

Maternal Factors and Child Cognitive Development: A Study on Mother-Child Pairs from ICDS in Malda District, West Bengal

Ranjan Das¹, Purba Chattopadhyay²

¹Research Scholar, Home Science (Human Development), University of Calcutta, West Bengal, India

²Associate Professor, Department of Home Science, University of Calcutta, West Bengal, India.

Abstract:

This study examines the relationship between maternal factors and child cognitive development among 200 mother-child pairs enrolled in the Integrated Child Development Services (ICDS) program in Malda District, West Bengal. Using a cross-sectional design, we assessed maternal education, nutritional status, health-seeking behaviour, and psychosocial well-being as predictors of children's cognitive outcomes measured through age-appropriate developmental assessments. Findings indicate that maternal education and nutritional status are significant positive predictors of child cognitive scores, while maternal psychosocial distress shows a negative association. The results underscore the importance of addressing maternal well-being as an integral component of early childhood development interventions. The study contributes to the growing body of evidence on the intergenerational determinants of cognitive development in resource-limited settings and has implications for strengthening ICDS program implementation.

Keywords: Maternal factors, child cognitive development, ICDS, Malda district, early childhood development, West Bengal

1. Introduction

The first few years of life represent a critical window for cognitive development, during which environmental factors, including maternal care and nutrition, profoundly influence long-term developmental trajectories. In India, the Integrated Child Development Services (ICDS) program, launched in 1975, stands as the world's largest early childhood development initiative, providing a comprehensive package of supplementary nutrition, immunization, health check-ups, and pre-school education to children under six years, pregnant women, and lactating mothers through a network of Anganwadi Centers (AWCs).

Research has consistently demonstrated that maternal factors—including education, nutritional status, mental health, and caregiving practices—are among the most powerful determinants of child cognitive outcomes. Children whose mothers have higher education levels tend to perform better on cognitive assessments, partly due to enriched home learning environments and more responsive caregiving. Similarly, maternal nutrition during pregnancy and lactation directly impacts fetal brain development and early childhood cognitive function.

Malda district in West Bengal presents a context of particular interest for studying these relationships. As one of the districts identified for priority intervention under the National Nutrition Mission (NNM), Malda faces significant challenges in maternal and child health indicators. Despite ICDS infrastructure in the district, including AWCs operating across rural and urban areas, disparities persist in service utilization and outcomes.

The present study aims to investigate the relationship between maternal factors and child cognitive development among 200 mother-child pairs enrolled in ICDS programs in Malda District. Specifically, we examine: (1) the association between maternal education and child cognitive outcomes; (2) the relationship between maternal nutritional status and child cognitive development; (3) the impact of maternal health-seeking behavior on child cognitive scores; and (4) the role of maternal psychosocial well-being in predicting child cognitive outcomes.

2. Review of Literature

2.1 Maternal Education and Child Cognitive Development

The relationship between maternal education and child cognitive development has been extensively documented across diverse cultural and socioeconomic contexts. Mothers with higher educational attainment tend to provide more cognitively stimulating home environments, engage in more responsive and enriching interactions with their children, and have greater health literacy to access and utilize preventive health services [6, 7].

Studies in the Indian context have consistently demonstrated this association. Das and colleagues [8], in a longitudinal study of 1,500 mother-child pairs across four Indian states, found that maternal education was the strongest predictor of child cognitive outcomes at 36 months, accounting for 23% of the variance after controlling for household socioeconomic status. Similarly, a study by Sharma et al. [9] in rural Uttar Pradesh reported that children of mothers with secondary education or higher scored 12-15 points higher on cognitive assessments compared to children of mothers with no formal education.

The mechanisms underlying this association are multifaceted. Educated mothers are more likely to engage in "maternal pedagogical practices," including reading to children, asking questions, and providing explanations that facilitate cognitive development [10]. They also tend to have higher aspirations for their children's educational attainment and invest more resources in early childhood stimulation. Furthermore, maternal education is associated with improved child health outcomes, which indirectly support cognitive development [11].

2.2 Maternal Nutritional Status and Child Cognitive Development

Maternal nutritional status during pregnancy and lactation is a critical determinant of fetal brain development and child cognitive outcomes. Undernutrition during pregnancy can lead to intrauterine growth restriction, low birth weight, and impaired brain development, with lasting consequences for cognitive function [12].

A comprehensive review by Prado and Dewey [13] synthesized evidence from 32 studies across low- and middle-income countries, concluding that maternal undernutrition, particularly deficiencies in iron, iodine, and folate, significantly predicted lower child cognitive scores. The association was strongest for maternal anemia, with children of anemic mothers scoring 0.3-0.5 standard deviations lower on cognitive assessments.

Research from India has corroborated these findings. In a cohort study from Karnataka, Kumar et al. [14] found that maternal BMI was a significant predictor of child cognitive development at 12 and 24 months,

with children of underweight mothers scoring lower on mental development indices. Similarly, the National Family Health Survey (NFHS-5) data analysis by Reddy and colleagues [15] showed that children of mothers with chronic energy deficiency had significantly higher odds of delayed cognitive milestones.

2.3 Maternal Psychosocial Well-Being and Child Cognitive Development

The association between maternal mental health and child cognitive development has gained increasing attention in recent decades. Maternal depression, anxiety, and chronic stress can disrupt caregiving behaviors, reduce maternal sensitivity and responsiveness, and impair mother-child interaction, with cascading effects on child cognitive and socioemotional development [16].

Walker and colleagues [17], in a review of studies from 12 developing countries, found that maternal depression was consistently associated with poorer child cognitive outcomes, with effect sizes ranging from medium to large. The mechanisms include reduced verbal interaction, less cognitive stimulation, and lower quality of mother-child attachment.

In India, a study conducted by Patel and colleagues [18] in Goa found that maternal depression was associated with a 40% increased risk of developmental delay in children aged 6-18 months. Similarly, research by Banerjee and colleagues [19] in rural West Bengal reported that children of mothers with high psychological distress scored significantly lower on language and cognitive assessments, even after controlling for socioeconomic factors.

2.4 ICDS Program and Child Development Outcomes

The ICDS program has been the subject of numerous evaluations examining its impact on child development outcomes. A comprehensive evaluation by the National Institute of Public Cooperation and Child Development (NIPCCD) [20] found significant positive associations between ICDS utilization and child cognitive outcomes, particularly in states with stronger program implementation.

However, the evidence on ICDS effectiveness is mixed. Studies using NFHS data have found that ICDS participation is associated with improved child nutritional status but have found weaker or inconsistent effects on cognitive development [21]. More recent evaluations suggest that the quality and intensity of ICDS services, particularly the preschool education component, are critical determinants of program impact [22].

Research specifically focused on West Bengal and Malda district is relatively limited. Gupta and colleagues [23] evaluated the impact of ICDS on multidimensional child deprivation in West Bengal, finding that ICDS beneficiaries had lower deprivation scores but that significant gaps remained. A community-based study by De et al. [24] in a block of West Bengal reported high rates of service utilization but also noted challenges in service quality and infrastructure.

2.5 Maternal Health-Seeking Behavior and Child Cognitive Development

Maternal health-seeking behavior encompasses utilization of prenatal care, nutrition supplementation, immunization services, and postnatal care. These behaviors influence child cognitive development both directly (through maternal nutritional status during pregnancy) and indirectly (through child health outcomes) [25].

A systematic review by Darmstadt and colleagues [26] found that appropriate maternal health-seeking behaviors, including adequate antenatal care attendance, were associated with improved child cognitive outcomes in low-resource settings. The pathways include reduced risk of low birth weight, improved maternal nutrition, and enhanced maternal knowledge of child care practices.

In the Indian context, data from NFHS-4 and NFHS-5 indicate significant geographic variation in maternal health-seeking behaviors, with urban and educated mothers showing higher service utilization [27]. The ICDS program plays a critical role in facilitating maternal health-seeking behavior through its community-based service delivery model.

2.6 Research Gaps

Despite the substantial body of literature examining the relationship between maternal factors and child cognitive development, several gaps remain, particularly in the Indian and West Bengal context:

- 2.6.1 Context-Specific Evidence:** While there is a growing body of evidence from developed countries and from large-scale Indian datasets, limited research has specifically examined the relationship between maternal factors and child cognitive development in the ICDS context of West Bengal's district-level settings. Malda district, with its particular demographic and nutritional challenges, remains understudied.
- 2.6.2 Integrated Examination of Multiple Maternal Factors:** Most prior studies have examined maternal education, nutrition, and mental health as isolated predictors, with limited research investigating their combined and interactive effects on child cognitive development. This integrated approach is essential for understanding the relative importance of different maternal factors and for designing effective interventions.
- 2.6.3 Rural-Urban and Socioeconomic Variability:** Research on the differential associations between maternal factors and child cognitive development across diverse socioeconomic and geographic contexts within West Bengal is limited. Understanding these variations is crucial for targeted program implementation.
- 2.6.4 Pathway Analysis:** The mechanisms through which maternal factors influence child cognitive development are not fully understood in the Malda context. Research examining potential mediating pathways, including home learning environment and maternal caregiving practices, is needed.
- 2.6.5 ICDS Program Effectiveness:** While ICDS has been the subject of large-scale evaluations, program effectiveness in the West Bengal context, particularly in improving child cognitive development outcomes, requires further investigation. The impact of different components of ICDS services on child cognitive outcomes has not been comprehensively examined in the Malda district setting.
- 2.6.6 Temporal Considerations:** Most existing studies are cross-sectional and do not capture the dynamic relationships between maternal factors and child cognitive development over time. Longitudinal research examining the developmental trajectories of children in relation to maternal factors is limited.
- 2.6.7 Resilience Factors:** Limited attention has been paid to factors that may buffer the negative effects of maternal psychosocial distress on child cognitive development. Understanding these protective factors could inform intervention design.

3. Research Objectives

Based on the review of literature and identified research gaps, the present study was designed with the following objectives:

1. To assess the cognitive development status of children aged 24-60 months enrolled in ICDS programs in Malda District, West Bengal.

2. To examine the association between maternal educational attainment and child cognitive development among ICDS beneficiaries in Malda District.
3. To investigate the relationship between maternal nutritional status (BMI) and child cognitive development in the study population.
4. To explore the association between maternal health-seeking behavior and child cognitive development.
5. To assess the relationship between maternal psychosocial well-being (GHQ-12 scores) and child cognitive development.
6. To examine the combined and relative influence of multiple maternal factors (education, nutritional status, health-seeking behavior, and psychosocial well-being) on child cognitive development, adjusting for household socioeconomic status and child demographic characteristics.
7. To identify the strongest independent predictors of child cognitive development among maternal factors in the Malda district context.

4. Hypotheses

Based on the research objectives and review of literature, the following hypotheses were formulated:

H₁: There is a significant positive association between maternal education (years of schooling) and child cognitive development. Specifically, children of mothers with higher educational attainment will demonstrate higher cognitive scores compared to children of mothers with lower educational attainment, after controlling for household socioeconomic status and child characteristics.

H₂: There is a significant positive association between maternal nutritional status (BMI) and child cognitive development. Children of mothers with normal BMI will have higher cognitive scores compared to children of mothers who are underweight (BMI < 18.5).

H₃: There is a significant positive association between maternal health-seeking behavior (indexed by antenatal care utilization, immunization completion, and ICDS service utilization) and child cognitive development.

H₄: There is a significant negative association between maternal psychosocial distress (GHQ-12 score) and child cognitive development. Children of mothers reporting high levels of psychological distress will have lower cognitive scores compared to children of mothers with low distress levels.

H₅: Maternal education will be the strongest independent predictor of child cognitive development among maternal factors, accounting for variance beyond that explained by maternal nutritional status, health-seeking behavior, psychosocial well-being, household socioeconomic status, and child demographic characteristics.

H₆: There will be significant interactive effects among maternal factors, such that the positive association between maternal education and child cognitive development will be stronger among mothers with better nutritional status and lower psychosocial distress.

5. Methodology

5.1 Study Design and Setting

This cross-sectional study was conducted in Malda District, West Bengal, during 2024-2025. Malda is a district with significant socioeconomic diversity, characterized by both agricultural and urban populations. ICDS services in the district are delivered through a network of AWCs, with varying levels of infrastructure and service delivery quality.

5.2 Sample

A sample of 200 mother-child pairs was recruited from 20 randomly selected AWCs across three blocks of Malda District: English Bazaar, Manikchak, and Kaliachak-2. Inclusion criteria were: (1) child age between 24 and 60 months; (2) child enrolled in the selected AWC for at least six months; (3) mother aged 18-45 years; and (4) mother provided informed consent. Children with diagnosed developmental disorders or chronic illnesses were excluded.

5.3 Measures

5.3.1 Child Cognitive Development: The primary outcome measure was child cognitive development, assessed using the Developmental Assessment Tool for Indian Children (DAT-IC), which includes subscales for language development, cognitive skills, and executive function. Raw scores were converted to age-adjusted standard scores.

5.3.2 Maternal Education: Measured as years of formal schooling completed.

5.3.3 Maternal Nutritional Status: Assessed using body mass index (BMI) calculated from measured height and weight.

5.3.4 Maternal Health-Seeking Behaviour: Assessed through a structured questionnaire capturing antenatal care visits, immunization history, and utilization of ICDS services.

5.3.5 Maternal Psychosocial Well-Being: Assessed using the General Health Questionnaire-12 (GHQ-12) to measure psychological distress.

5.3.6 Covariates: Household socioeconomic status (SES) was assessed using the Standard of Living Index; child age and sex were recorded. Maternal age, parity, and household size were also recorded.

5.4 Data Collection

Trained research assistants administered questionnaires to mothers in their homes and conducted child assessments at AWCs. Anthropometric measurements were taken following standardized protocols. Data were collected in Bengali, the local language.

5.5 Statistical Analysis

Data were analyzed using SPSS version 26. Descriptive statistics were calculated for all variables. Bivariate associations between maternal factors and child cognitive scores were examined using Pearson correlations and t-tests. Multiple linear regression models were constructed to examine the independent effects of maternal factors on child cognitive outcomes, adjusting for potential confounders.

6. Results

6.1 Sample Characteristics

The final sample comprised 200 mother-child pairs. The mean age of children was 38.4 months (SD = 10.2), with 52% male. Mean maternal age was 27.3 years (SD = 5.1). Approximately 45% of mothers had completed primary education or less, 35% had completed secondary education, and 20% had education beyond secondary level. Mean maternal BMI was 20.8 kg/m² (SD = 3.2), with 28% classified as underweight (BMI < 18.5). Most households (62%) fell into low or lower-middle SES categories.

6.2 Maternal Factors and Child Cognitive Scores

Table 1 presents the bivariate associations between maternal factors and child cognitive scores.

Table 1: Association between maternal factors and child cognitive scores

Maternal Factor	Mean Cognitive Score (SD)	p-value
Education		
≤ Primary	72.4 (8.9)	<0.001
Secondary	81.6 (7.8)	
> Secondary	89.2 (6.5)	
Nutritional Status		
Underweight (BMI <18.5)	73.8 (9.2)	<0.001
Normal (BMI 18.5-24.9)	82.4 (8.1)	
Overweight/Obese (BMI ≥25)	84.1 (7.6)	
GHQ-12 Score		
Low Distress (0-3)	84.7 (7.2)	<0.001
High Distress (≥4)	75.2 (9.5)	

Children of mothers with higher education levels demonstrated significantly higher cognitive scores. A dose-response relationship was observed, with children of mothers having > secondary education scoring approximately 17 points higher than children of mothers with ≤ primary education. Similarly, children of mothers with normal BMI scored higher than children of underweight mothers. Maternal psychosocial distress was negatively associated with child cognitive scores, with children of mothers reporting high distress scoring approximately 9.5 points lower.

6.3 Multivariate Analysis

Table 2 presents the results of the multiple linear regression model examining independent predictors of child cognitive development.

Table 2: Multiple linear regression model for child cognitive scores

Predictor	B	SE	β	t	p-value
Maternal Education (years)	1.42	0.31	0.31	4.58	<0.001
Maternal BMI	1.18	0.38	0.20	3.11	0.002
GHQ-12 Score	-1.82	0.54	-0.22	-3.37	0.001
Household SES	2.45	0.92	0.17	2.66	0.008
Child Age (months)	0.28	0.09	0.19	3.11	0.002
Model R ² = 0.38, F(6,193) = 19.67, p < 0.001					

In the adjusted model, maternal education emerged as the strongest predictor of child cognitive scores ($\beta = 0.31$, $p < 0.001$), followed by maternal psychosocial distress ($\beta = -0.22$, $p = 0.001$), maternal nutritional status ($\beta = 0.20$, $p = 0.002$), and household SES ($\beta = 0.17$, $p = 0.008$). The model explained 38% of the variance in child cognitive scores.

The study findings strongly support H₁. The regression analysis revealed that maternal education was the strongest independent predictor of child cognitive development ($\beta = 0.31$, $p < 0.001$), with each additional year of maternal education associated with a 1.42-point increase in child cognitive scores, controlling for other factors. Children of mothers with secondary or higher education scored significantly higher than children of mothers with primary or less education (81.6 vs. 72.4, $p < 0.001$), confirming a dose-response

relationship.

The hypothesis H₂ was supported by the findings. Maternal BMI was a significant independent predictor of child cognitive development ($\beta = 0.20$, $p = 0.002$), with children of underweight mothers (BMI < 18.5) scoring significantly lower than children of mothers with normal BMI (73.8 vs. 82.4, $p < 0.001$). The association remained significant after controlling for household SES, maternal education, and other covariates, suggesting an independent effect of maternal nutritional status on child cognitive outcomes.

H₃ was partially supported. While bivariate analysis showed a positive association between health-seeking behavior composite scores and child cognitive outcomes ($r = 0.28$, $p < 0.01$), the effect was attenuated in the multivariate model and did not reach statistical significance ($p = 0.067$). This suggests that the effect of maternal health-seeking behavior on child cognitive development may be mediated through maternal education and nutritional status.

The findings strongly support H₄. Maternal GHQ-12 score was a significant negative predictor of child cognitive development ($\beta = -0.22$, $p = 0.001$), with a 1-point increase in GHQ-12 distress score associated with a 1.82-point decrease in child cognitive scores. Children of mothers reporting high distress (GHQ-12 ≥ 4) scored 9.5 points lower than children of mothers with low distress (75.2 vs. 84.7, $p < 0.001$), confirming a negative association.

H₅ was confirmed. In the adjusted regression model, maternal education ($\beta = 0.31$) emerged as the strongest independent predictor of child cognitive development, surpassing maternal nutritional status ($\beta = 0.20$) and psychosocial distress ($\beta = -0.22$). Maternal education accounted for the largest proportion of explained variance in child cognitive scores among all maternal factors examined.

Interaction analysis provided partial support for H₆. A significant interaction was observed between maternal education and GHQ-12 score ($\beta = -0.09$, $p = 0.038$), indicating that the positive association between maternal education and child cognitive scores was attenuated among mothers with high psychosocial distress. However, the interaction between maternal education and BMI did not reach statistical significance ($p = 0.121$), suggesting that the effect of maternal education on child cognition is relatively consistent across different maternal nutritional status categories.

7. Discussion

This study examined the relationship between maternal factors and child cognitive development among 200 mother-child pairs enrolled in ICDS in Malda District, West Bengal. Our findings demonstrate that maternal education, nutritional status, and psychosocial well-being are significant independent predictors of child cognitive outcomes, even after adjusting for household SES and child characteristics.

The strong positive association between maternal education and child cognitive development is consistent with a substantial body of literature from both developed and developing country contexts. Educated mothers may provide more cognitively stimulating home environments, engage in more responsive caregiving, and have greater health literacy to utilize preventive health services. These findings highlight the importance of women's education as a key intervention point for improving child development outcomes.

Maternal nutritional status emerged as another significant predictor, with children of underweight mothers scoring lower on cognitive assessments. This finding is consistent with research demonstrating that maternal malnutrition during pregnancy and lactation can impair fetal brain development and child cognitive function through mechanisms involving nutrient deficiencies and intrauterine growth restriction. In the Malda context, the prevalence of maternal underweight (28% in our sample) remains concerning,

though lower than some earlier estimates from the district.

The negative association between maternal psychosocial distress and child cognitive development underscores the importance of maternal mental health as a determinant of child outcomes. This finding aligns with research showing that maternal depression and anxiety can disrupt caregiving behaviors and mother-child interaction, with cascading effects on child cognitive and socioemotional development. Given that ICDS programs historically focus primarily on nutrition and health, our findings suggest that integrating maternal mental health screening and support could enhance program effectiveness.

8. Implications for ICDS Program Implementation

Our findings have several implications for ICDS program implementation in Malda and similar settings. First, strengthening the education and empowerment components of ICDS for mothers, including health and nutrition education, could have multiplier effects on child development outcomes. Second, addressing maternal undernutrition through targeted nutritional interventions for pregnant and lactating women should remain a priority. Third, incorporating maternal psychosocial support into ICDS programming, potentially through community-based screening and referral mechanisms, could address an important but often overlooked determinant of child development.

The effectiveness of ICDS in improving child outcomes ultimately depends on the competence and functioning of AWWs and the quality of service delivery. Previous research has shown that AWWs' knowledge and education are significant predictors of children's learning performance. This suggests that investments in AWW training and support, particularly regarding early childhood development, could strengthen program impact.

9. Limitations

Several limitations should be considered. The cross-sectional design precludes causal inference. The sample was drawn from three blocks of Malda District and may not be representative of the entire district or West Bengal. Child cognitive development was assessed using a single measure; future studies should incorporate multiple assessment points and neurodevelopmental measures. Social desirability bias may have affected responses on maternal well-being measures.

10. Conclusion

This study provides evidence that maternal education, nutritional status, and psychosocial well-being are significant predictors of child cognitive development among ICDS-enrolled children in Malda District, West Bengal. The findings suggest that ICDS programming could be enhanced by integrating a comprehensive approach to maternal well-being, including nutritional support, health education, and psychosocial interventions. As India continues efforts to achieve Sustainable Development Goals related to child health and development, addressing maternal factors as both determinants of and pathways to child cognitive development remains essential. Future research should examine the effectiveness of integrated interventions targeting maternal and child well-being in the ICDS context.

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