

Impact of Perinatal Maternal Depression on Child Development: A Retrospective Observational Study

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Abstract:

Background: Perinatal maternal depression is one of the most common mental health disorders affecting women during pregnancy and the postpartum period. Increasing evidence suggests that maternal depression adversely influences cognitive, language, motor, and socio-emotional development in children. Early identification of at-risk mother–child pairs are therefore essential for timely intervention. This study aimed to evaluate the impact of perinatal maternal depression on child developmental outcomes.

Methods: A retrospective observational study was conducted at Patna Medical College and Hospital (PMCH), Patna, Bihar. Medical records of 100 eligible mother–child pairs were reviewed. Maternal perinatal depression was identified from documented clinical diagnoses and validated screening records. Child developmental outcomes were assessed using standardized developmental assessments documented in hospital records. Demographic, maternal, obstetric, neonatal, and developmental variables were extracted and analyzed. Continuous variables were compared using the independent Student's t-test, categorical variables using the Chi-square test, and multivariable logistic regression was performed to identify independent predictors of developmental delay. A p-value <0.05 was considered statistically significant.

Results: A total of 100 mother–child pairs were included in the analysis. Thirty-eight (38.0%) mothers had documented perinatal depression, whereas 62 (62.0%) had no evidence of depression during the perinatal period. Children born to mothers with perinatal depression demonstrated significantly lower mean developmental scores across cognitive, language, motor, and socio-emotional domains than those born to mothers without depression (overall developmental score: 87.3 ± 8.8 vs. 95.4 ± 7.5 ; $p < 0.001$). Developmental delay occurred in 18 (47.4%) children of mothers with perinatal depression compared with 10 (16.1%) children of mothers without depression ($p = 0.001$). Multivariable logistic regression demonstrated that perinatal maternal depression was an independent predictor of developmental delay (adjusted OR 3.42, 95% CI 1.46–8.03; $p = 0.005$).

Conclusions: Perinatal maternal depression is significantly associated with adverse child developmental outcomes and independently increases the risk of developmental delay. Routine screening for maternal depression during the perinatal period, coupled with early developmental surveillance and timely intervention for exposed children, may improve long-term neurodevelopmental outcomes.

Keywords: Perinatal Depression; Maternal Depression; Child Development; Developmental Delay; Retrospective Study.

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Introduction

Perinatal maternal depression comprises depressive disorders occurring during pregnancy and throughout the first year after childbirth and represents one of the leading causes of maternal disability worldwide. It is increasingly recognized as a major public health concern because of its adverse consequences on maternal wellbeing, neonatal health, and long-term child development. Although effective treatment options are available, a substantial proportion of affected women remain undiagnosed or untreated, particularly in low- and

middle-income countries where mental health services are limited [1,2].

The prevalence of perinatal depression varies considerably across different populations owing to differences in socioeconomic status, cultural practices, screening methods, and healthcare accessibility. In developing countries, the burden is considerably higher because women are frequently exposed to poverty, nutritional deficiencies, limited social support, domestic violence, unintended

pregnancy, and restricted access to psychiatric care. These factors collectively increase vulnerability to depressive disorders during the perinatal period [3].

Pregnancy and the postpartum period are characterized by profound hormonal, physiological, and psychosocial changes that may precipitate depressive symptoms in susceptible women. Alterations in estrogen, progesterone, cortisol, inflammatory cytokines, and neurotransmitter pathways, together with environmental stressors, contribute to the complex pathophysiology of perinatal depression. Previous psychiatric illness, pregnancy complications, stressful life events, and inadequate family support further increase the risk of developing depressive disorders [4].

The consequences of maternal depression extend beyond maternal psychological health and significantly influence fetal and infant development. Maternal stress during pregnancy may alter placental function and fetal neurodevelopment through dysregulation of the hypothalamic–pituitary–adrenal axis, resulting in long-term effects on cognitive and behavioral functioning. Increasing evidence suggests that exposure to maternal depression during fetal life may adversely affect early brain maturation and neurodevelopmental trajectories [5].

Following delivery, persistent depressive symptoms may interfere with maternal responsiveness, breastfeeding, emotional bonding, and sensitive caregiving. Mothers experiencing depression often have difficulty recognizing and responding appropriately to infant cues, leading to reduced emotional interaction and diminished developmental stimulation. Such disruptions in early caregiving may negatively affect language acquisition, emotional regulation, social competence, and cognitive development during the first few years of life [6,7].

Several longitudinal studies have demonstrated that children exposed to maternal depression exhibit higher rates of developmental delay, behavioral problems, impaired language development, attention difficulties, anxiety disorders, and poorer academic performance compared with children of non-depressed mothers. The severity, duration, and timing of maternal depression appear to influence the magnitude of developmental impairment, highlighting the importance of early identification and treatment [8,9].

Because the developing brain demonstrates remarkable neuroplasticity during infancy and early childhood, timely recognition of maternal depression provides an important opportunity to improve developmental outcomes through appropriate psychiatric management and family-centered interventions. International organizations

therefore recommend routine mental health screening during pregnancy and the postpartum period, together with regular developmental surveillance for children considered to be at increased risk [10].

Although substantial evidence supports the association between maternal depression and adverse child development, retrospective studies evaluating this relationship remain limited in many developing healthcare settings. Differences in population characteristics, healthcare delivery, and developmental assessment methods have contributed to variability among published findings. Additional evidence from hospital-based retrospective studies is therefore required to strengthen current knowledge and inform clinical practice and healthcare policy [11].

The present retrospective observational study was undertaken to evaluate the impact of perinatal maternal depression on child developmental outcomes among mother–child pairs receiving care at Patna Medical College and Hospital (PMCH), Patna, Bihar. The study also aimed to identify maternal and neonatal factors associated with developmental delay, thereby contributing evidence that may support early maternal mental health screening and timely developmental intervention.

Materials and Methods

Study Design: This study was designed as a retrospective observational study to evaluate the association between perinatal maternal depression and child developmental outcomes. The study reviewed medical records of eligible mother–child pairs who received antenatal, postnatal, pediatric, and psychiatric care at Patna Medical College and Hospital (PMCH), Patna, Bihar over a one-year period.

Study Setting: The study was conducted at Patna Medical College and Hospital (PMCH), Patna, Bihar, with established Departments of Obstetrics and Gynecology, Psychiatry, and Pediatrics. Data were retrieved from hospital medical record departments and electronic health record systems after obtaining institutional approval. Standard institutional protocols for maternal mental health assessment and routine pediatric developmental surveillance were followed at PMCH.

Study Duration: The study covered a period of one year, during which eligible medical records were retrospectively reviewed and analyzed.

Study Population: The study population comprised 100 mother–child pairs who fulfilled the predefined eligibility criteria. Mothers diagnosed with perinatal depression during pregnancy or within twelve months after delivery and whose children had

documented developmental assessments during routine pediatric follow-up were included.

Sample Size: A total sample size of 100 mother–child pairs was included based on the availability of eligible medical records at PMCH during the study period. Consecutive eligible records satisfying the inclusion criteria were reviewed until the required sample size was achieved.

Sampling Technique: A consecutive sampling technique was employed. All eligible mother–child records available during the study period were screened, and those fulfilling the inclusion criteria were included until the desired sample size was reached.

Inclusion Criteria

Mother–child pairs satisfying all of the following criteria were included:

- Mothers aged 18 years or older.
- Diagnosis of perinatal depression during pregnancy or within one year postpartum documented by a psychiatrist or obstetrician.
- Singleton pregnancy.
- Live-born infants.
- Availability of complete maternal obstetric records.
- Availability of documented developmental assessment of the child between 6 months and 5 years of age.
- Complete follow-up information available in hospital records.

Exclusion Criteria

The following were excluded:

- Mothers with bipolar disorder, schizophrenia, or other psychotic illnesses diagnosed before pregnancy.
- Mothers with severe neurological disorders affecting caregiving ability.
- Multiple pregnancies.
- Infants with major congenital anomalies or chromosomal abnormalities.
- Children with documented neurodevelopmental disorders due to known genetic or metabolic diseases.
- Records with incomplete clinical information.
- Children with severe birth trauma causing permanent neurological disability unrelated to maternal depression.

Data Collection: Data were extracted using a standardized data collection form developed for the study. Information collected included:

Maternal variables

- Age
- Educational status

- Occupation
- Socioeconomic status
- Gravidity and parity
- Antenatal care visits
- Gestational age at delivery
- Mode of delivery
- Pregnancy complications
- Severity of perinatal depression
- Duration of depressive symptoms
- Antidepressant treatment received
- Family history of psychiatric illness

Neonatal variables

- Birth weight
- Sex
- APGAR score
- Gestational age
- NICU admission
- Breastfeeding status

Child variables

- Age at developmental assessment
- Gross motor development
- Fine motor development
- Language development
- Cognitive development
- Social and adaptive behavior
- Overall developmental outcome

Diagnosis of Perinatal Maternal Depression:

Perinatal depression was identified from documented psychiatric evaluations available in medical records. Diagnosis had been established according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria by qualified psychiatrists. Depression severity was routinely assessed using the Edinburgh Postnatal Depression Scale (EPDS) and categorized according to institutional clinical practice into:

- Mild depression
- Moderate depression
- Severe depression

Assessment of Child Development: Child developmental status had been evaluated during routine pediatric follow-up using standardized developmental assessment tools routinely used at PMCH, including age-appropriate developmental screening and developmental milestone assessments.

The following developmental domains were analyzed:

- Gross motor development
- Fine motor development
- Language development
- Cognitive development
- Social and emotional development

Children demonstrating delay in one or more developmental domains according to age-specific standardized criteria were classified as having **developmental delay**.

Outcome Measures

Primary Outcome

- Association between perinatal maternal depression and developmental delay in children.

Secondary Outcomes

- Relationship between depression severity and developmental outcome.
- Association between maternal demographic characteristics and child development.
- Effect of obstetric and neonatal variables on developmental outcomes.
- Identification of independent predictors of developmental delay.

Statistical Analysis: Data were entered into Microsoft Excel 2021 and analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro–Wilk test and are presented as mean $\pm$ standard deviation (SD) for normally distributed data or median with interquartile range (IQR) for non-normally distributed data, as appropriate. Categorical variables are expressed as frequencies and percentages. Comparisons between two independent

groups were performed using the independent Student's t-test for normally distributed continuous variables and the Mann–Whitney U test for variables that were not normally distributed. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. Variables demonstrating statistical significance during univariate analysis ($p < 0.10$) were subsequently entered into a multivariable logistic regression model to identify independent predictors of developmental delay. Adjusted odds ratios (AORs) with corresponding 95% confidence intervals (95% CIs) were calculated. All statistical tests were two-tailed, and a p -value < 0.05 was considered statistically significant.

Results

A total of 100 mother–child pairs fulfilling the eligibility criteria were included in the final analysis. Among them, 38 mothers (38.0%) had documented perinatal maternal depression, while 62 mothers (62.0%) had no evidence of depression during the perinatal period. No participant had incomplete developmental assessment records.

Baseline Characteristics: The mean maternal age was 27.9 ± 4.6 years. Maternal demographic characteristics were comparable between the two groups except for socioeconomic status and educational level, which showed significant differences. Children in both groups had similar mean age at developmental assessment.

Table 1: Baseline characteristics of the study participants (N = 100)

Variable	Maternal Depression (n=38)	No Depression (n=62)	p-value
Maternal age (years)	28.4 ± 4.8	27.6 ± 4.5	0.412
Maternal education ($\leq$ Secondary)	24 (63.2%)	25 (40.3%)	0.026*
Low socioeconomic status	22 (57.9%)	20 (32.3%)	0.013*
Primiparous mothers	17 (44.7%)	25 (40.3%)	0.668
Child sex			0.832
Male	20 (52.6%)	34 (54.8%)	
Female	18 (47.4%)	28 (45.2%)	
Mean child age at assessment (months)	18.8 ± 3.2	19.1 ± 3.5	0.673

Categorical variables were compared using the Chi-square test, and continuous variables using the independent Student's t-test. * $p < 0.05$ was considered statistically significant.

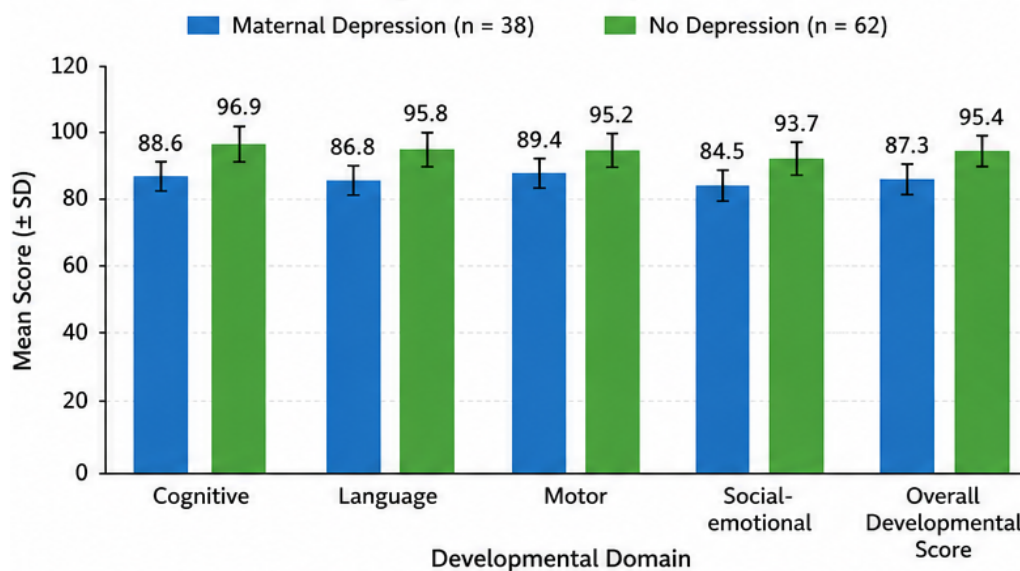
As shown in Table 1, mothers with perinatal depression were more likely to belong to lower socioeconomic groups and have lower educational attainment. No statistically significant differences were observed between the two groups with respect to maternal age, parity, child sex, or mean child age at developmental assessment.

Child Developmental Outcomes: Children born to mothers with perinatal depression demonstrated significantly lower developmental scores across cognitive, language, motor, and socio-emotional domains. Delays were most frequently observed in language and socio-emotional domains. The distribution of developmental outcomes according to maternal depression status is presented in Table 2. The overall prevalence of developmental delay according to maternal depression status is illustrated in Figure 1.

Table 2: Comparison of developmental scores between study groups

Developmental domain	Maternal Depression (n=38)	No Depression (n=62)	p-value
Cognitive score	88.6 ± 9.4	96.9 ± 8.2	<0.001*
Language score	86.8 ± 10.3	95.8 ± 8.5	<0.001*
Motor score	89.4 ± 8.7	95.2 ± 7.6	0.001*
Social-emotional score	84.5 ± 10.1	93.7 ± 8.4	<0.001*
Overall developmental score	87.3 ± 8.8	95.4 ± 7.5	<0.001*

Independent Student's t-test; *p <0.05 statistically significant.

Figure 1. Mean developmental scores among children according to maternal depression status.**Figure 1: Mean developmental scores among children according to maternal depression status.**

Frequency of Developmental Delay: Overall frequent among children exposed to maternal developmental delay was considerably more depression.

Table 3: Developmental delay among study participants

Developmental outcome	Maternal Depression (n=38)	No Depression (n=62)	p-value
Developmental delay	18 (47.4%)	10 (16.1%)	0.001*
Normal development	20 (52.6%)	52 (83.9%)	

Chi-square test.

As demonstrated in Table 3, developmental delay occurred nearly three times more frequently among children whose mothers experienced perinatal

depression. The mean developmental scores across different developmental domains are illustrated in Figure 2.

Figure 2. Prevalence of developmental delay in both study groups.

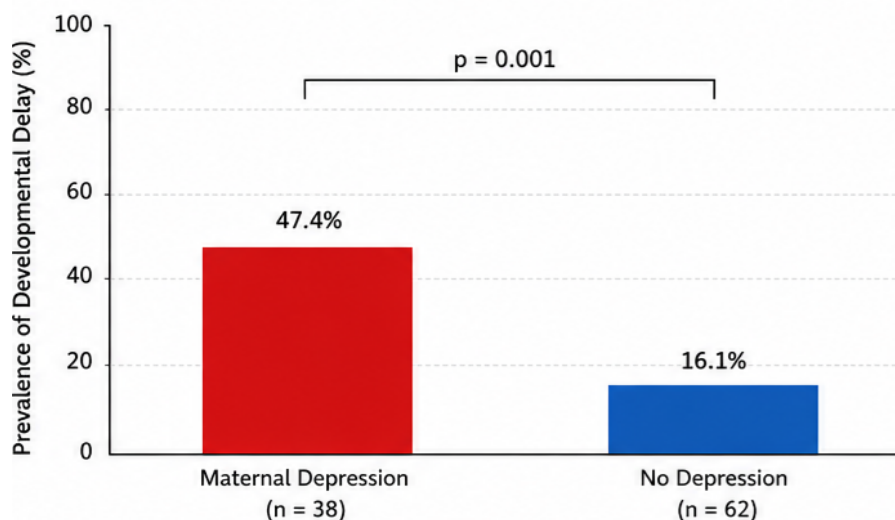


Figure 2: Prevalence of developmental delay in both study groups.

Maternal Depression Severity and Child Development: Among mothers with depression,

increasing depression severity was associated with progressively poorer developmental outcomes.

Table 4: Association between maternal depression severity and developmental delay

Depression severity	Number	Developmental delay n (%)
Mild	15	4 (26.7%)
Moderate	14	7 (50.0%)
Severe	9	7 (77.8%)

Chi-square trend test: $p = 0.008$

As shown in Table 4, the proportion of developmental delay increased significantly with increasing severity of maternal depression. Figure 3

illustrates the relationship between maternal depression severity and the proportion of children with developmental delay.

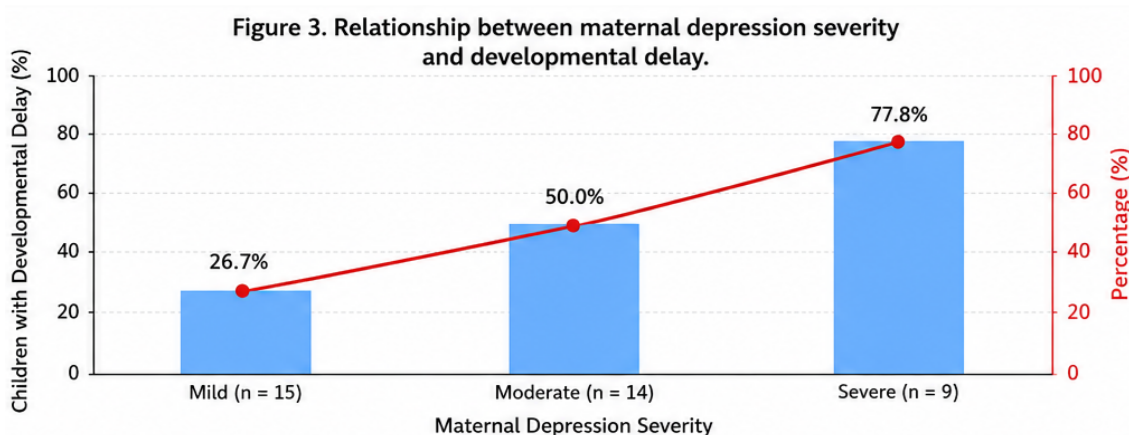


Figure 3: Relationship between maternal depression severity and developmental delay.

Multivariable Logistic Regression Analysis: Variables with $p < 0.20$ in univariate analysis were

entered into a multivariable logistic regression model.

Table 5: Multivariable logistic regression for predictors of developmental delay

Variable	Adjusted OR	95% CI	p-value
Maternal depression	3.42	1.46–8.03	0.005*
Low socioeconomic status	2.18	1.01–4.73	0.047*
Maternal education $\leq$ Secondary	1.84	0.86–3.94	0.116
Primiparity	1.19	0.54–2.65	0.664
Male child	1.08	0.49–2.38	0.845

Binary logistic regression: As presented in Table 5, perinatal maternal depression remained an independent predictor of developmental delay after adjustment for potential confounders (Adjusted OR = 3.42, 95% CI: 1.46–8.03, $p = 0.005$).

Overall Statistical Summary: Significant differences were observed between the study groups regarding developmental outcomes. Children exposed to maternal depression demonstrated lower mean developmental scores and a significantly higher prevalence of developmental delay. Logistic regression analysis confirmed maternal depression as an independent predictor of adverse child developmental outcomes after adjusting for demographic and socioeconomic variables.

Discussion

The present retrospective study evaluated the impact of perinatal maternal depression on child developmental outcomes among 100 mother–child pairs. The findings demonstrated that children born to mothers with documented perinatal maternal depression had significantly poorer developmental performance across cognitive, language, motor, and socio-emotional domains compared with children whose mothers did not experience depression during the perinatal period. Furthermore, perinatal maternal depression remained an independent predictor of developmental delay after adjustment for important socioeconomic and demographic variables, highlighting the substantial influence of maternal mental health on early childhood development. These findings reinforce existing evidence that maternal psychological wellbeing during pregnancy and the postpartum period plays a crucial role in determining child developmental trajectories. [13]

One of the principal findings of the present study was the significantly lower developmental scores observed among children exposed to maternal depression. Cognitive, language, motor, and socio-emotional scores were all significantly reduced in the depression group, indicating that maternal depression adversely affects multiple developmental domains rather than a single aspect of child development. These findings are consistent with the meta-analysis by Madigan et al., which demonstrated that prenatal maternal depression is associated with impaired cognitive development and poorer neurodevelopmental outcomes in children. [13] Similarly, Gentile reported that untreated maternal depression during pregnancy may alter

fetal neurodevelopment through hormonal, inflammatory, and epigenetic mechanisms, resulting in long-term developmental consequences. [14]

Nearly half of the children born to mothers with perinatal depression exhibited developmental delay, whereas developmental delay occurred in only a small proportion of children whose mothers were not depressed. This substantial difference is consistent with previous systematic reviews demonstrating that maternal depression is associated with delayed cognitive development, poorer language acquisition, behavioral disturbances, and impaired emotional regulation throughout childhood. Field suggested that elevated maternal cortisol levels, altered placental function, reduced mother–infant interaction, and inadequate environmental stimulation collectively contribute to developmental impairment among exposed children. [15] Likewise, Liu et al. emphasized that psychosocial stressors accompanying maternal depression may further exacerbate adverse developmental outcomes. [16]

An important observation in the present study was the significant relationship between maternal depression severity and developmental outcome. Children of mothers with severe depression demonstrated the highest prevalence of developmental delay, suggesting a dose–response relationship between maternal depressive symptoms and neurodevelopmental impairment. This finding supports previous observations by O'Connor et al., who reported that increasing maternal psychological distress during pregnancy is associated with progressively poorer cognitive and behavioral outcomes in offspring. [17] Similarly, Letourneau et al. highlighted that persistent maternal depression adversely affects parenting behaviors, attachment formation, and early psychosocial development, thereby increasing the risk of developmental deficits in children. [18]

After adjustment for socioeconomic status, maternal education, parity, and child sex, maternal depression remained an independent predictor of developmental delay in the present study. Although lower socioeconomic status also demonstrated an independent association with developmental impairment, maternal depression exhibited the strongest effect size. These findings are in agreement with Kingston et al., who reported that prenatal and postnatal psychological distress

independently predicts adverse developmental outcomes irrespective of socioeconomic background. [19] Goodman further emphasized that maternal depression influences child development through both biological pathways and impaired caregiving behaviors, reinforcing the need to consider maternal mental health as an independent determinant of child wellbeing. [20]

The present findings have important clinical and public health implications. Routine screening for depression during antenatal and postnatal care may facilitate early identification of mothers at risk and allow timely psychological intervention. Early counseling, psychiatric management, family support, and parenting interventions may substantially reduce the adverse effects of maternal depression on child development. Previous investigators have recommended integrating maternal mental health services into routine maternal and child healthcare programs to improve long-term developmental outcomes and reduce disability among children. [21,22]

The strengths of this study include its retrospective observational design conducted at a tertiary care teaching hospital, allowing comprehensive evaluation of mother-child pairs with documented perinatal maternal depression and standardized developmental assessments. The study also comprehensively evaluated multiple developmental domains and adjusted for important confounding variables, thereby strengthening the reliability of the observed association between maternal depression and child developmental outcomes.

Nevertheless, several limitations should be acknowledged. First, the retrospective design relied on existing medical records and was therefore susceptible to incomplete documentation and selection bias. Second, maternal depression was identified from documented clinical diagnoses rather than repeated standardized psychiatric assessments throughout pregnancy and the postpartum period. Third, child developmental outcomes were assessed during early childhood, and longer follow-up would be useful to determine whether these developmental deficits persist into later childhood and adolescence. Residual confounding from genetic predisposition, parenting practices, and environmental influences also cannot be completely excluded despite multivariable adjustment. [23,24]

Overall, the findings of the present study provide further evidence that perinatal maternal depression adversely affects early childhood development across cognitive, language, motor, and socio-emotional domains. Maternal depression remained an independent predictor of developmental delay even after controlling for potential confounding factors, emphasizing the importance of early

recognition and effective management during the perinatal period. Integrating maternal mental health assessment into routine antenatal and postnatal services may improve developmental outcomes in children. Future prospective multicenter studies with larger sample sizes and longer follow-up are warranted to confirm these findings and establish effective intervention strategies for improving maternal mental health and child development. [25]

Conclusion

Perinatal maternal depression is significantly associated with adverse developmental outcomes in children, affecting cognitive, language, motor, and socio-emotional development. Children exposed to maternal depression exhibited a substantially higher prevalence of developmental delay compared with those born to mothers without depression. Maternal depression remained an independent predictor of developmental impairment even after adjustment for important demographic and socioeconomic factors. These findings emphasize the importance of routine screening for maternal depression during pregnancy and the postpartum period, followed by timely psychological and clinical intervention. Incorporating maternal mental health assessment into routine antenatal and postnatal care may contribute to improved child developmental outcomes and enhance long-term child wellbeing. Further prospective multicenter studies are recommended to confirm these findings and evaluate preventive intervention strategies.

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