included in this population-based retrospective cohort study. Data were obtained from the Sina Health Information System (13). The study covered pregnancies from March 1, 2017, to June 20, 2025; however, only pregnancies with completed outcomes (live births) prior to data extraction were included, ensuring full ascertainment of both exposure (maternal depression) and outcome (birth weight). Pregnancies without completed follow up at the time of data extraction were excluded from the analysis. The exposed group consisted of pregnant women diagnosed with depression during pregnancy who met the inclusion criteria, while pregnant women without depression were considered as the non-exposed group.

2.2 Study variables:

1. Outcome variable: According to the World Health Organization definition, neonates weighing less than 2500 grams are considered low birth weight. In the present study, the same amount was considered for low birth weight. The outcome variable, Low Birth Weight (LBW), is measured as follows: the infant's weight is measured immediately after birth in the hospital (delivery room) by the medical staff using calibrated digital scales. This information is subsequently recorded in the Sina Health Electronic Record System by the health center teams, including midwives and health care providers, during postnatal visits. Neonates weighing less than 2500 grams are identified and categorized as LBW cases.

2.Confounding variables: gender of the newborn, place of residence, number of the mother's pregnancies, nationality, mother’s education level, mother’s job, maternal hospitalization, history of low birth weight newborn, domestic violence, type of delivery, history of abortion, anxiety (ICD code 10 F41 for history of anxiety), history of cancer, thyroid disease, diabetes, maternal obesity, hypertension and genitourinary disease.

3. Exposure variable: depression (ICD code 10 F32 was used depression)

2.3 Measurement tool:

In this study, the HITS short questionnaire was used to measure domestic violence; a tool designed by Sherin et al. in the United States with the aim of rapid screening for domestic violence. This questionnaire consists of 4 questions that focus on verbal and physical violence. Each question has 5 answer options and is scored from 1 to 5; therefore, the total score ranges from 4 to 20. A score greater than 10 is considered a positive result and indicates the presence of domestic violence(13).

2.4 Sampling technique and procedure:

In this study, data were collected from 256 primary health care centers. The study population comprised two distinct cohorts: an exposure group of 35,934 pregnant mothers diagnosed with depression, and a non-exposure group of 72,109 mothers who did not experience depression during the pregnancy period. This study utilized a combination of census and random sampling techniques to enroll participants. All pregnant women with a confirmed clinical diagnosis of depression (ICD-10 code F32) within the affiliated health centers were included in the study through a census approach to ensure the inclusion of all exposed individuals. Conversely, for the non-exposed cohort, participants were randomly selected from the population of pregnant women who had no record of depressive symptoms or history in the "Sina" Electronic Health System. This strategy was implemented to ensure a robust comparison between the two groups while investigating the impact of antenatal depression on birth weight outcomes. The non-exposed group was selected using random sampling to ensure computational feasibility. To address potential sampling bias, all regression analyses were adjusted for baseline characteristics, and sensitivity analyses were conducted to confirm the robustness of the findings.

1. **2.5 Collect information**:
2. 1. Patient Enrollment and Multidisciplinary Care: Upon the clinical confirmation of pregnancy, expectant mothers visited one of the 256 participating primary healthcare centers to establish their prenatal care records. From the outset, each mother was placed under the supervision of a multidisciplinary health team. This collaborative team consisted of a general practitioner, a midwife, a mental health specialist, a disease control expert, and a community health worker, ensuring that every patient received comprehensive and holistic routine care throughout her pregnancy.
3. 2. Systematic Screening Protocols: A key component of this study was the proactive monitoring of maternal well-being. The midwives conducted rigorous screenings for mental health disorders and domestic violence at three critical milestones: weeks 6 – 10, 16 – 20, and 24 – 30 of gestation. This strategic timing allowed for the continuous assessment of the mother’s psychological state across all three trimesters.
4. 3. Referral Pathway and Clinical Diagnosis: The study utilized a structured referral system to ensure diagnostic accuracy. If any red flags or symptoms were identified during the initial screenings, the mother was immediately referred to the center’s mental health specialist for in-depth counseling and clinical evaluation. In cases where symptoms persisted despite counseling, the patient was further referred to the center’s physician and a psychiatrist for a definitive medical diagnosis.
5. 4. Documentation and Longitudinal Follow up: Once a diagnosis of depression was clinically confirmed, the case was formally documented in the Integrated Electronic Health System. These

mothers were not merely recorded but were closely monitored by the healthcare team until full recovery was achieved. Based on this robust clinical pathway, the study population was categorized into two cohorts: an exposure group of 35,934 mothers diagnosed with prenatal depression and a nonexposure group of 72,109 mothers with no history of the disorder.

2.6. Definitions:

Depression status was defined based on a confirmed clinical diagnosis by a specialist physician according to the International Classification of Diseases, 10th Revision (ICD-10, code F32). As part of routine prenatal care, all pregnant women underwent initial psychological screening using the Kessler Psychological Distress Scale (K6), which is a validated instrument for detecting non-specific psychological distress rather than depression specifically. Women with elevated K6 scores (≥ 12) were referred for further clinical evaluation by a specialist physician and psychologist.Only those who received a confirmed clinical diagnosis of depression were classified into the exposed group. Therefore, the K6 questionnaire was used solely as a preliminary screening tool and was not used as a diagnostic criterion for defining depression in this study. The proportion of women with positive K6 screening results who were subsequently confirmed with a clinical diagnosis of depression was evaluated to assess the validity of the screening process. Maternal obesity was defined based on body mass index (BMI) recorded in the electronic health system prior to or during early pregnancy. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m²).

2.7. Inclusion Criteria:

- • Pregnancy Status: All pregnant women during the study period (March 1, 2017, to June 20, 2025).
- • Comprehensive Healthcare Services: Women receiving routine antenatal and postnatal care at affiliated primary healthcare centers.
- • Electronic Health Record: Availability of complete demographic and clinical data in the Sina system.
- • **Exposed Cohort**: Mothers with a confirmed clinical diagnosis of depression during pregnancy (ICD-10 code F32).
- • **Non-exposed Cohort**: Mothers with no recorded clinical diagnosis of depression (ICD-10 code F32) during pregnancy and no documented history of depressive disorders in the electronic health records prior to or during pregnancy.

The classification of exposure status was based exclusively on clinically confirmed diagnoses recorded in the electronic health system.

2.8. Exclusion Criteria:

- Missing Outcome Data: Neonates with no recorded birth weight in the system (e.g., due to delivery in nonaffiliated hospitals).

- Multiple Gestations: Multiple pregnancies (twins or triplets), as they are naturally associated with lower birth weights.
- Congenital Anomalies: Newborns with major congenital malformations or known genetic disorders.
- Severe Comorbidities: Mothers with severe pre-existing psychiatric conditions (e.g., schizophrenia or bipolar disorder) to ensure the observed effect is specific to depression.
- Incomplete Records: Participants with missing data on critical confounding variables that would preclude adjusted statistical modeling.

2.9 Statistical Analysis:

After data collection, the information was coded and subsequently entered into Excel software. It was then transferred to Stata version 16 for analysis purposes. Frequencies and percentages were calculated to describe the characteristics of categories and quantitative variables in both case and control groups. Initially, bivariate analysis including chi-square test was performed to assess the unadjusted relationships between each factor and low birth weight. Variables were selected for multivariate analysis based on prior knowledge and clinical relevance, rather than solely on statistical significance in bivariate analysis, to avoid model misspecification. The final model estimated the adjusted odds ratio (OR) and 95% confidence intervals indicating independent relationships. The final model estimated the adjusted odds ratio (AOR) and 95% confidence intervals indicating independent relationships between variables entered into the model. An alpha level of 0.05 determined statistical significance in the regression analysis. Statistical analysis was performed using Stata software version 16.

Table 1
Comparison of demographic and clinical characteristics between low birth weight and normal birth weight groups

Variable		Birth weight baby			P-value*
		Normal birth weight N (%)	Low birth weight N (%)	Total N (%)	
Gender	Male	50603 (51.8)	4768 (45.8)	55371 (51.2)	< 0.001
	Female	47021 (48.2)	5651 (54.2)	52672 (48.8)	
Place of residence	Small city	16238 (16.6)	1635 (15.7)	17873 (16.5)	< 0.001
	Metropolis	25888 (26.5)	2563 (24.6)	28451 (26.3)	
	Village	27663 (28.3)	3076 (29.5)	30739 (28.5)	
	Suburban	27835 (28.5)	3145 (30.2)	30980 (28.7)	
Number of pregnancies of the mother	First	35865 (36.7)	4208 (40.4)	40073 (37.1)	< 0.001
	Second	22962 (23.5)	2193 (21.0)	25155 (23.3)	
	Third	18914 (19.4)	1903 (18.3)	20817 (19.3)	
	Fourth and more	19883 (20.4)	2115 (20.3)	21998 (20.4)	
Nationality	Foreign	8421 (8.6)	749 (7.2)	9170 (8.5)	< 0.001
	Iranian	89203 (91.4)	9670 (92.8)	98873 (91.5)	
Mother's education	Illiterate	27183 (27.8)	3198 (30.7)	30381 (28.1)	< 0.001
	Diploma	50812 (52.0)	5158 (49.5)	55970 (51.8)	
	Above the diploma	19629 (20.1)	2063 (19.8)	21692 (20.1)	
Mother's Job	Housewife	86129 (88.2)	9205 (88.3)	95334 (88.2)	< 0.001
	Self-employed	1804 (1.8)	237 (2.3)	2041 (1.9)	
	Employee	2450 (2.5)	260 (2.5)	2710 (2.5)	
	Student	7241 (7.4)	717 (6.9)	7958 (7.4)	
Maternal hospitalization	No	89678 (92.0)	6369 (61.2)	96047 (89.1)	< 0.001
	Yes	7764 (8.0)	4041 (38.8)	11805 (10.9)	

* P-values were calculated using the chi-square test

Variable		Birth weight baby			P-value*
		Normal birth weight N (%)	Low birth weight N (%)	Total N (%)	
History of Low-Birth-Weight Newborn	No	94220 (96.5)	9528 (91.4)	103748 (96.0)	< 0.001
	Yes	3404 (3.5)	891 (8.6)	4295 (4.0)	
Domestic Violence	No	96450 (98.8)	10233 (98.2)	106683 (98.7)	< 0.001
	Yes	1174 (1.2)	186 (1.8)	1360 (1.3)	
Type of Delivery	Natural	52618 (53.9)	3807 (36.5)	56425 (52.2)	< 0.001
	Cesarean	45006 (46.1)	6612 (63.5)	51618 (47.8)	
History of abortion	No	90412 (92.6)	9569 (91.8)	99981 (92.5)	< 0.001
	Yes	7212 (7.4)	850 (8.2)	8062 (7.5)	
Depression	No	65767 (67.4)	6342 (60.9)	72109 (66.7)	< 0.001
	Yes	31857 (32.6)	4077 (39.1)	35934 (33.3)	
Anxiety	No	89191 (91.4)	9395 (90.2)	98586 (91.2)	< 0.001
	Yes	8433 (8.6)	1024 (9.8)	9457 (8.8)	
History of Cancer	No	96660 (99.0)	10257 (98.4)	106917 (99.0)	< 0.001
	Yes	964 (1.0)	162 (1.6)	1126 (1.0)	
Thyroid Disease	No	90802 (93.0)	9461 (90.8)	100263 (92.8)	< 0.001
	Yes	6822 (7.0)	958 (9.2)	7780 (7.2)	
Diabetes	No	96494 (98.8)	10260 (98.5)	106754 (98.8)	< 0.001
	Yes	1130 (1.2)	159 (1.5)	1289 (1.2)	
Mother's Obesity	No	93445 (95.7)	10036 (96.3)	103481 (95.8)	< 0.001
	Yes	4179 (4.3)	383 (3.7)	4562 (4.2)	
Hypertension	No	95569 (97.9)	9998 (96.0)	105567 (97.7)	< 0.001
	Yes	2055 (2.1)	421 (4.0)	2476 (2.3)	

* P-values were calculated using the chi-square test

Variable		Birth weight baby			P-value*
		Normal birth weight N (%)	Low birth weight N (%)	Total N (%)	
Genitourinary disease	No	89039 (91.2)	9373 (90.0)	98412 (91.1)	< 0.001
	Yes	8585 (8.8)	1046 (10.0)	9631 (8.9)	
* P-values were calculated using the chi-square test					

3. Results

All of the variables in Table 1 showed statistically significant associations with low birth weight. The percentage of low birth weight newborns was greater for females, (54.2%) in the exposed group, compared to males (45.8%) ($p < 0.001$). Low birth weight was most prevalent in newborns born from first time pregnancies, with a breakdown of 40.4% and 36.7% in the exposed and unexposed groups, respectively ($p < 0.001$). The place of residence revealed stark contrasts, where low birth weight babies were reported in rural (29.5%) and suburban (30.2%) areas ($p < 0.001$). Looking at maternal medical history, in the exposed group, 38.8% of mothers reported being hospitalized, and 8.6% disclosed having a history of a previous low birth weight newborn ($p < 0.001$). From a psychosocial aspect, mothers experiencing depression had a higher degree of low birth weight (39.1%), and those with anxiety or domestic violence also felt higher proportions of low birth weight babies, (9.8% and 1.8%, $p < 0.001$). Looking at medical factors of interest, cesarean was the delivery method for 63.5% of the exposed group, with patients also disclosing thyroid disease, hypertension and genitourinary disease at higher rates than the unexposed group ($p < 0.001$). Finally, maternal obesity was slightly less common among low birth weight babies, with an incidence of 3.7% of mothers being in the exposed group, compared to the unexposed ($p < 0.001$). (Table 1)

Table 2
Association between depression and low birth weight, controlling for demographic factors.

Variables		Univariate regression analysis		Multivariate logistic regression	
	Categories	OR (95% CI)	p-value	OR (95% CI)	p-value
Gender	Male (Ref)	1.00	—	1.00	—
	Female	1.27 (1.22–1.32)	< 0.001	1.27 (1.22–1.33)	< 0.001
Nationality	Foreign (Ref)	1.00	—	1.00	—
	Iranian	1.21 (1.12–1.31)	< 0.001	1.21 (1.11–1.31)	< 0.001
Place of residence	Small city (Ref)	1.00	—	1.00	—
	Metropolis	0.90 (0.90–1.04)	0.06	0.98 (0.92–1.05)	0.06
	Village	1.10 (1.03–1.17)	< 0.001	1.05 (0.99–1.12)	0.01
	Suburban	1.12 (1.05–1.19)	< 0.001	1.13 (1.06–1.20)	< 0.001
Mother's Job	Housewife (Ref)	1.00	—	1.00	—
	Self-employed	1.22 (1.07–1.41)	< 0.001	1.25 (1.09–1.44)	< 0.001
	Employee	0.90 (0.80–1.10)	0.09	1.03 (0.90–1.18)	0.06
	Student	0.90 (0.80–1.03)	0.06	0.96 (0.88–1.04)	0.03
Mother's education	Illiterate (Ref)	1.00	—	1.00	—
	Diploma	0.86 (0.82–0.90)	< 0.001	0.86 (0.82–0.90)	< 0.001
	Above the diploma	0.89 (0.80–0.94)	< 0.001	0.95 (0.89–1.01)	< 0.001
Depression	No (Ref)	1.00	—	1.00	—
	Yes	1.32 (1.27–1.38)	< 0.001	1.30 (1.24–1.35)	< 0.001

The results from Table 2 reveal the univariate and multivariate logistic regression analyses found that there are various variables associated with low birth weight. Newborn female neonates are found to be more likely to be born with low birth weight compared to newborn male neonates ($p < 0.001$). In addition, maternal nationality appears to be significant, as Iranian mothers had a higher percentage of low birth

weight neonates compared to foreign mothers ($p < 0.001$). In relation to place of residence those who lived in the village or suburban environment had a higher prevalence of low birth weight, however, there was no significant association of living in metropolitan areas and low birth weight ($p < 0.001$). Concerning mother's job, self employed mothers had a higher percentage of low birth weight babies compared to housewives, and employed or student mothers had no significant association ($p < 0.001$). Mother's education appears to have a protective association, as mother with a diploma or higher have a lower likelihood of low birth weight ($p < 0.001$). Lastly, maternal depression was one of the strongest associated variables with mothers who had depression during their pregnancy having a higher percentage of low birth weight neonates, and even with all other covariates accounted for the association remained statistically significant ($p < 0.001$). (Table 2)

Table 3
Association between depression and low birth weight, adjusted for maternal clinical characteristics

Variables		Univariate regression analysis		Multivariate logistic regression	
	Categories	OR (95% CI)	p-value	OR (95% CI)	p-value
Parity (number of pregnancies)	First (Ref)	1.00	—	1.00	—
	Second	0.84 (0.77–0.85)	< 0.001	0.79 (0.75–0.84)	< 0.001
	Third	0.85 (0.81–0.90)	< 0.001	0.80 (0.75–0.85)	< 0.001
	≥ 4	0.90 (0.85–0.95)	< 0.001	0.77 (0.72–0.82)	
Maternal hospitalization	No (Ref)	1.00	—	1.00	—
	Yes	7.67 (7.01–7.93)	< 0.001	6.90 (6.58–7.23)	< 0.001
History of Low-Birth-Weight Newborn	No (Ref)	1.00	—	1.00	—
	Yes	2.50 (2.39–2.79)	< 0.001	2.60 (2.42–2.88)	< 0.001
Type of Delivery	Vaginal delivery (Ref)	1.00	—	1.00	—
	Cesarean	2.03 (1.94–2.17)	< 0.001	1.81 (1.73–1.89)	< 0.001
History of abortion	No (Ref)	1.00	—	1.00	—
	Yes	1.11 (1.03–1.19)	< 0.001	1.10 (1.02–1.20)	< 0.001
Depression	No (Ref)	1.00	—	1.00	—
	Yes	1.32 (1.27–1.38)	< 0.001	1.42 (1.36–1.49)	< 0.001

Table 3 presents the associations between maternal and obstetric characteristics and low birth weight. The number of previous pregnancies was significantly associated with low birth weight. Compared with first pregnancies, second, third, and fourth or subsequent pregnancies were associated with lower odds of low birth weight in both univariate and multivariable logistic regression analyses (all $p < 0.001$). A history of maternal hospitalization during pregnancy was associated with substantially higher odds of low birth weight in both analyses ($p < 0.001$). Similarly, a history of delivering a low birth weight infant was strongly associated with higher odds of recurrent low birth weight ($p < 0.001$). Regarding delivery mode, elective cesarean delivery was associated with higher odds of low birth weight compared with vaginal delivery ($p < 0.001$). A history of abortion was also associated with slightly higher odds of low

birth weight (p < 0.001). Importantly, maternal depression remained significantly associated with increased odds of low birth weight after adjustment for the obstetric characteristics included in the multivariable model (AOR: 1.42, 95% CI: 1.36 − 1.49; p < 0.001).

Table 4
Association between depression and low birth weight, with other maternal psychological control

Variables		Univariate regression analysis		Multivariate logistic regression	
	Categories	OR (95% CI)	p-value	OR (95% CI)	p-value
Domestic Violence	No (Ref)	1.00	— < 0.001	1.00	—
	Yes	1.49 (1.27–1.74)		1.39 (1.19–1.63)	< 0.001
Anxiety	No (Ref)	1.00	— < 0.001	1.00	—
	Yes	1.15 (1.07–1.23)		1.07 (1.01–1.14)	0.04
Depression	No (Ref)	1.00	— < 0.001	1.00	—
	Yes	1.32 (1.27–1.38)		1.32 (1.25–1.36)	< 0.001

As shown in Table 4, the results indicate that several psychosocial factors are significantly associated with low birth weight. Domestic violence was one of the most important variables, with women experiencing domestic violence having a higher chance of having a low birth weight baby, and this relationship remained significant in both univariate and multivariate analyses (p < 0.001). Anxiety was also associated with a slightly increased chance of having a low birth weight baby, and remained significant in the adjusted model (p = 0.04). Depression was also significantly associated with low birth weight with women with depression having a higher chance of having a low birth weight baby than women without depression; this relationship remained stable even after controlling for other factors (p < 0.001). (Table 4)

Table 5
Multivariate logistic regression analysis of maternal medical conditions and depression associated with low birth weight

Variables		Univariate regression analysis		Multivariate logistic regression	
	Categories	OR (95% CI)	p-value	OR (95% CI)	p-value
History of Cancer	No (Ref)	1.00	—	1.00	—
	Yes	1.58 (1.33–1.87)	< 0.001	1.40 (1.18–1.66)	< 0.001
Thyroid Disease	No (Ref)	1.00	—	1.00	—
	Yes	1.34 (1.25–1.44)	< 0.001	1.30 (1.21–1.39)	< 0.001
Diabetes	No (Ref)	1.00	—	1.00	—
	Yes	1.32 (1.12–1.56)	< 0.001	1.25 (1.02–1.33)	< 0.001
Mother's Obesity	No (Ref)	1.00	—	1.00	—
	Yes	0.85 (0.76–0.94)	< 0.001	0.78 (0.72–0.87)	< 0.001
Hypertension	No (Ref)	1.00	—	1.00	—
	Yes	1.95 (1.76–2.17)	< 0.001	1.78 (1.61–2.01)	< 0.001
Genitourinary disease	No (Ref)	1.00	—	1.00	—
	Yes	1.15 (1.08–1.28)	< 0.001	1.05 (0.98–1.12)	0.15
Depression	No (Ref)	1.00	—	1.00	—
	Yes	1.32 (1.27–1.38)	< 0.001	1.27 (1.22–1.33)	< 0.001

The analysis as presented in Table 5 reveals that both health condition factors and psychological factors appear to be significantly associated with low birth weight. Mothers with a history of cancer were significantly more likely to have low birth weight neonates in both the univariate and multivariate analyses ($p < 0.001$). Mothers with thyroid disorders and diabetes were also more often identified in the low birth weight group, and this remained significant after controlling for other factors ($p < 0.001$). Interestingly, maternal obesity appeared to be protective, as obese mothers were less likely to deliver low birth weight neonates ($p < 0.001$). Hypertension emerged as a strong risk factor as mothers with hypertension were associated with low birth weight delivery in both the unadjusted and adjusted models ($p < 0.001$). Genitourinary disease was statistically significant in the univariate analysis, but no longer had an effect in the multivariate model ($p = 0.15$). Maternal depression had a significant positive effect on low birth weight across all analyses, suggesting the continued impact of maternal psychological health on fetal growth ($p < 0.001$). (Table 5)

4. Discussion

The findings of this study showed that a range of demographic, obstetric and medical factors were associated with an increased likelihood of low birth weight. Factors such as maternal hospitalization during pregnancy, history of low birth weight newborn, type of delivery (cesarean section), history of abortion, domestic violence, anxiety, thyroid disorders, diabetes, hypertension, cancer, maternal obesity and genitourinary diseases were all significantly related to low birth weight in the univariate analysis. Many of these factors remained significant in the multivariate model and continued to act as independent predictors. Among these variables, maternal depression demonstrated a particularly notable role. Even after adjusting for other influential factors, depression remained an independent and strong predictor of low birth weight, indicating that the psychological state of the mother exerts a direct effect on fetal growth beyond the influence of medical, demographic, or social stressors. Interestingly, the adjusted odds ratio increased after controlling for obstetric variables, suggesting the presence of negative confounding. This indicates that some obstetric factors may have masked the true association between maternal depression and low birth weight in the unadjusted model.

In population-based studies in developing countries, it has been reported that female neonates are at greater risk of low birth weight than male neonates, a pattern that has been confirmed in population and epidemiological analyses(14–17). In addition, the World Health Organization has identified female gender as a nonmodifiable predictor of low birth weight(18). In contrast, there is extensive evidence that male neonates born with low birth weight face higher mortality rates than female neonates, a finding that has been consistently observed in multiple studies and over time. This pattern suggests that although girls are more likely to be born with low birth weight boys are more vulnerable to low birth weight and have consistently been reported to have more severe outcomes, including higher mortality(19). In the present study, female gender was also associated with an increased likelihood of having a low birth weight baby, and this finding is consistent with patterns reported in the research literature of developing countries and reports from the World Health Organization. Sociodemographic factors and maternal characteristics both in urban and rural areas, showed a significant relationship with the prevalence of low birth weight and play an important role in explaining this adverse outcome(20).

In our study place of residence was also one of the factors affecting the incidence of low birth weight; living in rural and suburban areas was associated with a significant increase in the likelihood of having a low birth weight baby. Inappropriate health care seeking behaviors and limited access to quality health services can indirectly affect the baby's birth weight and increase the likelihood of low birth weight(21). The socioeconomic status of mothers has a direct impact on infant weight; mothers with low income or low education are more likely to have low birth weight babies(22). These inequalities have also been observed in South Asia and could threaten the achievement of global nutrition goals in the region(21, 23). In the present study, having a stable job and sufficient income as well as a higher level of maternal education, were identified as protective factors against the birth of a low birth weight infant, indicating that economic conditions and maternal education level can play an important role in reducing the risk of low birth weight. In the study by Shah et al(24). women with no history of childbirth were associated with reduced birth weight, increased likelihood of having a small for gestational age baby, and increased chances of having a low birth weight baby. While in the study by Alehegn et al(25). women with a high

number of pregnancies were at higher risk of having a low birth weight baby compared to women with fewer pregnancies, the results of the present study show that the likelihood of having a low birth weight baby decreases with increasing number of pregnancies. In the last few decades, there has been a trend towards more medical interventions in childbirth. The increased emphasis on medical induction of labor and elective cesarean section is contributing to an increase in preterm birth rates. This shift in interventional practices in prenatal care reflects a shift in health systems toward medical approaches to the management of pregnancy and childbirth, which aim to reduce maternal and fetal risks, but can also have unintended consequences, such as an increase in preterm birth. Furthermore, this trend may have implications for birth weight and other indicators of infant growth, highlighting the importance of timely and appropriate interventions in prenatal care(26). In our study, cesarean section was strongly associated with low birth weight, and this association was maintained even after adjustment. Maternal hospitalization during pregnancy was strongly associated with low birth weight.

Based on the evidence from this study, it can be said that maternal hospitalization during pregnancy can be an indicator of a high risk pregnancy condition that is associated with an increased likelihood of having a low birth weight baby. Various other studies also show that increased medical care can have a negative effect on the baby(27). The results of Amer Sindiani et al. show that the number of prenatal visits and low birth weight are negatively correlated(28). In the present study, a history of low birth weight was one of the strongest predictors of recurrence of this outcome, with mothers who had previously given birth to a low birth weight infant having a 2.6-fold increased chance of having a low birth weight infant in the current pregnancy. This finding is consistent with previous studies. In the review, several studies have shown that a history of LBW plays an important role in the recurrence of low birth weight(29, 30). For example, the study by Mvunta et al(31). reported that women with a history of low birth weight were significantly more likely to have recurrent LBW in late pregnancy than mothers who had previously given birth to a normal weight infant. According to many epidemiological studies, a history of miscarriage, especially recurrent miscarriages, can be associated with an increased risk of having a low birth weight baby in subsequent pregnancies(32, 33). This association was also seen in the present study. Violence during pregnancy can have adverse effects on women's physical, sexual, reproductive, and mental health, potentially causing negative consequences for the mother and fetus(34). Failure to prevent violence during pregnancy can lead to an increased likelihood of low birth weight, indicating a direct impact of violence on fetal development outcomes(35). Maternal anxiety during pregnancy is associated with an increased risk of low birth weight, as severe anxiety can cause reduced placental blood flow, premature birth, and fetal growth restriction, directly or indirectly reducing birth weight. The results of these studies are consistent with the findings of the present study, showing that mothers who experienced more anxiety during pregnancy gave birth to babies with lower birth weights(36, 37). Our study found that a history of cancer in the mother is associated with an increased risk of low birth weight, which is consistent with the study by Sun et al(38). Gestational diabetes is usually associated with increased birth weight, but mothers with poor glycemic control or chronic diabetes with vascular complications also have an increased risk of having a low birth weight baby(39). This pattern was also observed in our study, with 25% of mothers with diabetes giving birth to a low birth weight baby. Thyroid

dysfunction is a common endocrine complication in pregnant women: the association between low birth weight (LBW) of the infant and thyroid dysfunction during pregnancy has been confirmed(40). Previous studies have shown that maternal thyroid disorders, especially untreated hypothyroidism or hyperthyroidism, are associated with an increased risk of low birth weight and may be affected through mechanisms such as intrauterine growth restriction, reduced placental blood flow, and the incidence of preterm birth(41, 42). The results of the present study are consistent with these findings, showing that mothers with thyroid disorders during pregnancy had neonates with lower birth weight. Previous studies have shown that maternal obesity or high body mass index before pregnancy can be associated with different outcomes in birth weight. Some systematic reviews and meta analyses have reported that overweight or obese women have a lower risk of having a low birth weight baby(43), while other large studies have shown that the same group of women may have a higher risk of having a low or very low birth weight baby, especially when obesity is associated with metabolic complications(44).

The findings of the present study are also consistent with these results of the first study and suggest that maternal obesity before pregnancy can be a protective factor against having a low birth weight baby. Studies have shown that maternal blood pressure disorders during pregnancy particularly preeclampsia and gestational hypertension are highly associated with the risk of low birth weight. For example, a meta-analysis in Ethiopia reported that women with gestational hypertension were about four times more likely to have a low birth weight infant than women with normal blood pressure(45). Also, a study in China found that hypertension and preeclampsia were associated with LBW with an OR of 1.77 and 3.01, respectively(46). The findings of the present study are also consistent with this international evidence, indicating that mothers who developed high blood pressure during pregnancy were more likely to have a low birth weight infant. Despite controlling for demographic, psychological, medical, and maternal comorbidities, the association between maternal depression during pregnancy and low birth weight remained, indicating that depression is a strong and independent factor in increasing the risk of low birth weight. An important point that has been observed in various studies is that women who experience major depression and psychological stress during pregnancy are at higher risk of giving birth to premature or low birth weight babies. This pattern was also clearly observed in the present study, emphasizing that maternal mental health plays a key role in birth outcomes and that paying attention to it can be effective in reducing the birth of low birth weight babies(47–49).

One of the main strengths of this study is the large sample size and the use of a population-based dataset derived from an electronic health record system, which enhances the generalizability of the findings. Additionally, the use of clinically confirmed diagnoses of depression improves the validity of exposure classification. This study has several limitations. First, due to the retrospective nature of the study, causal inferences cannot be definitively established. Second, potential residual confounding may still exist despite adjustment for multiple variables. Third, information on certain important factors such as maternal nutrition, smoking status, and body mass index changes during pregnancy was not available in the dataset.

Conclusions

The present study found compelling evidence that maternal depression during pregnancy is an independent risk factor for low birth weight even after adjusting for medical, psychological and demographic factors. Maternal mental health is indeed important to fetal growth, and should be examined in prenatal care. Addressing maternal mental health through integrated mental health screening, counseling and early intervention is important in reducing potential risks for poor birth outcomes. When considering addressing depression, domestic violence and other stressful conditions related to pregnancy, a comprehensive multilevel approach is very important. Strengthening the maternal mental health of mothers is important not only with birth outcomes, but for the long term health of mothers and children.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki (2013 version) as adopted by the World Medical Association. Ethical approval was granted by the Research Ethics Committee of Mashhad University of Medical Sciences (Approval Code: IR.MUMS.FHMPM.REC.1403.218). Informed consent to participate was obtained from all participants prior to their inclusion in the study.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

Clinical trial number

not applicable

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Author Contribution

MN is the principal investigator and research leader. AM and EM designed the Study and drafted the manuscript and analyzed the data. MS and SA contributed to the conception, design, data interpretation,

and revising the manuscript. All authors read and approved the final manuscript.

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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