

# Early Childhood Research Quarterly

## Effect of children's socio-economic and health status in Early Childhood Education Programs in Bangladesh: A cross-sectional Study of MICS-2019

--Manuscript Draft--

|                              |   |
|------------------------------|---|
| <b>Manuscript Number:</b>    | ECRQ-D-23-00579   |
| <b>Article Type:</b>         | Research Paper  |
| <b>Keywords:</b>             | Early Childhood Education (ECE) programs; Early childhood disease; mother's education; stunting; wasting; underweight   |
| <b>Corresponding Author:</b> | Md Jamal Uddin, PhD<br>Shahjalal University of Science and Technology<br>BANGLADESH   |
| <b>First Author:</b>         | A T M Shariful Alam   |
| <b>Order of Authors:</b>     | A T M Shariful Alam<br>Mohammad Nayeem Hasan<br>Md. Nahidul Islam Emon<br>Robiul Islam Akash<br>Muhammad Abdul Baker Chowdhury<br>Md Jamal Uddin, PhD   |
| <b>Abstract:</b>             | <p><b>Introduction</b></p> <p>Early Childhood Education (ECE) programs are one of the vital parts of UNESCO's development objective as ECE programs exhibit a positive development of children in their childhood life as well as future life. Children who attain ECE programs are more likely to complete their further primary studies than their counterparts. ECE program enrollment rate among children between 36 to 59 months in Bangladesh is subsequently very low. Different types of covariates such as the mother's education level, Early childhood disease, and nutritional status (underweight, stunting, Wasting, and overweight) have been used for this study. The main objective of this study is to find out the effect of different socio-economic and health-related variables on the ECE program enrollment rate.</p> <p><b>Methodology</b></p> <p>This study has obtained data from the Multiple Indicator Cluster Survey (MICS) 2019. For this study, a total number of 9447 children between 36 to 59 months of age has been selected. Descriptive statistics and the chi-square test have been used in this study to find the relationship between the dependent and independent variables. Multinomial logistic regression has been used to find the association of the independent variables' independent variables.</p> <p><b>Result</b></p> <p>19.86% of male children and 18.92% of female children have enrolled in ECE programs. Children from the urban and rural areas have a respective 23.64% and 18.27% participation in ECE programs. For secondary Complete or Higher mothers, the Odd Ratio (OR) is 2.20 (CI: 1.61-3.02) compared to the primary incomplete mothers. ECE program enrollment among children from the Richest families has an OR of 1.23(CI: 0.93-1.64) compared to the poor families. Households that contain picture books for children have an OR of 1.76 (CI:1.5-2.07) compared to their counterparts. Stunned children have an OR of 0.60 (CI: 0.49-0.73) compared to their counterparts.</p> <p><b>Conclusion</b></p> <p>The conclusion emphasizes the need to increase ECE program participation by emphasizing health factors, mother's education, and socioeconomic factors. It</p> |

|                             |   |
|-----------------------------|---|
|                             | emphasizes the significance of social awareness, parental education, and girl's education in promoting early childhood education. |
| <b>Suggested Reviewers:</b> | Lydia Nganga<br>Inganga@uwyo.edu  |
|                             | Fantahun Admas<br>fantahun.admas@aau.edu.et   |

October 14, 2023

Department of Statistics

Shahjalal University of Science & Technology  
Sylhet-3114, Bangladesh

To:  
Editors-in-Chief – Early Childhood Research Quarterly

Subject: Submission of Manuscript

Dear Sir/Madam,

I'm sending you this letter to submit my manuscript entitled "*Effect of Children's Socio-economic and Health Status in Early Childhood Education Programs in Bangladesh: A Cross-sectional Study of MICS-2019*" for consideration for publication in **Early Childhood Research Quarterly**.

We thoroughly evaluated the journal's scope and prior publications, and we feel that our study is well aligned with the journal's aims and objectives.

As Early childhood Education (ECE) Programs are crucial to a child's development, it is very important to figure out how the factors are affecting enrollment rate in ECE Programs. The main objective of this study was to figure out the underlying factors affecting ECE program enrollment. We used the MICS-2019 data set. The result of this study's findings is an important contribution to the area, and I think your renowned journal's readers would find this study's results interesting the enrollment rate in males and females in ECE programs among 36- to 59-month-old children is very low in Bangladesh (Male:19.86% Female:18.92%). Children from the urban and rural areas have a respective 23.64% and 18.27% participation in ECE programs. For secondary Complete or Higher mothers, the Odd Ratio (OR) is 2.20 (CI: 1.61-3.02) compared to the primary incomplete mothers. ECE program enrollment among children from the Richest families has an OR of 1.23(CI: 0.93-1.64) compared to the poor families. Households that contain picture books for children have an OR of 1.76 (CI:1.5-2.07) compared to their counterparts. Stunned children have an OR of 0.60 (CI: 0.49-0.73) compared to their counterparts.

I have made sure the work complies with the formatting standards and submission procedures of the journal. I certify that this paper has not already been published and is not being considered for publication in any other journals. All co-authors have been thanked and have given their permission for this work to be submitted to **Early Childhood Research Quarterly**. I'd also be grateful if the editorial board would take reviewers into account who have expertise in **Early Childhood Research Quarterly**.

I value your time and consideration given to my proposal. Regarding the outcome of the review process, I'm looking forward to hearing from you shortly.

Sincerely



Dr. Md Jamal Uddin (Corresponding Author)

Professor

Phone: +8802996636454, 02996634850, 02996633825 (ext. 2257), M: +8801716972846

Fax: 880-821-715257

Email: jamal-sta@sust.edu, jamalsust@gmail.com

## Highlights

1. Children from mothers with higher education have a 2.2 times higher chance to enroll in early childhood education (ECE) Programs compared to the primary incomplete mothers.
2. Children from the Richest families have a 1.23 times higher chance to enroll in ECE programs compared to poor families.
3. Children who contain picture books in the household have a 1.76 times higher chance of enrolling in ECE programs compared to their counterparts.
4. Stunned children have 40% less chance to enroll in ECE programs Compared to their counterparts.

**Title: Effect of children's socio-economic and health status in Early Childhood Education  
Programs in Bangladesh: A cross-sectional Study of MICS-2019**

**Authors Details**

**A T M Shariful Alam**

Department of Statistics

Shahjalal University of Science & Technology, Sylhet-3114, Bangladesh

Email: [alamshihab1@gmail.com](mailto:alamshihab1@gmail.com)

Orcid ID: <https://orcid.org/0000-0001-8651-4763>

**Mohammad Nayeem Hasan**

Department of Statistics

Shahjalal University of Science & Technology, Sylhet-3114, Bangladesh

Email: [nayeem5847@gmail.com](mailto:nayeem5847@gmail.com)

Orcid ID: <https://orcid.org/0000-0002-2383-0459>

**Md. Nahidul Islam Emon**

Department of Statistics

Shahjalal University of Science & Technology, Sylhet-3114, Bangladesh

Email: [emon.192679@gmail.com](mailto:emon.192679@gmail.com)

Orcid ID: <https://orcid.org/0000-0003-4942-7016>

**Robiul Islam Akash**

Department of Statistics

Shahjalal University of Science & Technology, Sylhet-3114, Bangladesh

Email: [robiulislamakash89@gmail.com](mailto:robiulislamakash89@gmail.com)

Orcid ID: <https://orcid.org/0000-0001-6592-6670>

**Muhammad Abdul Baker Chowdhury , +**

Department of Emergency Medicine

University of Florida College of Medicine, Gainesville, FL, USA.

Email: [mchow023@fiu.edu](mailto:mchow023@fiu.edu)

Orcid ID: <https://orcid.org/0000-0002-2145-0938>

**Md Jamal Uddin** <sup>1, +, \*</sup>

Department of Statistics

Shahjalal University of Science & Technology, Sylhet-3114, Bangladesh

Department of General Education and Development,

Daffodil International University, Dhaka, Bangladesh

Email: [jamal-sta@sust.edu](mailto:jamal-sta@sust.edu) , [jamalsust@gmail.com](mailto:jamalsust@gmail.com)

Orcid ID: <https://orcid.org/0000-0002-8360-3274>

Phone: +880-821-713491, 714479, 713850, 717850, 716123, 715393 (ext. 2257)

Fax: 880-821-715257

+ Senior authors

\* Corresponding author

### **Acknowledgement**

This paper utilizes data collected from Multiple Indicator Cluster Survey initiative 2019 which was jointly conducted by UNICEF and BBS (Bangladesh Bureau of Statistics).

### **Funding Information**

The authors received no financial support for the research, authorship, or publication of the article.



**Title: Effect of children's socio-economic and health status in Early Childhood Education Programs in Bangladesh: A cross-sectional Study of MICS-2019**

**Abstract:**

**Introduction:** Early Childhood Education (ECE) programs are one of the vital parts of UNESCO's development objective as ECE programs exhibit a positive development of children in their childhood life as well as future life. Children who attain ECE programs are more likely to complete their further primary studies than their counterparts. ECE program enrollment rate among children between 36 to 59 months in Bangladesh is subsequently very low. Different types of covariates such as the mother's education level, Early childhood disease, and nutritional status (underweight, stunting, Wasting, and overweight) have been used for this study. The main objective of this study is to find out the effect of different socio-economic and health-related variables on the ECE program enrollment rate.

**Methodology:** This study has obtained data from the Multiple Indicator Cluster Survey (MICS) 2019. For this study, a total number of 9447 children between 36 to 59 months of age has been selected. Descriptive statistics and the chi-square test have been used in this study to find the relationship between the dependent and independent variables. Multinomial logistic regression has been used to find the association of the independent variables' independent variables.

**Result:** 19.86% of male children and 18.92% of female children have enrolled in ECE programs. Children from the urban and rural areas have a respective 23.64% and 18.27% participation in ECE programs. For secondary Complete or Higher mothers, the Odd Ratio (OR) is 2.20 (CI: 1.61-3.02) compared to the primary incomplete mothers. ECE program enrollment among children from the Richest families has an OR of 1.23(CI: 0.93-1.64) compared to the poor families. Households that contain picture books for children have an OR of 1.76 (CI:1.5-2.07) compared to their counterparts. Stunned children have an OR of 0.60 (CI: 0.49-0.73) compared to their counterparts.

**Conclusion:** The conclusion emphasizes the need to increase ECE program participation by emphasizing health factors, mother's education, and socioeconomic factors. It emphasizes the significance of social awareness, parental education, and girl's education in promoting early childhood education.

**Keyword:** Early Childhood Education (ECE) programs, Early childhood disease, mother's education, socioeconomic status, stunting, wasting, underweight.



## **Introduction**

Ensuring a globally guaranteed minimum of one year of Early Childhood Education (ECE) constitutes a crucial element of UNESCO's developmental objective in the post-2015 agenda (Strietholt et al., 2020). Children who do not participate in Early Childhood Education (ECE) programs may fail to acquire essential academic competencies, including language, literacy, and mathematical skills, which are pivotal for their subsequent primary school performance (Ansari et al., 2019). ECE programs refer to different types of educational activities or initiatives such as preschool programs, Nursery or kindergarten, Early intervention programs, childcare centers, and pre-primary education centers (Ansari et al., 2019). Early Childhood Education (ECE) programs assume a pivotal role in delineating the life trajectory of children, engendering a robust groundwork for their emotional, social, and cognitive maturation and these programs exert a constructive impact not only in the immediate context but also reverberate into the long term, substantively influencing the realm of academic accomplishments (Ansari et al., 2019)(Reynolds et al., 2011). Participation in ECE programs for a year or more positively correlates with later primary school participation and fosters comprehensive physical and mental preparedness (Aboud, 2007; MPME, 2013)

Due to socioeconomic and cultural differences, there is a significant inequality in the number of participants in ECE Programs among different regions. Internationally, the participation rate in ECE programs among children aged 36 to 59 months stands at a mere 39% (UNICEF, 2023). Regionally, the Latin America and Caribbean area leads with a substantial participation rate of 64%, followed by a 46% participation rate in South Asia (UNICEF, 2023). Conversely, the lowest participation rate in ECE programs, amounting to 24%, is reported in West and Central Africa (UNICEF, 2023). Some studies have found growth in the participation of ECE programs in

Cambodia, India, and Ghana (Yoshikawa & Kabay, 2015). In Pakistan participation rate in ECE programs was 37.2% (UNESCO, 2007). According to the MICS, reports in 2006 only 14.6% of children between 36-59 months of age attended ECE programs, whereas in 2012-13, the ECE Programs participation rate was 13.4% and in 2019 the rate increased by ending up at 18.9% ECE Programs participation rate in Bangladesh (BBS-UNICEF, 2007; Progotir Pothey, 2015; UNICEF, 2019). In 2023, Bangladesh has a very low participation rate of 19% in ECE programs, which is just 1% greater than the Least developed countries combinedly (UNICEF, 2023).

Some studies have shown that positive results at school entry are strongly correlated with high-quality ECE programs (NSW Department of Education, 2018), Family socioeconomic status, mother's education level, ethnic background, and Wealth index has been seen positively influencing greatly in ECE Programs attainment in the UK (Sammons et al., 2004). A longitudinal study has been conducted in rural Pakistan to investigate the impact of the health of the children (nutritional factors) on school participation (Alderman et al., 2001). Another study from Lahore, Pakistan has demonstrated how "Family size", "Income groups" (economic status), and "Household Head's Education" impact school participation (Baluch & Shahid, 2008). E. Gurm and D. Etana showed that children's enrolment in primary schools heavily depends on Socioeconomic and demographic factors such as "Economic Status", "Number of siblings", and "place of residence" an impact on primary school participation (Gurm & Etana, 2013).

Greenberg has shown that maternal education has a significant impact on the children's ECE Programs participation, where the increase in the mother's education level shows an increasing participation rate in ECE Programs (Greenberg, 2011). A study was conducted using data from 1968 to 2013 on 3 to 4-year-old children's participation in ECE Programs, they found that family income impacted children's ECE Programs participation and their performance in the

program was less well than other children (Magnuson & Waldfogel, 2016). Another study from Kenya has found that poor health condition of children has a significant effect on low participation rate in preschool (Gakii Murungi, 2012). A study has found that parent's engagement in certain learning-stimulating activities and presence of child books at home both have a positive impact on participation in ECE Programs (Alam et al., 2022). A study conducted in the UK found that the income of the family, the mother's qualification level, and ethnic and language backgrounds have a positive and significant impact on the attainment of ECE Programs (Sammons et al., 2004). In Bangladesh through different types of activities and programs organized by NGOs in rural areas accessibility of ECE Programs has increased because of this participation rate has also increased in past years (UNESCO, 2015).

The main gap in the current knowledge is all studies were focused on some selective socio-economic characteristics, such as "Mother's Education" or "Wealth Index" and their effect in ECE programs (Bustamante et al., 2022; Crosnoe et al., 2021; Greenberg, 2011; Sammons et al., 2004). Moreover, some studies have studied effect of different socio-economic characteristics such as "Economic Status", "Number of Siblings", and "Place of Residence" where other research studied the effect of "Family Size", "Income Groups" (economic status), and "Household Head's Education" on Primary School participation (Baluch & Shahid, 2008; Gurmu & Etana, 2013; Sultana et al., 2019). But no study was focused on figuring out the effect of health and socioeconomic characteristics on the ECE programs. This research aims to find how different socio-economic and health factors are associated with ECEP participation.

## **Methods**

### **Data Sources**

This research utilized data from the 2019 Multiple Indicator Cluster Survey (MICS), a comprehensive national household survey carried out in collaboration with UNICEF and administered by the Bangladesh Bureau of Statistics (BBS). The Multiple Indicator Cluster Survey (MICS) is a comprehensive and systematic undertaking designed to gather standardized data and essential metrics for evaluating the present circumstances of children. It places particular emphasis on various factors, including child nutrition, maternal and newborn healthcare, and reproductive health, all of which directly impact child development. Furthermore, the survey systematically collects socioeconomic data pertaining to individuals and households throughout its data collection procedure.(Begum et al., 2019) .

### **Sampling design and sample size:**

The MICS survey is a two-stage stratified cluster sampling procedure to collect data at the household level. MICS 2019 is based on a sample of 64000 households interviewed with a response rate of 99.4% whereas eligible children under five years were 24,686 with a response rate of 93.6%. MICS gives a complete picture of the children's health in the seven administrative divisions (Dhaka, Chittagong, Sylhet, Rajshahi, Rangpur, Barisal, and Khulna) in Bangladesh. In this survey, 64 districts were defined as the strata and among these strata a total of 3,220 sample clusters had been selected (Progotir Pathey, 2019). In this study, secondary data has been used. A total number of 9,447 observations of 36 to 59 months old was selected from a total number of 64400 observations on the basis of information which has been illustrated in **figure1**.

## Outcome Variable

The variable "Early Childhood Education (ECE) Programs" is a dichotomous variable with the value '1' indicating a positive response (i.e., 'yes') and the value '0' indicating a negative response (i.e., 'no') which represents the respondent's response on child participated in early childhood education (Progotir Pathey, 2019).

## Covariates

A list of covariates such as child's age, sex, place of residence, region of the country (geographical location), mother's educational level, wealth index, religion, sex of household head, ethnicity of household head, mother's age, early childhood diseases, nutritional status (underweight, stunting, wasting, and overweight), toilet facility, mother stimulation, father stimulation, other stimulation, salt iodization, books, toys, media accessibility (possession of television, newspaper or radio), and child punishment had been used in this study. A detail of these covariates including the levels of the covariates have been given in **Table 1**.

WHO recommended four anthropometric indicators such as, weight-for-age and weight-for-height z-score, have been used to measure a children's nutritional status (WHO, 2022). Here, we have used the z-score to compare stunting, wasting, being underweight and overweight across gender and two age groups between 36 months to 47 months and 48 to 59 months. In both cases, the children were considered wasted or stunted if the value of the weight-for-height z-score and the height-for-age z-score was less than -2 distinctly. Similarly, if the weight-for-age z-score of a child was less than -2 then the child has been considered underweight and if it was higher than +2 then the child has been considered overweight. Toilet facilities has been categorized into two separate categories improved and unimproved, where improved toilet facilities included pit latrine

,flush toilet, flush to piped sewer system or septic tank with slab and unimproved toilet facilities includes hanging toilet, open pit, bucket toilet (Progotir Pathey, 2019)

The educational level of a mother was categorized into four levels: primary incomplete, primary complete, secondary incomplete, secondary complete or higher. Wealth index was categorized as poor, second, middle, fourth, richest. Early childhood diseases were categorized into two categories “yes” and “no”. If the child has symptoms like diarrhea, fever, or symptoms of acute respiratory infection (ARI), confirmed by the mother or caretaker’s then it has been categorized as ‘yes’ otherwise ‘no’. In this study we used to measure three types of stimulations they are mother’s stimulation, father’s stimulation & other’s stimulation. In this study we used involvement of individual adults (ex: Mother, Father or other) such as reading books, telling stories, looking at picture books, playing with children, spending time with children naming, counting, or drawing things or taking children outside the home, compound, or yard in the household with children was measured as stimulation. If children with whom (fathers/mothers/ others) have engaged in any of these activities, then the response has been recorded as “yes” otherwise “no”(Progotir Pathey, 2019).

Inadequate supervision was considered as any children aged below 5 years were left under the supervision of another child younger than 10 years of age or left alone for more than one hour at least once in the last week. Salt iodization was classified into two categories as ‘yes’ and ‘no’. If the resident uses salt more than 0 ppm, then it was considered as ‘yes’ and if in the household there was no salt or the iodine level was 0 ppm then it was considered as ‘no’ (Progotir Pathey, 2019).

## **Statistical Analysis**

In this study, we used bivariate analysis with a chi-square test to evaluate the association between ECEP with other covariates and the univariate (unadjusted) and Multivariable (adjusted) logistic regression model was fitted separately. All the covariate with a p-value smaller than 0.2 has been included into the adjusted model (Nayeem Hasan et al., 2020). During univariate analysis, we added one predictor variable at a time in the regression model and during analysis in the adjusted model all possible predictor variables added together in the model.

To evaluate the accuracy of the best model the Area under the receiver Operating Characteristic curve (AUROC), Specificity, the indicators of sensitivity, Calibration belt plot and Hosmer-Lemeshow goodness of fit test was used. ROC curve indicates the performance of the model. If the area under ROC is higher than the performance of the models is better. Lower P-values on the ROC curve indicate that the model can discriminate between two groups and that the area under the curve is greater than 0.50 (Cook & Rajbhandari, 2018). It could be known how well the model-estimated probabilities agree with the observed outcomes by Calibration and Hosmer-Lemeshow goodness of fit test. The greater the P-value than 0.05 in Calibration belt plot and Hosmer-Lemeshow goodness of fit indicates that the ability to correctly classify observations into outcome categories (Fagerland & Hosmer, 2012; Nattino et al., 2017).

Svyset command in Stata (StataCorp LP, College Station, Texas) was used to account for the complex survey design. During analysis, the Svyset command helps us to design elements such as the primary sampling unit, strata, cluster, and sample weight (Stata, 2022).

### **Check for multicollinearity:**

The Variance inflation factor (VIF) was also used to examine multicollinearity in the final model where the cut-off value was 4.00 (Parang et al., 2000). This study has conducted all the variables with a VIF value less than 4.00.

### **Ethics Statements:**

This freely available secondary data analysis was exempt from ethics assessment because no study on human subjects was done as part of this project.

## **Results**

**Table 1** presents the relationship between ECE Programs and different covariates. The results of the cross-tabulation analysis indicate that a mere 14.03% of children identified as underweight are currently enrolled in ECE Programs. In contrast, a higher proportion of non-underweight children, specifically 21.17%, are actively participating in these educational programs. Among the cohort of children who have encountered episodes of diarrhea, 15.89% are actively participating in ECE Programs. In comparison, 19.54% of their counterparts who have not experienced diarrhea are also enrolled in such programs. Moreover, the data reveals that a mere 11.69% of children displaying indications of stunting are enrolled in ECE Programs, while their non-stunted counterparts exhibit a significantly higher participation rate of 22.63% in such programs.

In the context of geographical residency, it is visible that children who reside in urban areas demonstrate a greater rate of participation in ECE Programs, accounting for 23.64% of the



population. Conversely, their rural counterparts exhibit a comparatively lower attendance rate of 18.27%. The influence of maternal education on ECE participation is evident, with a participation rate of 27.25% observed when mothers have attained a higher educational level. In contrast, a significantly lower rate of 12.95% is observed when mothers have received incomplete primary education or less. Similarly, there is a noticeable influence of the family's wealth index on the participation rate of children in ECE Programs. Specifically, children from households with a high wealth index demonstrate a participation rate of 26.76% in ECE Programs. In contrast, children from poor households, characterized by a lower wealth index (i.e., poorest families), exhibit a significantly lower participation rate of 15.40% in ECE Programs.

**Table 2** shows us the relationship between ECE Programs and its factors. Most of these predictor variables show a significant association at a 5% significance level. The multivariable logistic regression result shows that 48–59-month-old children had 8.33 times more chance of attending ECE Programs than 36–47-month-old children (odds ratio (OR): 8.33, 95% CI: 7.01–9.99). We can also see that child from rural areas the odd ratio is 0.86 (OR: 0.86, 95% CI: 0.7–1.07) that means children from this area have 14% less participation in ECE Programs compared to the rural children. Children from those mothers who were highly educated were more likely to participate in ECE Programs 120% (OR: 2.20, 95% CI: 1.61–3.02), and primary-educated mother's children 41% (OR: 1.41, 95% CI: 1.08–1.84) more than primary-incomplete mother's children. Unfortunately, the multi-logistic regression model shows some variables have a low chance. The household which had books for the children have 76% more chance to enroll in ECE Programs compared to the counterpart.

For multivariable model, model fitting criteria the AUC of receiver operating characteristic curve (ROC) was found to be 0.7806 (Asymptotic p-value: 0.000 and 95% CI: 0.7650 -0.7892)

(figure 2). which showed that higher area under curve than 0.50. The output of the Calibration belt plot reports that the p-value was 0.086 which suggests that the hypothesis of good calibration is not a rejected model. According to Hosmer-Lemeshow chi-squared and p-value was 0.9736 which indicates that the model fitted best. A classification plot illustrates in figure 2 also which intersect sensitivity and specificity in a probability cutoff value. The intersection point is equivalent to classification accuracy of the model. The classification accuracy MICS-2019 81.44% (**Table 3**). In this model the AIC and BIC were respectively 6383.56 and 6508.86.

Figure 3 illustrates the participation rates in ECE programs among children under the age of five. Among children who had experienced Acute Respiratory Infections (ARIs), only 26.6% attended ECE programs. Conversely, children presenting with symptoms of Fever and Diarrhea exhibited lower participation rates, standing at 20.09% and 15.89%, respectively. Figure 4, on the other hand, provides a graphical representation of the percentage participation in ECE programs differentiating between Urban and Rural Areas. In urban areas only 23.64% where in rural area 18.27% children have attended ECE programs.

## **Discussions**

This study found that the children with the age group 48 to 59 months have a higher chance of participating in an ECE Programs than the other child group who are 36 to 47 months of age. ECE Programs participation rate differs in rural and urban areas, the children who live in the rural area were less likely to participate in the ECE Programs than the children who were from the urban area. Due to the remoteness of access to educational resources and lack of teachers and other problems the people in the rural areas get access to ECE Programs less than the urban areas

(Begum et al., 2019). Another study has also confirmed the disparity in participation in ECE programs between urban and rural areas (Kamal et al., 2016).

This study has revealed a substantial influence of maternal education on children's participation in children's ECE Programs. Mothers with elevated levels of educational attainment exhibit a heightened acumen in parenting, leading to a heightened understanding and awareness of nutritional factors compared to mothers with lower educational backgrounds (Chen & Li, 2009). A study was conducted among the slums of Nairobi where they found a strong association between a mother's education on a child's nutrition level (Abuya et al., 2012). Another study was conducted using the data of 1986 Brazilian Demographic and Health Survey where they said mother's education affects child height (Thomas et al., 2016). The more educated the mother is, she is more likely to send their child to an ECE Program.

This study also found that the children from those households that had children's books or picture books were more likely to participate in the ECE Programs. A study also found the similar finding (Weng et al., 2021). This study identified that the children's weight plays a significant effect on ECE Programs. We found that 22.74% of children were underweight. Those who were underweight were 24% less likely to enroll in the ECE Programs. Underweight is one of the main indicators of malnutrition in children and can create long term effects that can cause low educational participations and achievements (Acquah et al., 2019; GDHS, 2014; Millennium & Goals, 2010). In 2019 a study was conducted in Debre Tabor Town, Amhara Region Ethiopia, where they found that the cause of being underweight is family education and family wealth which was aligned with our study (Selomon Tibebu et al., 2020). In our study we found that those who were stunted were 40% less likely to enroll in ECE Programs. As stunted children are shorter than a normal child, it could be possible to have less interest in the parents to send their children in ECE

Programs as they may think their children is not enough grown to start attending school. In a study, they found that wealth index and parental education has an impact of being a child stunted. Wasting is a type of acute malnutrition marked by a loss of body weight in proportion to height, which raises a child's risk of illness and death while also reducing their capacity to learn. This study found that the children who were wasted were more likely to take part in ECE Programs. It can be because the children may seem taller though their weight is low. Thus, their parents think that their child may be big enough to start attending school. From our study we see that 26% of children who were wasted were more likely to enroll in ECE Programs.

### **Conclusions**

To increase the participation in ECE Programs it should focus on some areas like health factors, mother's education, and some other socioeconomic factors. For healthy development, children need active stimulation and interaction with others. This is where early childhood education is the most beneficial.

Social awareness for child health, parental awareness, children health knowledge etc. should be more spread out to both urban and rural area's people. Mass media, television programs, and the internet can be used for this. Moreover, in our study we have seen that mother education is an important factor. In Asia subcontinent early marriage(girls), less education for girls is a common factor. People should be more aware about girls' education as this may help to increase the ECE Programs very significantly.

Some countries like Ethiopia, Zambia, Tanzania, Kenya, Nigeria, South Africa, etc. has taken various types of policy to increase the rate of participation in ECE Programs. Like in South Africa ECE Programs was considered the basic part of education and they set a goal that those entering Grade One in 2010 would have finished their Reception year (Mwamwenda, 2014). Again, personnel training for parents and caregivers, as well as curriculum development, has been provided in various nations. Our country also can set some goals to improve the participation in ECE Programs by developing such policies, making some Govt. and private NGO for this and by the help of UNICEF.

More research on the implementation of ECE Programs policies throughout Asia and beyond is also needed to know from successful procedures, implementation structures, and methods so that governments can better promote the healthy growth, development, and learning of young children.

### **Abbreviations**

There are several kinds of abbreviations used in this study. They are given following:

1. ECE: Early Childhood Education
2. MICS: Multiple Indicator Cluster Survey
3. ECER: Early childhood education
4. KDHS: Kenya Demographic and Health Survey
5. BBS: Bangladesh Bureau of Statistics
6. ECD: Early Childhood Development
7. AUROC: Area under the receiver Operating Characteristic curve

8. ROC: Receiver operating characteristic curve
9. OR: Odds Ratio
10. VIF: Variance inflation factor
11. AUC: Area Under the Curve
12. AIC: Akaike information criterion
13. BIC: Bayesian Information Criterion

### **Limitations:**

This study relies on secondary data. Cross-sectional study design has been employed in this study. A cross-sectional study is ideally a study to determine the distribution (prevalence) of an interest quantity in a target population at a specific point in time (or the joint distribution of several values). This type of study has several flaws, including the inability to estimate risk or determine incidence. Moreover, as secondary data is used there can be some errors during data collection which may cause some variation in the results.

### **Reference**

- About, F. E. (2007). Evaluation of an early childhood parenting programme in rural Bangladesh. *Journal of Health, Population and Nutrition*, 25(1), 3–13.
- Abuya, B. A., Ciera, J., & Kimani-Murage, E. (2012). Effect of mother's education on child's nutritional status in the slums of Nairobi. *BMC Pediatrics*, 12(1998), 80.  
<https://doi.org/10.1186/1471-2431-12-80>
- Acquah, E., Darteh, E. K. M., Amu, H., & Adjei, D. K. A. (2019). *Predictors of underweight in children under-five years in Ghana*. 53(1), 71–78.
- Alam, M. I., Mansur, M., & Barman, P. (2022). Early childhood development in Bangladesh and

- its socio-demographic determinants of importance. *Early Child Development and Care*, 192(12), 1901–1920. <https://doi.org/10.1080/03004430.2021.1951260>
- Alderman, H., Behraan, J. R., Lavy, V., & Menon, R. (2001). Child health and school enrollment: A longitudinal analysis. *Journal of Human Resources*, 36(1), 203–205. <https://doi.org/10.2307/3069675>
- Ansari, A., Pianta, R. C., Whittaker, J. V., Vitiello, V. E., & Ruzek, E. A. (2019). Starting Early: The Benefits of Attending Early Childhood Education Programs at Age 3. *American Educational Research Journal*, 56(4), 1495–1523. <https://doi.org/10.3102/0002831218817737>
- Baluch, M. ul H., & Shahid, S. (2008). Determinants of enrollment in primary education: A case study of district Lahore. *Pakistan Economic and Social Review*, 46(2), 161–200.
- BBS-UNICEF. (2007). Bangladesh Multiple Indicator Cluster Survey 2006, Final Report. *Bbs-Unicef*, 1.
- Begum, H. A., Perveen, R., Chakma, E., Dewan, L., Afroze, R. S., & Tangen, D. (2019). The challenges of geographical inclusive education in rural Bangladesh. *International Journal of Inclusive Education*, 23(1), 7–22. <https://doi.org/10.1080/13603116.2018.1514729>
- Bustamante, A. S., Dearing, E., Zachrisson, H. D., & Vandell, D. L. (2022). Adult outcomes of sustained high-quality early child care and education: Do they vary by family income? *Child Development*, 93(2), 502–523. <https://doi.org/10.1111/cdev.13696>
- Chen, Y., & Li, H. (2009). Mother's education and child health: Is there a nurturing effect? *Journal of Health Economics*, 28(2), 413–426. <https://doi.org/10.1016/j.jhealeco.2008.10.005>
- Cook, J. A., & Rajbhandari, A. (2018). Heckroccurve: ROC curves for selected samples. *Stata Journal*, 18(1), 174–183. <https://doi.org/10.1177/1536867X1801800110>
- Crosnoe, R. L., Johnston, C. A., & Cavanagh, S. E. (2021). Maternal education and early childhood education across affluent English-speaking countries. *International Journal of*

*Behavioral Development*, 45(3), 226–237. <https://doi.org/10.1177/0165025421995915>

Fagerland, M. W., & Hosmer, D. W. (2012). A generalized Hosmer-Lemeshow goodness-of-fit test for multinomial logistic regression models. *Stata Journal*, 12(3), 447–453. <https://doi.org/10.1177/1536867X1201200307>

Gakii Murungi, C. (2012). *Children Health Needs and It'S Influence on Pre-School Education Enrolments*. 1(1). [www.iresearcher.org](http://www.iresearcher.org)[www.iresearcher.org](http://www.iresearcher.org)[www.iresearcher.org](http://www.iresearcher.org)[www.iresearcher.org](http://www.iresearcher.org)

GDHS. (2014). *Ghana demographic health survey*.

Greenberg, J. P. (2011). The impact of maternal education on children's enrollment in early childhood education and care. *Children and Youth Services Review*, 33(7), 1049–1057. <https://doi.org/10.1016/j.chilyouth.2011.01.016>

Gurmu, E., & Etana, D. (2013). Socio-economic and Demographic Determinants of Children's Primary School Enrolment in Ethiopia. *Eastern Africa Social Science Research Review*, 29(1), 1–30. <https://doi.org/10.1353/eas.2013.0004>

Kamal, N., Curtis, S., Hasan, M. S., & Jamil, K. (2016). Trends in equity in use of maternal health services in urban and rural Bangladesh. *International Journal for Equity in Health*, 15(1), 1–11. <https://doi.org/10.1186/s12939-016-0311-2>

Magnuson, K., & Waldfogel, J. (2016). Trends in Income-Related Gaps in Enrollment in Early Childhood Education: 1968 to 2013. *AERA Open*, 2(2), 1–13. <https://doi.org/10.1177/2332858416648933>

Millennium, T., & Goals, D. (2010). *The Millennium Development Goals Report*.

MPME. (2013). *Country Report On Early Childhood Care & Education in Bangladesh*. September, 34.

Mwamwenda, T. S. (2014). *Early Childhood Education in Africa*. 5(20), 1403–1412. <https://doi.org/10.5901/mjss.2014.v5n20p1403>



- Nattino, G., Lemeshow, S., Phillips, G., Finazzi, S., & Bertolini, G. (2017). Assessing the calibration of dichotomous outcome models with the calibration belt. *The Stata Journal*, 17(4), 1003–1014.
- Nayeem Hasan, M., Abdul Baker Chowdhury, M. I., Jahan, J., Jahan, S., Ahmed ID, N. U., & Jamal Uddin, M. (2020). *Cesarean delivery and early childhood diseases in Bangladesh: An analysis of Demographic and Health Survey (BDHS) and Multiple Indicator Cluster Survey (MICS)*. <https://doi.org/10.1371/journal.pone.0242864>
- NSW Department of Education. (2018). *A Review of Research on the Effects of Early Childhood Education*. 1–28.
- Parang, K., Wiebe, L. I., & Knaus, E. E. (2000). *Novel Approaches for Designing 5'-O-Ester Prodrugs of 3'-Azido-2',3'-dideoxythymidine (AZT)*. 995–1039.
- Progotir Pathey. (2019). *Bangladesh multiple indicator cluster survey 2019 Key findings*.
- Progotir Pothey. (2015). Bangladesh: Multiple Indicator Cluster Survey 2012–2013: Final Report. In *Bangladesh Bureau of Statistics (BBS) and United Nations Children's Fund (UNICEF)*.
- Reynolds, A. J., Temple, J. A., Ou, S. R., Arteaga, I. A., & White, B. A. B. (2011). School-based early childhood education and age-28 well-being: Effects by timing, dosage, and subgroups. *Science*, 333(6040), 360–364.  
[https://doi.org/10.1126/SCIENCE.1203618/SUPPL\\_FILE/1203618.REYNOLDS.SOM.REVISION1.PDF](https://doi.org/10.1126/SCIENCE.1203618/SUPPL_FILE/1203618.REYNOLDS.SOM.REVISION1.PDF)
- Sammons, P., Elliot, K., Sylva, K., Melhuish, E., Siraj-Blatchford, I., & Taggart, B. (2004). The impact of pre-school on young children's cognitive attainments at entry to reception. *British Educational Research Journal*, 30(5), 691–712.  
<https://doi.org/10.1080/0141192042000234656>
- Selomon Tibebu, N., Dessie Emiru, T., Marew Tiruneh, C., Dessie Getu, B., & Amogne Azanaw, K. (2020). A Community-Based Cross-Sectional Study. *Pediatric Health*.  
<https://doi.org/10.2147/PHMT.S288071>

Stata. (2022). *Survey Data Analysis in Stata*. <https://stats.oarc.ucla.edu/stata/seminars/svy-stata-8/>

Strietholt, R., Hoglebe, N., & Zachrisson, H. D. (2020). Do increases in national-level preschool enrollment increase student achievement? Evidence from international assessments. *International Journal of Educational Development*, 79, 102287. <https://doi.org/10.1016/J.IJEDUDEV.2020.102287>

Sultana, M., Sarker, A. R., Sheikh, N., Akram, R., Ali, N., Mahumud, R. A., & Alam, N. H. (2019). Prevalence, determinants and health care-seeking behavior of childhood acute respiratory tract infections in Bangladesh. *PLOS ONE*, 14(1), e0210433. <https://doi.org/10.1371/JOURNAL.PONE.0210433>

Thomas, D., Strauss, J., Henriques, M., Strauss, J., & Henriques, M. (2016). *Board of Regents of the University of Wisconsin System How Does Mother ' s Education Affect Child Height ?* 26(2), 183–211.

UNESCO. (2007). *Pakistan ECCE Case Study*.

UNESCO. (2015). *Pre-primary Education and the School Learning Improvement Plan in Bangladesh. Case Study*.

UNICEF. (2019). *Progotir Pathay Bangladesh- Multiple Indicator Cluster Survey 2019*.

UNICEF. (2023). *Early childhood education - UNICEF DATA*. <https://data.unicef.org/topic/early-childhood-development/early-childhood-education/#data>

Weng, L., Wu, Z., & Xiao, W. (2021). Research in the use of picture books in educational activities in five domains of early childhood education. *ACM International Conference Proceeding Series*. <https://doi.org/10.1145/3456887.3456935>

WHO. (2022). *Child growth standards*. <https://www.who.int/tools/child-growth-standards>

Yoshikawa, H., & Kabay, S. . (2015). The evidence base on early childhood care and education in global contexts. Background paper, UNESCO 2015 Global Monitoring Report on

## Tables

**Table 1.** Early childhood education program status at different levels of covariates.

|                            | Early Childhood Education Program |              |             | P-value |
|----------------------------|-----------------------------------|--------------|-------------|---------|
|                            | YES n (%)                         | NO n (%)     | Total       |         |
| <b>Age of child(month)</b> |                                   |              |             |         |
| 36-47                      | 288(5.98%)                        | 4527(94.02%) | 4815 (100%) | <0.001  |
| 48-59                      | 1544(33.34%)                      | 3087(66.66%) | 4631 (100%) |         |
| <b>Child's sex</b>         |                                   |              |             |         |
| Male                       | 949(19.86%)                       | 3828(80.14%) | 4777 (100%) | 0.2962  |
| Female                     | 883(18.92%)                       | 3786(81.08%) | 4669 (100%) |         |
| <b>Place of residence</b>  |                                   |              |             |         |
| Urban                      | 466(23.64%)                       | 1507(76.36%) | 1973 (100%) | <0.001  |
| Rural                      | 1366(18.27%)                      | 6108(81.73%) | 7474 (100%) |         |
| <b>Division</b>            |                                   |              |             |         |
| Barisal                    | 96(18.10%)                        | 439(81.90%)  | 535 (100%)  | 0.011   |
| Chattogram                 | 407(19.62)                        | 1666(80.38)  | 2073 (100%) |         |
| Dhaka                      | 471(21.63)                        | 1706(78.37)  | 2177 (100%) |         |
| Khulna                     | 197(19.96)                        | 789(80.04)   | 986 (100%)  |         |
| Mymensingh                 | 163(22.64)                        | 557(77.36)   | 720 (100%)  |         |
| Rajshahi                   | 201(17.05)                        | 980(82.95)   | 1181 (100%) |         |
| Rangpur                    | 181(17.76)                        | 840(82.24)   | 1021 (100%) |         |
| Sylhet                     | 155(15.29)                        | 638(84.71)   | 793 (100%)  |         |
| <b>Mother's Education</b>  |                                   |              |             |         |

|  |             |             |             |        |
|--|-------------|-------------|-------------|--------|
| Primary incomplete                     | 161(12.95)  | 1084(87.05) | 1245 (100%) | <0.001 |
| Primary complete                       | 374(16.25)  | 1930(83.75) | 2304 (100%) |        |
| Secondary incomplete                   | 926(20.40)  | 3612(79.60) | 4538 (100%) |        |
| Or Higher                              | 371(27.25)  | 990(72.75)  | 1361 (100%) |        |
| <b>Wealth Index</b>                    |             |             |             |        |
| Poor                                   | 325(15.40)  | 1786(84.60) | 2111 (100%) | <0.001 |
| Second                                 | 305(16.19)  | 1581(83.81) | 1886 (100%) |        |
| Middle                                 | 336(19.07)  | 1428(80.93) | 1764 (100%) |        |
| Fourth                                 | 367(20.13)  | 1457(79.87) | 1824 (100%) |        |
| Richest                                | 498(26.76)  | 1363(73.24) | 1861 (100%) |        |
| <b>Religion</b>                        |             |             |             |        |
| Islam                                  | 251(19.38)  | 995(80.62)  | 1246 (100%) | 0.5996 |
| Other                                  | 1480(19.49) | 6153(80.51) | 7633 (100%) |        |
| <b>Household Head Sex</b>              |             |             |             |        |
| Male                                   | 1479(19.49) | 6110(80.51) | 7589 (100%) | 0.9956 |
| Female                                 | 2501(19.50) | 1038(80.50) | 3539 (100%) |        |
| <b>Ethnicity of the Household Head</b> |             |             |             |        |
| Bengali                                | 1801(19.30) | 7529(80.70) | 9330 (100%) | 0.0969 |
| Others                                 | 31(26.64)   | 85(73.36)   | 116 (100%)  |        |
| <b>Mother's Age at the survey Time</b> |             |             |             |        |
| 15-19                                  | 363(20.65)  | 1395(79.35) | 1758 (100%) | 0.0963 |
| 20-34                                  | 1075(19.63) | 4402(80.37) | 5477 (100%) |        |
| 35+                                    | 266(17.27)  | 1273(82.73) | 1539 (100%) |        |

|                               |             |             |             |        |
|-------------------------------|-------------|-------------|-------------|--------|
| <b>Mother Stimulation</b>     |             |             |             |        |
| Yes                           | 1587(20.44) | 6176(79.56) | 7763 (100%) | <0.001 |
| No                            | 245(14.55)  | 1439(85.45) | 1684 (100%) |        |
| <b>Father Stimulation</b>     |             |             |             |        |
| Yes                           | 807(19.1)   | 3424(80.9)  | 4231 (100%) | 0.5277 |
| No                            | 1025(19.7)  | 4191(80.3)  | 5216 (100%) |        |
| <b>Other Stimulation</b>      |             |             |             |        |
| Yes                           | 993(19.66)  | 4038(80.34) | 5031 (100%) | 0.426  |
| No                            | 830(19.06)  | 3577(80.94) | 4407 (100%) |        |
| <b>Inadequate Supervision</b> |             |             |             |        |
| Yes                           | 129(16.24)  | 667(83.76)  | 796 (100%)  | 0.0259 |
| No                            | 1703(19.68) | 6947(80.32) | 8650 (100%) |        |
| <b>Books</b>                  |             |             |             |        |
| Yes                           | 1261(25.62) | 3661(74.38) | 4922 (100%) | <0.001 |
| No                            | 571(12.61)  | 3954(87.39) | 4525 (100%) |        |
| <b>Toys</b>                   |             |             |             |        |
| Yes                           | 1495(19.19) | 6296(80.81) | 7791 (100%) | 0.3533 |
| No                            | 337(20.36)  | 1318(79.64) | 1655 (100%) |        |
| <b>Mass Media</b>             |             |             |             |        |
| Yes                           | 996(19.02)  | 4242(80.98) | 5238 (100%) | 0.315  |
| No                            | 708(20.02)  | 2828(79.98) | 3536 (100%) |        |
| <b>Child Punishment</b>       |             |             |             |        |
| Yes                           | 106.(21.06) | 396(78.94)  | 502 (100%)  | 0.4157 |
| No                            | 1726(19.30) | 7219(80.70) | 8945 (100%) |        |

|                                 |             |             |             |        |
|---------------------------------|-------------|-------------|-------------|--------|
| <b>Early Childhood Diseases</b> |             |             |             |        |
| Yes                             | 534(19.68)  | 2178(80.32) | 2712 (100%) | 0.7002 |
| No                              | 1296(19.28) | 5427(80.72) | 6723 (100%) |        |
| <b>Underweight</b>              |             |             |             |        |
| Yes                             | 318(14.03)  | 1945(85.97) | 2263 (100%) | <0.001 |
| No                              | 1452(21.17) | 5406(78.83) | 6858 (100%) |        |
| <b>Stunned</b>                  |             |             |             |        |
| Yes                             | 301(11.69)  | 2269(88.31) | 2570 (100%) | <0.001 |
| No                              | 1463(22.63) | 5000(77.37) | 6463 (100%) |        |
| <b>Wasted</b>                   |             |             |             |        |
| Yes                             | 191(21.55)  | 696(78.45)  | 887 (100%)  | 0.162  |
| No                              | 1563(19.26) | 6551(80.74) | 8114 (100%) |        |
| <b>Overweight</b>               |             |             |             |        |
| Yes                             | 114(18.93)  | 489(81.07)  | 603 (100%)  | 0.795  |
| No                              | 1718(19.4)  | 7126(80.6)  | 8844 (100%) |        |
| <b>Sanitation</b>               |             |             |             |        |
| Improved                        | 1685(19.57) | 6923(80.43) | 8608 (100%) | <0.001 |
| Unimproved                      | 45(16.93)   | 224(83.07)  | 269 (100%)  |        |
| <b>Salt Iodization</b>          |             |             |             |        |
| Yes                             | 1415(19.6)  | 5787(80.4)  | 7202 (100%) | <0.001 |
| No                              | 316(18.9)   | 1357(81.1)  | 1673 (100%) |        |

**Table 2.** Factor associated with the early childhood education program.

| <b>Adjusted Logistic Regression</b> |                            |                |
|-------------------------------------|----------------------------|----------------|
| <b>Characteristics</b>              | <b>Odds Ratio (95% CI)</b> | <b>P-value</b> |
| <b>Age of child (month)</b>         |                            |                |

|                                 |                 |        |
|---------------------------------|-----------------|--------|
| 36-47                           | Ref             | <0.001 |
| 48-59                           | 8.33(7.01-9.9)  |        |
| Place of residence              |                 |        |
| Urban                           | Ref             |        |
| Rural                           | 0.86(.7-1.07)   | 0.175  |
| Division                        |                 |        |
| Barisal                         | Ref             |        |
| Chattogram                      | 1.09(0.78-1.53) | 0.61   |
| Dhaka                           | 1.2(0.85-1.69)  | 0.29   |
| Khulna                          | 1.05(0.74-1.5)  | 0.77   |
| Mymensingh                      | 1.74(1.15-2.63) | 0.01   |
| Rajshahi                        | 0.85(0.58-1.24) | 0.41   |
| Rangpur                         | 1.07(0.73-1.56) | 0.73   |
| Sylhet                          | 1.12(0.73-1.71) | 0.60   |
| Mothers' education level        |                 |        |
| Primary incomplete              | ref             |        |
| Primary complete                | 1.41(1.08-1.84) | 0.01   |
| Secondary incomplete            | 1.63(1.26-2.12) | 0.00   |
| Secondary Complete Or Higher    | 2.20(1.61-3.02) | 0.00   |
| Wealth index                    |                 |        |
| Poor                            | Ref             |        |
| Second                          | 0.94(0.75-1.19) | 0.63   |
| Middle                          | 1.06(0.84-1.35) | 0.63   |
| Fourth                          | 0.95(0.74-1.21) | 0.66   |
| Richest                         | 1.23(0.93-1.64) | 0.15   |
| Ethnicity of the Household Head |                 |        |
| Bengali                         | 0.46(0.26-0.81) | 0.01   |
| Others                          | ref             |        |
| Mother's Age at the survey Time |                 |        |

|                               |                  |        |
|-------------------------------|------------------|--------|
| 15-19                         | ref              |        |
| 20-34                         | 0.96 (0.81-1.15) | 0.68   |
| 35+                           | 0.82(0.65-1.04)  | 0.10   |
| <b>Mother Stimulation</b>     |                  |        |
| Yes                           | 1.13(0.92-1.40)  | 0.25   |
| No                            | Ref              |        |
|                               |                  |        |
| <b>Inadequate supervision</b> |                  |        |
| Yes                           | 0.85(0.66-1.1)   | 0.23   |
| No                            | Ref              |        |
| <b>Books</b>                  |                  |        |
| Yes                           | 1.76(1.5-2.07)   | <0.001 |
| No                            | ref              |        |
| <b>Underweight</b>            |                  |        |
| Yes                           | 0.76(0.6-0.96)   | 0.02   |
| No                            | Ref              |        |
| <b>Stunned</b>                |                  |        |
| Yes                           | 0.60(0.49-0.73)  | <0.001 |
| No                            | Ref              |        |
| <b>Wasted</b>                 |                  |        |
| Yes                           | 1.26(0.97-1.64)  | 0.08   |
| No                            | Ref              |        |
| <b>ARI</b>                    |                  |        |
| Yes                           | 1.37(0.80-2.36)  | 0.25   |
| No                            | ref              |        |
| <b>Sold iodization</b>        |                  |        |
| Yes                           | 0.88(0.6-1.31)   | 0.53   |
| No                            | ref              |        |



**Table 3. Hosmer-Lemeshow Test, Area under ROC Curve, and Calibration test and classification accuracy for final logistic regression model.**

| Hosmer-Lemeshow Test |         | Area Under ROC Curve |         | Calibration test |         | Correctly classified |
|----------------------|---------|----------------------|---------|------------------|---------|----------------------|
| Chi- square          | P-value | AUC                  | P-value | Test-statistic   | P-value |                      |
| 5585.44              | 0.9736  | 0.7806               | <0.001  | 2.96             | 0.0856  | 81.44%               |

-

**Figures:**

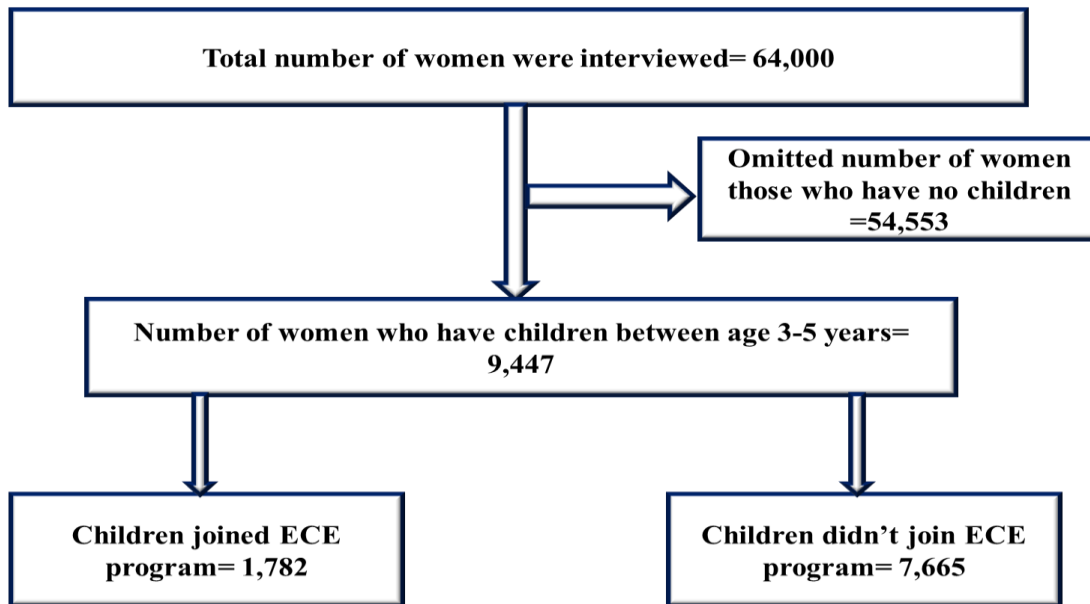
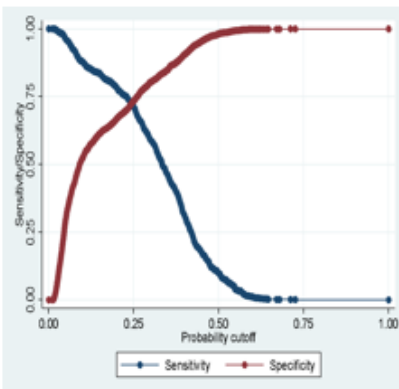
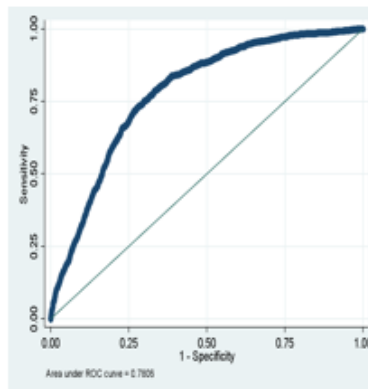


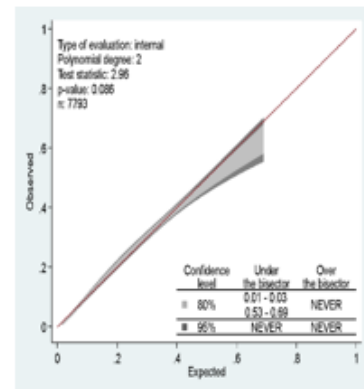
Figure 1: Schematic diagram of the analytic study



2(a)



2(b)



2(c)

Figure 2: 2(a).Model assessment curve of fitted final model 2(b).Area Under ROC curve 2(c).Calibration belt plot

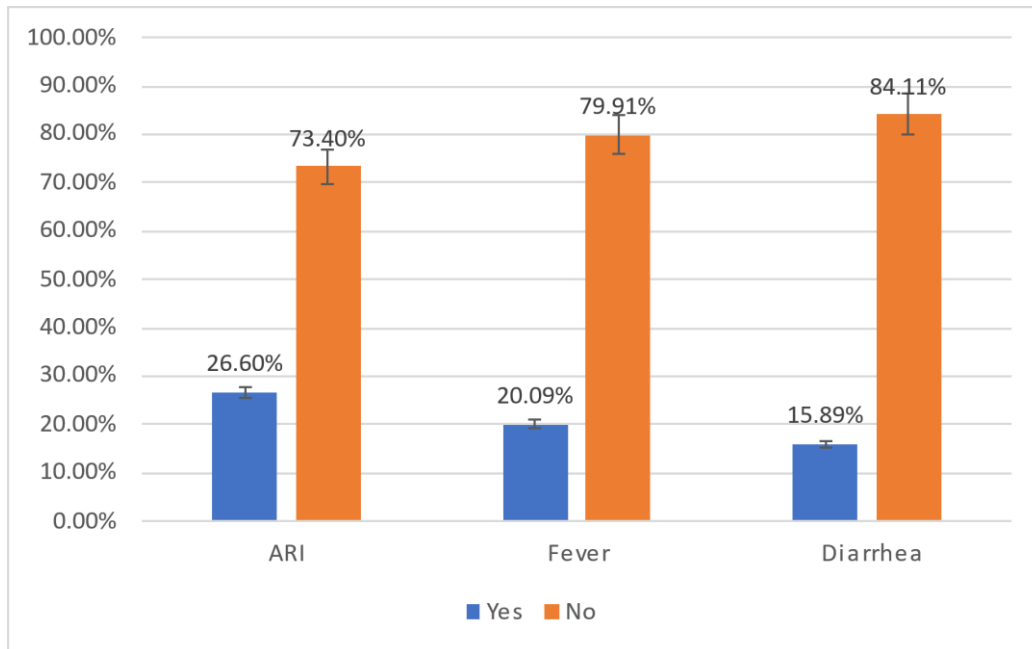


Figure 3: Percentage of ECE Program participation with different types of disease

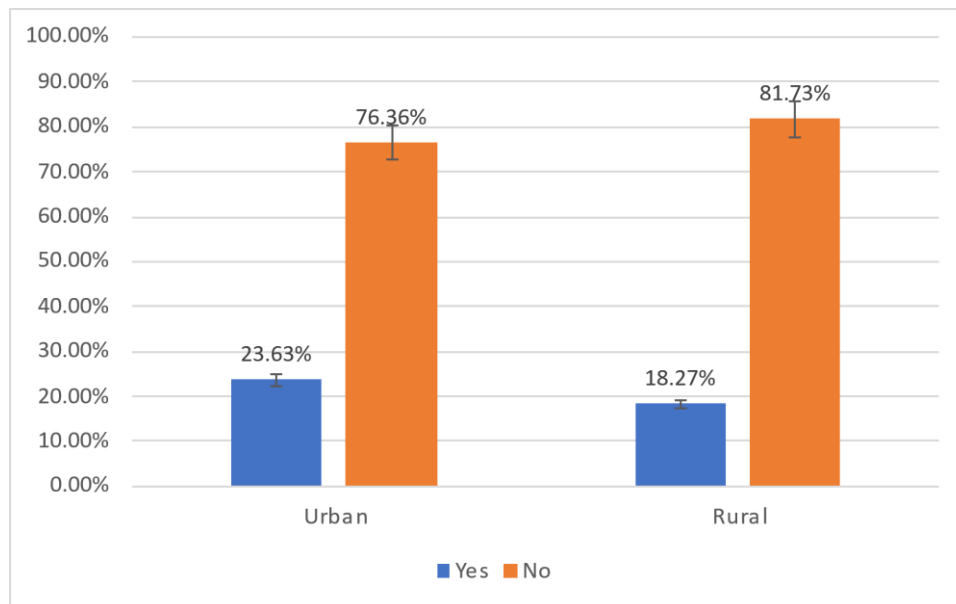


Figure 4: Participation in ECE program in Urban and Rural Area

## Supplementary

| Crude Logistic Regression |                     |         |
|---------------------------|---------------------|---------|
| Characteristics           | Odds Ratio (95% CI) | P-value |
| Age of child(month)       |                     |         |
| 36-47                     | Ref                 | <0.001  |
| 48-59                     | 7.86(6.78-9.12)     |         |
| Child’s sex               |                     |         |
| Male                      | Ref                 | 0.296   |
| Female                    | 0.94(0.84-1.05)     |         |
| Place of residence        |                     |         |
| Urban                     | Ref                 | <.001   |
| Rural                     | 0.72 (0.62-0.84)    |         |
| Division                  |                     | 0.0219  |
| Barisal                   | Ref                 | 0.44    |
| Chattogram                | 1.1(.86-1.42)       |         |
| Dhaka                     | 1.25(0.97-1 .61)    | 0.08    |
| Khulna                    | 1.13(0.86-1.48)     | 0.38    |
| Mymensingh                | 1.32(0.97-1.81)     | 0.08    |
| Rajshahi                  | 0.93(0.7-1.29)      | 0.62    |
| Rangpur                   | 0.98(0.74-1.29)     | 0.87    |
| Sylhet                    | 0.82(0.59-1.13)     | 0.22    |
| Mother’s Education        |                     | <0.001  |
| Primary incomplete        | Ref                 | 0.017   |
| Primary complete          | 1.3(1.05-1.6)       |         |
| Secondary incomplete      | 1.72(1.41-2.11)     | <0.001  |
| Or Higher                 | 2.52(1.99-3.18)     | <0.001  |
| Wealth Index              |                     | <0.001  |

|  |                  |        |
|--|------------------|--------|
| Poor                                   | Ref              |        |
| Second                                 | 1.06(0.88-1.29)  | 0.546  |
| Middle                                 | 1.29(1.08-1.56)  | 0.006  |
| Fourth                                 | 1.38(1.14-1.168) | 0.001  |
| Richest                                | 2.01(1.66-2.42)  | <0.001 |
| <b>Religion</b>                        |                  |        |
| Islam                                  | 0.95 (0.8-1.14)  | 0.6    |
| Other                                  | Ref              |        |
| <b>Household Head Sex</b>              |                  |        |
| Male                                   | 0.99 (0.84-1.2)  | 0.996  |
| Female                                 | Ref              |        |
| <b>Ethnicity of the Household Head</b> |                  |        |
| Bengali                                | 0.66(0.4-1.08)   | 0.1    |
| Others                                 | Ref              |        |
| <b>Mother’s Age at the survey Time</b> |                  |        |
| 15-19                                  | Ref              |        |
| 20-34                                  | 0.94(0.8-1.1)    | 0.44   |
| 35+                                    | 0.8(0.65-0.99)   | 0.04   |
| <b>Mother Stimulation</b>              |                  |        |
| Yes                                    | 1.5(1.27-1.79)   | <0.001 |
| No                                     | Ref              |        |
| <b>Father Stimulation</b>              |                  |        |
| Yes                                    | 0.96(8-0.861.08) | 0.528  |
| No                                     | Ref              |        |
| <b>Other Stimulation</b>               |                  |        |
| Yes                                    | 1.05(0.93-1.18)  | 0.426  |
| No                                     | Ref              |        |

|                                 |                  |        |
|---------------------------------|------------------|--------|
| <b>Inadequate Supervision</b>   |                  |        |
| Yes                             | 0.79(0.64-0.97)  | 0.026  |
| No                              | Ref              |        |
| <b>Books</b>                    |                  |        |
| Yes                             | 2.39(2.1-2.72)   | <0.001 |
| No                              | Ref              |        |
| <b>Toys</b>                     |                  |        |
| Yes                             | 0.93(0.79-1.09)  | 0.353  |
| No                              | NO               |        |
| <b>Mass Media</b>               |                  |        |
| Yes                             | 0.94(0.83-1.06)  | 0.315  |
| No                              | Ref              |        |
| <b>Child Punishment</b>         |                  |        |
| Yes                             | 1.12(0.86-1.45)  | 0.42   |
| No                              | Ref              |        |
| <b>Early Childhood Diseases</b> |                  |        |
| Yes                             | 1.03(0.9-1.7)    | 0.7    |
| No                              | Ref              |        |
| <b>Underweight</b>              |                  |        |
| Yes                             | 0.61(0.52-0.71)  | <0.001 |
| No                              | Ref              |        |
| <b>Stunned</b>                  |                  |        |
| Yes                             | 0.45 (0.39-0.53) | <0.001 |
| No                              | Ref              |        |
| <b>Wasted</b>                   |                  |        |
| Yes                             | 1.15(0.945-1.4)  | 0.16   |
| No                              | Ref              |        |
| <b>Overweight</b>               |                  |        |
| Yes                             | 0.97(0.76-1.23)  | 0.79   |

|                        |                 |       |
|------------------------|-----------------|-------|
| No                     | Ref             |       |
| <b>Sanitation</b>      |                 |       |
| Improved               | Ref             | 0.353 |
| Unimproved             | 0.84(0.58-1.22) |       |
| <b>Salt Iodization</b> |                 |       |
| Yes                    | 1.05(.9-1.23)   | 0.527 |
| No                     | ref             |       |