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Early childhood developmental status and its associated factors in Bangladesh: a comparison of two consecutive nationally representative surveys

--Manuscript Draft--

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Abstract:	Inadequate cognitive and socio development in children results in physical and mental illness. We aimed to examine the status of early childhood development (ECD) and its associated factors using two multiple indicator cluster surveys (MICS) in Bangladesh. We used the nationally representative MICS 2012 and 2019 survey data. A total 17494 [8148 from MICS 2012 and 9346 from MICS 2019] children aged 36 to 59 months were included in the study. The outcome variable was ECD status (i.e. either developmentally on-track or not). We applied the Chi-square test, crude and adjusted multivariable survey logistic regression model to evaluate the ECD status and its associated factors. When comparing both MICS surveys, the overall and individual domains of ECD status improved from 2012 (65.46%) to 2019 (74.86%) and the indicators of child literacy-numeracy [21.2% vs 28.8%], physical [92.2% vs 98.4%], social-emotional [68.4% vs 72.7%] and approaches to learning [87.5% vs 91.4%] showed an upward trend in 2019. According to the logistic regression analyses in both surveys (2012 vs 2019), age of 4 years [adjusted odds ratio (AOR): 1.62 vs 1.80], female children [AOR: 1.42 vs 1.41], children growing up with secondary or higher educated mothers [AOR:1.77 vs 1.36], rich families [AOR: 1.33 vs 1.75], attended early childhood education programs [OR: 1.44 vs 1.59], and families with books [AOR: 1.50 vs 1.53] had a higher likelihood of being developmentally on track than their counterpart. Our study shows that the overall ECD status improved (i.e. developmentally on-track) from MICS 2012 to MICS 2019. Several important factors, such as early childhood education programs, families have child books, mother education, and wealth index are significantly positively associated with the ECD status. Our study findings will assist public health efforts to improve early childhood development in Bangladesh.

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Department of Statistics
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To:
Editor in Chief –Early Childhood Research Quarterly

Subject: Submission of Manuscript

Dear Sir/Madam,

Please find enclosed our manuscript entitled "Early childhood developmental status and its associated factors in Bangladesh: a comparison of two consecutive nationally representative surveys", which we hope you will consider for publication as a research article to Early Childhood Research Quarterly.

Childhood period is the golden period for children's life to make themselves highly thirsty for learning and physically fit to become a successful and productive person in later life. Children begin to learn about the world around them within five years of birth, and this development refers to the sequence of physical, language, thought, and emotional changes, which allows them to stay focused, understand and follow directions, communicate with others, and solve increasingly complex problems. Hence, we aimed to determine whether the early childhood development status and its associated factors changed in two consecutive Multiple Indicator Cluster Surveys (MICS) in Bangladesh. We used the latest available nationally representative data from a multiple indicator cluster survey (MICS, 2012 and 2019). We found the proportions of children developmentally on track status increase gradually in Bangladesh. The results from the MICS 2012 and MICS 2019 data showed a significant association between developmentally on track status and some other variables (child age, child sex, division, mothers' education, early childhood program, other stimulation, books, toys and child punishment). Therefore, we think our study is relevant and timely for readers of Early Childhood Research Quarterly.

This manuscript represents original research, and it has not been published and is not being considered for publication elsewhere, in whole or in part, in any language. The authors believe this study is a key addition to the literature by demonstrating that the association between children developmentally on track status and associated factors using three recent nationally representative survey datasets. All authors have approved the manuscript and affirm contributing to the conception, design analysis, and interpretation of the data. None of the authors report a conflict of interest.

Any consideration you may be able to give this manuscript in Early Childhood Research Quarterly will be much appreciated.

Sincerely,

Md Jamal Uddin
(Corresponding Author)

Early childhood developmental status and its associated factors in Bangladesh: a comparison of two consecutive nationally representative surveys

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- The prevalence of ECD status has increased for physical, cognitive, socio-emotional, and motor development.

- The highest increase rate in ECD on track status was found in the literacy-numeracy domain and lowest rate of increase was found in the social-emotional domain.

- The child growing in rich families were found with higher chance of being developmentally on track than the low-income family.

- Children with early mother stimulation was found to have higher chance of developmentally on track than the children without early mother stimulation.

Early childhood developmental status and its associated factors in Bangladesh: a

comparison of two consecutive nationally representative surveys

Abstract

Inadequate cognitive and socio development in children results in physical and mental illness. We aimed to examine the status of early childhood development (ECD) and its associated factors using two multiple indicator cluster surveys (MICS) in Bangladesh. We used the nationally representative MICS 2012 and 2019 survey data. A total 17494 [8148 from MICS 2012 and 9346 from MICS 2019] children aged 36 to 59 months were included in the study. The outcome variable was ECD status (i.e. either developmentally on-track or not). We applied the Chi-square test, crude and adjusted multivariable survey logistic regression model to evaluate the ECD status and its associated factors. When comparing both MICS surveys, the overall and individual domains of ECD status improved from 2012 (65.46%) to 2019 (74.86%) and the indicators of child literacy-numeracy [21.2% vs 28.8%], physical [92.2% vs 98.4%], social-emotional [68.4% vs 72.7%] and approaches to learning [87.5% vs 91.4%] showed an upward trend in 2019. According to the logistic regression analyses in both surveys (2012 vs 2019), age of 4 years [adjusted odds ratio (AOR): 1.62 vs 1.80], female children [AOR: 1.42 vs 1.41], children growing up with secondary or higher educated mothers [AOR:1.77 vs 1.36], rich families [AOR: 1.33 vs 1.75], attended early childhood education programs [OR: 1.44 vs 1.59], and families with books [AOR: 1.50 vs 1.53] had a higher likelihood of being developmentally on track than their counterpart. Our study shows that the overall ECD status improved (i.e. developmentally on-track) from MICS 2012 to MICS 2019. Several important factors, such as early childhood education programs, families have child books, mother education, and wealth

index are significantly positively associated with the ECD status. Our study findings will assist

public health efforts to improve early childhood development in Bangladesh.

Key words: Early childhood development, child literacy-numeracy, physical, social-emotional,

approaches to learning, multiple indicator cluster surveys (MICS), Bangladesh

Introduction

The early years of a child's life play a key role in their cognitive development, social and emotional abilities (McCoy et al., 2016). According to the World Health Organization (WHO), early childhood development (ECD) refers to the physical, cognitive, socio-emotional, and motor development in the early years of a child's life (WHO, 2017). At the early age of prenatal periods to infancy and early childhood, a child's newly developing brain is highly productive and responsive to change (Currie & Vogl, 2012). This period is the golden period for them to make themselves highly thirsty for learning and physically fit to become a successful and productive person in later life (Heckman, 2007). Children begin to learn about the world around them within five years of birth, and this development refers to the sequence of physical, language, thought, and emotional changes, (Junek, 2007) which allows them to stay focused, understand and follow directions, communicate with others, and solve increasingly complex problems (McCoy et al., 2016).

According to world bank press news March 2021, more than 40% of the children below primary-school age, need child care but don't have the access (The World Bank, 2021). From 2010 to 2016, for 63 Low and Middle-Income countries, 25.3% of the children were developmental delay and at regional level, 10.1% were in Europe and Central Asia, 32.6% were in South Asia, 17.0% were in East Asia and Pacific and 41.4% were in West and Central Africa developmental delay to achieve developmental goal (Gil et al., 2020). For Sub-Saharan Africa (SSA), the median prevalence of cognitive 16.1% were not on track and 28.6% of social-emotional domain were not developmentally on track (G. Y et al., 2021). For Bangladesh based on MICS 2013, 70% of the children were developmentally on track (Hossain et al., 2021), and

for Bangladesh MICS 2019, 25.26% of the children were not developmentally on the track of

ECDI (Alam et al., 2021).

Since the turn of the twenty-first century, the interest in ECD has become popular

worldwide. Population-based measures, according to developed countries, may help measure

ECD and predict later life wellness (McCoy et al., 2016). Yet, despite the practical importance of

the ECD, population-based estimates have not been readily available in low-and middle-income

countries (LMICs) (UNICEF, 2017a). Using the data from United Nations Children's Fund

(UNICEF) and the World Bank, the Lancet 2016 child development series concluded that 43

percent children under five fail to achieve their developmental potential each year, children

living in low- and middle-income countries (LMICs) are at risk of suboptimal development due

to poverty, stunting, microbial deficiencies, infectious diseases, environmental exposure, and

psychological factors (Richter et al., 2016; Walker et al., 2011).

In Bangladesh, government and non-government organizations are working with many

developmental facilities for the child, child parents, and child caretakers to ensure all kinds of

rights they deserve ("Policy Brief: The Situation of Children in Bangladesh," 2020). Creating an

innovative foundation for strong development during the early years of life is essential for

thriving communities, economic productivity, and civil societies. But most parents in Bangladesh

are unaware of this scientific fact, which forms the core of ECD. UNICEF continues to

popularize the concept of ECD, demonstrate policies, strengthen networks and partnerships, and

provide technical assistance and support (UNICEF Bangladesh, n.d.). According to Rana et al.,

(2020), early childhood development is associated with household air pollution from solid fuel

use (Rana et al., 2020). (Alam et al., 2021) made a study with Multiple Indicator Cluster Survey

(MICS), they investigate the current ECD status among young children of 3–4 years of age in

Bangladesh and its relation to various sociodemographic and familial factors. (Jeong et al., 2016) have reported that increasing parental stimulation engagement in stimulation is likely to improve early child development in LMICs. (Gil et al., 2020) studied the prevalence and inequalities of suspected delay in child development in 63 low- and middle-income countries. (Kang et al., 2018) presented a study that examined associations between undernutrition and learning/cognition and social–emotional development indicators among South Asian children aged 36 to 59 months. For learning or cognitive domain in South Asia, stunted children were less developmentally on track (K. Y et al., 2018). (Islam et al., 2021) explored correlates of developmental status with a range of socio-demographic and environmental factors that may impact children's development. In Bangladesh, however, empirical research on overall ECD status and the comparison of different survey data is lacking. As a result, we sought to determine whether the ECD status and its associated factors changed in two consecutive Multiple Indicator Cluster Surveys (MICS) in Bangladesh.

Material and methods

We followed the STROBE guideline for strengthening the reporting of observational cross-sectional studies in epidemiology (see Supplementary Materials for more details).

Data source

We used two consecutive data from the Multiple Indicator Cluster Survey (MICS) conducted in 2012 and 2019. MICS is a large, multidimensional nationally representative household survey conducted by the UNICEF. This survey uses standardized questionnaires to provide the information and key indicators on the situation of children. Primarily, they focus on reproductive health, maternal and child health interventions, child nutrition status, and early childhood development. MICS also collects an identical set of socioeconomic characteristics of

individuals and households (Progotir Pathey, 2014a, 2019a). Datasets were open access for the

public domain (UNICEF MICS, 2018).

Sampling design and sample size

The MICS survey is a two-stage cluster sampling procedure, randomly selecting

households with children under five years. 2012 MICS is based on a sample of 51,895

households interviewed with a response rate of 98.5% and 2019 MICS is based on a sample of

61,246 interviewed with a response rate of 99.4%. MICS provides a comprehensive picture of

children's and women's health in the seven administrative divisions (Dhaka, Chittagong, Sylhet,

Rajshahi, Rangpur, Barisal, and Khulna) of Bangladesh. Districts were identified as the primary

sample strata for sample selection at two stages (Progotir Pathey, 2014b, 2019b). In this study, the

child age ranged from 36 to 59 months were included. Therefore, the sample included 17494

children, where 8148 were in 2012 MICS and 9346 children in 2019 MICS having the

information about the ECD and used in the analysis (see Fig. 1).

Outcome variables

The Early Childhood Development Index (ECDI), developed by UNICEF, made a

significant contribution. UNICEF's ECDI was launched for the first time in 2009 during the

fourth round of MICS (2012 MICS) and is now available in the following survey. The ECDI

took shape when UNICEF, in collaboration with countries and partners, developed indicators to

assess the quality of a child's home environment as well as access to early childhood care and

education (ECCE). It contains ten dichotomous (yes/no) items in four early developmental

domains: literacy-numeracy (3 items), physical (2 items), social-emotional (3 items), and

learning approaches (2 items). The MICS includes questions from the ECD module for children

under the age of five and is aimed at mothers (or caregivers) of children aged three and four

(UNICEF, 2017b).

For creating our outcome variable (ECD status), we assigned a score of 1 to each child

based on the number of items to which the mother indicated a 'yes' response, otherwise 0. The

ECDI variable was then constructed and used as the outcome variable based on the sum of these

scores. This had a possible range of 0 to 4, with at least three of these four domains or scores

greater than or equal to three indicating that the child was developmentally 'on track.' The rest

scores were treated as if they were developmentally 'on delay' (Progotir Pathey, 2014b, 2019b).

Confounding variables

For identifying the possible factors associated with ECD status, some reliable variables

are selected as the respondent. A set 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, early

childhood educational program, mother stimulation, father stimulation, other stimulation, salt

iodization, books, toys, media accessibility (possession of television, newspaper or radio), and

child punishment was used. Details, including levels of covariates, are provided in Table 2.

For measuring a child's nutritional status, four anthropometric indices, height-for-age,

weight-for-age and weight-for-height z-score, were used as recommended by the WHO (WHO,

2021). The z-score implies how many standard deviations a given value is apart from the mean,

and it is usually used to standardise data. In this particular case, the z-score was used to compare

stunting, wasting, underweight and overweight across gender and all age groups of under-five

children. A child was considered wasted if the weight-for-height z-score was less than -2 and

stunted if the height-for-age z-score was less than -2. Underweight was considered by weight-for-age z-score when it was less than -2 and overweight if the weight-for-height z-score was higher than +2.

Toilet facilities were categorised into improved (flush toilet, flush to piped sewer system, flush to septic tank, flush to pit latrine, pit latrine with slab and ventilated improved pit latrine) and not improved (e.g. hanging toilet, open pit). The mother's educational level was divided into three groups: no education, primary and secondary complete or higher (completing at least grade 10). Wealth index was re-categorised into high economic class (upper 20% asset value), middle economic class (middle 40% asset value) and low economic class (lower 40% asset value) (Martel, 2016). Early childhood diseases were categorized into "yes" if the mother's (or caretaker's) of the child reported that the child had such symptoms (diarrhoea, symptoms of acute respiratory infection or fever) during the two weeks preceding the survey, otherwise "no". To measure stimulation in this study, the involvement of adults in the household with children in the following activities: reading books or looking at picture books, telling stories, singing songs, taking children outside the home, compound or yard, playing with children, and spending time with children naming, counting, or drawing things. We categorized "yes" if children with whom (fathers/mothers/others) have engaged in any one activities, otherwise "no" (Progotir Pathey, 2014b, 2019b). A children under age 5 left alone or under the supervision of another child younger than 10 years of age for more than one hour at least once during the past week is defined as inadequate supervision (Progotir Pathey, 2014b, 2019b). Salt iodization was categorised into "yes" if the iodine level was between 0 and 15 ppm or above 15 ppm and "no" if the iodine level was 0 ppm or no salt in the house. Child punishment measured if a child aged between 1-14

years who experienced any physical punishment and/or psychological aggression by caregivers in the past one month.

Statistical Analysis

Bivariate analysis with chi-square test was conducted to evaluate the association between ECD statuses with other covariates. For both the 2012 and 2019 MICS survey data, the univariate [unadjusted] and multivariable [adjusted] logistic regression model were fitted separately. In univariate analyses, one confounding variable added at a time in the regression model and for the adjusted model, all possible confounding variables added together in the model. We used the Svyset command in Stata (StataCorp LP, College Station, Texas) to account for the complex survey design. The Svyset command helps us use design elements such as the primary sampling unit, strata, cluster, and sample weight (*Survey Data Analysis in Stata*, 2021).

Check for multicollinearity

Bivariate logistic regression was conducted separately for each of the 26 variables, and their unadjusted odds ratio (OR) was examined. A full multivariable model was formed with the selected predictor variables. We also used the variance inflation factor (VIF) value to examine multicollinearity in the final model with a cut-off value of 4.00 (Parang et al., 2012). All variables were included in the model in this stage because the VIF values of each variable were less than 4.00.

Ethics Statements

As no work on human subjects was carried out as part of this project, this freely available secondary data analysis was exempt from ethics review.

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Results

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Socio-demographic Characteristics

The prevalence of developmentally on track children increased from 65.46% in 2012 to 74.86% in 2019, and the change is significant in proportional test (p<0.001) (see Fig. 2).

For both surveys, the represented sample of age 3 was 4041 (49.59%) in MICS 2012 and 4750 (50.82%) in MICS 2019 and age 4 were 4107 (50.41%) in MICS 2012 and 4596 (49.18%) in MICS 2019. 4234 (51.96%) in MICS 2012 and 4823 (51.60%) in MICS 2019 of the respondent children were male and 3914 (48.04%) in MICS 2012 and 4523 (48.40%) in MICS 2019 of the respondent children were female. Based on residence status, 6855 (84.13%) in MICS 2012 and 7611 (81.44%) in MICS 2019 of the respondents were from rural and 1293 (15.87%) in MICS 2012 and 1735 (18.56%) in MICS 2019 of the respondent children were from urban. The distribution of developmentally on track status of 3 years old children was 59.46% according to 2012 MICS whereas it is increased to 68.72% in 2019 MICS and children of 4 years old were 71.40% on track in 2012 MICS whereas that increased to 81.26% in 2019 MICS. By the sex of the child, the female child was always more developmentally on track than the male child. In 2012 MICS, male child developmentally on track status was 63.41% and 67.65% for female. Similarly, in 2019 MICS, developmentally on track status for male and female children was 71.51% and 78.46%. The children from rural were 72.17% in 2012 MICS and 78.15% in 2019 MICS, who were more developmentally on track than the urban 63.72% in 2012 MICS and 73.99% in 2019 MICS children (see Fig. 3).

The comparison of ECD on-track status for indicated domains between the years 2012 and 2019 was assessed (see Table 1). The prevalence of this status has increased for each of the domains. The highest increase rate in ECD on track status (21.2% to 28.8%) was found in the literacy-numeracy domain. The lowest rate of increase in ECD on track status (68.4% to 72.7%) was found in the social-emotional domain.

The Overall ECD status by their socio-demographic and child characteristics for 2012 MICS and 2019 MICS surveys are shown in Table 2. The distribution of developmentally on track status of child bought in the family of the highly educated mother (Secondary complete or Higher) is 79.46% according to 2012 MICS. In contrast, it is increased to 81.27% in 2019 MICS A child bought by primary incomplete mother was lowest (58.80%) on track status in 2012 MICS whereas that increased to 68.53% in 2019 MICS still lower than other education group. By the wealth index of the child family, the richest family's child was always more developmentally on track than middle or poorest family's child. In 2012 MICS, richest family's child developmentally on track status was 77.55% and 60.36% for poorest.

Similarly, in 2019 MICS, 84.05% and 69.48% were the developmentally on track status for respectively richest and poorest. The children who were not underweight and not stunned are 65.72% and 70.83% in 2012 MICS were more developmentally on track than the children with underweight and stunned, respectively. The children who were not underweight and not stunned are 75.97% and 76.79% in 2019 MICS were more developmentally on track than the children with underweight and stunned. The distribution of developmentally on track status of a child who attends early childhood programs is 78.93% according to 2012 MICS. In contrast, it is increased to 85.99% in 2019 MICS, and a child bought in the family where books for children are present is 72.13% on track status in 2012 MICS whereas that increased to 80.65% in 2019 MICS and child bought in the family where it gets punishment is 49.01% on track status in 2012 MICS whereas that increased to 64.80% in 2019 MICS.

The bivariate and multivariable logistic regression model results refer to the degree of relationship between early childhood development status and children's socio-demographic profiles. To show associations between early childhood developmentally on track status and

child age, child sex, place of residence, division, mother's education, wealth index, religion, sex

of household head, ethnicity, mother's age early childhood diseases, underweight, stunned,

wasted, overweight, sanitation, early childhood programs, mother stimulation, father stimulation,

other stimulation, inadequate supervision, salt iodization, books, toys, mass media and child

punishment. The univariate logistic model indicates the individual associated with the ECD

status. Among all predictor variables, nine variables showed significant association at 5% level

of significance (child age, child sex, division, mothers education, early childhood program, other

stimulation, books, toys and child punishment) in 2012 MICS and 11 variables showed

significant association at 5% level of significance (child age, child sex, division, mothers

education, wealth index, early childhood program, father stimulation, other stimulation,

inadequate supervision, books and child punishment) in 2019 MICS data.

The multivariable result from 2012 and 2019 MICS data, child of age 4 had 62% (2012

MICS OR: 1.62, 95% CI: 1.39-1.87) and 80% (2019 MICS OR: 1.80, 95% CI: 1.59-2.03] higher

chance of being developmentally on track than the age of 3. According to child sex, when all

other variables are adjusted, the female child had 1.42 times higher chance (2012 MICS OR:

1.42, 95% CI: 1.23-1.63) and 1.41 times (2019 MICS OR: 1.41, 95% CI: 1.26-1.59) higher

chance of being in developmentally on track status than the male child respectively in both

datasets. By comparing both model the odds ratio of division gives different results in some

categories, however, Rajshahi [(2012 MICS OR: 0.88, 95% CI: 0.65-1.17) and (2019 MICS OR:

0.97, 95% CI: 0.77-1.23)] and Sylhet [(2012 MICS OR: 0.63, 95% CI: 0.46-0.85) and (2019

MICS OR: 0.76, 95% CI: 0.59-0.97)] had lower chance of early childhood development than

Barisal. In Both surveys, Rangpur had a higher chance [(2012 MICS OR: 1.89, 95% CI: 1.44-

2.48) and (2019 MICS OR: 2.66, 95% CI: 2.11-3.35)] of developmentally on track than the

Barisal. In both multivariable models, children bought by secondary complete or higher educated mothers had a 77% higher chance (2012 MICS OR: 1.77, 95% CI: 1.28, 2.44) and 36% higher chance (2019 MICS OR: 1.36, 95% CI: 1.05-1.78) to be developmentally on track compared to primary incomplete or uneducated mothers'. In both surveys, the child growing in rich families were found with higher chance [OR: 1.33, 95% CI: 0.98-1.79 in MICS 2012 and OR: 1.75, 95% CI: 1.40-2.19 in MICS 2019] of being developmentally on track than the low-income family. Early childhood education programs play a positive role in early childhood development. In both surveys, the child who attended an early childhood education program were found to have higher chance [OR: 1.44, 95% CI: 1.14-1.82 in MICS 2012] and [OR: 1.59, 95% CI: 1.32-1.92 in MICS 2019] of being developmentally on track than the children who did not attend in early childhood education program. Children with early mother stimulation was found to have higher chance in univariate models [OR: 1.30, 95% CI: 1.10-1.53 in MICS 2012] and [OR: 1.33, 95% CI: 1.17-1.53 in MICS 2019] to be developmentally on track than the children without early mother stimulation. Unfortunately, in the multivariable model, mother stimulation shows a lower chance of developmentally on track. However, it is not statistically significant.

Likewise, there were significant differences in ECD status among children who get father and other stimulation. Children with father and additional stimulation had a higher chance of being developmentally on track.

Supervision also plays a crucial role in ECD; compared with inadequate supervision, children raised with adequate supervision were found to have a higher chance of being developmentally on track in both surveys, but the 2012 MICS survey result was not significant. For example, children raised with adequate supervision had a 29% higher chance of developmentally on track. There was a substantial increase in ECD on track status among the

children with books and toys. Similarly, children mother or caretaker mass media access also plays a significant role in early childhood development.

Discussion

We investigated the ECD status among children of Bangladesh. We observed that a large portion of children (74.86%) had developmentally on track status. This finding is in line with the previous MICS reports in 2012 and 2019 (Progotir Pathey, 2014b, 2019b). However, this percentage is lower in Pakistan (Balochistan) and higher in Vietnam (Miller et al., 2016a). Moreover, this figure varies in low- and middle-income countries, mean rate of children aged 36–59 months with on-track development was 65·5%, ranging from 42·6% in Sierra Leone to 85·9 % in Sierra Leone Belize (Miller et al., 2016b). We also observed substantial impact of child age, child sex, residence, division, mother's education, and wealth index on the ECD status.

In this study, the boy's ECD on track status is low compared to girls and correspondingly had a higher chance of developmental delay. These findings are consistent with other cohort studies in Western Cape, South Africa, where they explored developmental performance by cognitive, language, and fine motor in very young children (Donald et al., 2019). Statistically significant gender differences among children with developmental delay in two or more countries were found using two indicators. Concerning "learning support", gender inequality was inconsistent (higher disadvantage among boys in Vietnam and girls in Nepal). Concerning "aggression" to others, a significantly higher prevalence was observed among boys with developmental delay in Bangladesh, Pakistan, and Vietnam (Centre for Disability Research and Policy, 2016a).

Child from the wealthiest family had a higher chance of overall development compared to their most impoverished counterparts. Because early childhood programs may exacerbate existing developmental inequalities if uptake of promoted activities is more significant in higher socio-economic groups that already have comparatively better growth and development (Bhopal et al., 2019). Evidence shows a graded effect of deprivation and adversity across the entire spectrum of socioeconomic status. Even those children from the second-highest social class lead to poorer health and development than those from families of the very highest socioeconomic status (Brennan et al., 2013). In five of the six countries, children with developmental delay were more likely to be living in poverty than their peers. In three countries (Bangladesh, Laos, and Vietnam), differences were statistically significant. The highest relative disadvantage rates were observed in Vietnam, with children with development delay being 2.2 times more likely to be living in poverty (Centre for Disability Research and Policy, 2016b). Poverty and adverse childhood experiences have long-term physiological and epigenetic effects on brain development and cognition (Luby, 2015).

Our study findings also confirmed that children's on-track developmental status occurred among secondary or higher educated mothers. Parents' cultural backgrounds have been associated with the learning environments provided to children of all ages. Parents tend to promote not only those skills that they value but also those they have mastered. In a recent study, immigrant parents of different cultural backgrounds—Cambodian, Dominican, and Portuguese— differed significantly concerning the areas of their children's education in which they were involved. These differences existed even when many parents in all groups reported valuing education and having high aspirations for their children's educational attainment.

According to our study, early childhood diseases and lack of nutrition children had a high risk of developmental delays. Children undernourished or frequently ill are at increased risk for developmental problems, emphasising the urgency of developing coordinated early childhood development programmes in collaboration with the health and nutrition sectors (Black et al., 2017a).

Early childhood programs are a critical outlet for fostering the mental and physical development of young children (Anderson et al., 2003). In our study, we found that, children who attended early childhood education program were significantly at more developmentally on track than their counterparts.

Adequate supervision, stimulation, having books and toys in household showed positive result on ECD on track status. Positive associations between nurturing care and children's health, growth, and development have been demonstrated worldwide, supported by neuroscientific evidence that nurturing care during early childhood attenuates the detrimental effects of low socioeconomic status on brain development (Bradley & Putnick, 2012; Noble et al., 2015).

In our study, mass media access of the household or caregivers can increase the chance of early childhood developmentally on track status. Television and other media can increase home access to early childhood development programming aimed at either children or parents (Black et al., 2017b). Local versions of the educational television programme Sesame Street reach children in over 150 countries (Cole CF, Richman BA, 2001). In Bangladesh, almost 50% of 3–5-year-old children watched television daily, and among television watchers, 83% of urban and 58% of rural pre-schoolers watched Sesame Street (Lee, 2007). A meta-analysis representing more than 10 000 children from 15 countries found significant benefits from watching Sesame Street in

literacy and numeracy, health and safety, and social reasoning and attitudes toward others (Mares & Pan, 2013).

It was found that child punishment causes a child developmental delay. Stressors such as physical abuse, family instability, unsafe neighbourhoods', and poverty can cause children to have inadequate coping skills, difficulty regulating emotions, and reduced social functioning compared to other children their age (Noble et al., 2007).

Strengths and limitations

To the best of our knowledge, this is the first study based on the most recent MICS data in the context of developmental status using ECDI scores with Bangladeshi children. We used a sufficiently large nationally representative dataset, which represents the general population of Bangladesh. We also considered a wide range of factors that are influencing the developmental status.

Despite all these strengths, our study had some limitations. As we used secondary data, the selection of variables, quality of data, and measurement indicators were beyond control. Data on child development are also available only for children of ages 3 and 4. It is unclear how similar developmental scores among younger children are to the outcomes observed among 3- and 4-y-olds. Additional data spanning the entire 0- to 5-y age range is needed to understand children's development at the country levels more precisely. Moreover, the survey was conducted in 2012 and 2019; in the meantime, the developmental status may have changed.

<div align="center">

Recommendations:

</div>

This study's findings have implications for governments, international agencies, non-government organisations, and public health professionals who are working to improve early childhood development. To ECD, future research is needed to develop more detailed and age-

specific measures that can more accurately capture children's abilities across a wide range of cultures and local contexts. Further work is required beyond typical development standards to understand the specific needs of children who may experience more severe disabilities requiring more intensive treatment and care. In response to the loss of human potential associated with early adversities, leaders from international organisations have issued urgent calls for strategies to ensure that young children reach their developmental potential. Low-cost activities, such as storytelling, singing, and playing with household objects expose young children to experiences that promote early development.

Conclusion

The study focused on the level and influencing factors of early childhood developmental status among children aged 3 and 4 years from rural and urban areas of Bangladesh. A strong impact of the child's age, region, division, mother's education, wealth index, religion, childhood education program, nutritional status, supervision and child punishment on the child's developmental status was detected. In Bangladesh, many children had developmentally on track came from highly educated mothers, initiatives should be taken to enlarge the mothers in higher education. Children in the poorest wealth status group of the countries are the most in need of assistance to reach their full development potential, the poorest group of Bangladesh are mostly in developmental delays. Early childhood diseases and the frequent of health complexity of children are some of the significant risk factors for developmental delay, we should be more careful about this problem. Lack of nutrition of a children interrupts the development, mothers or caregivers should be aware about that. In this study, nutritional balanced children are more developmentally on track than the poor nutritional child. The early learning setting procedures or pre-school learning could be a valuable step towards reducing the developmental delay, it also

helps a child to make good results in a primary education program. A deeper understanding of the relationship between the risk factors and children's early development and approaches to encouraging parents' engagement in children's learning, development, and health is needed to ensure that children in Bangladesh reach full developmental potential effectively. Additional research is required to increase the evidence base for what can successfully impact childhood development and education on health outcomes and disparities. This other evidence will facilitate public health efforts to address early childhood development and education as social determinants of health.

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Tables and figures

Total number of interviewed households were

MICS 2012: 51895 & MICS 2019: 64400

The Children under 5 years of age were selected from MICS 2012 & 2019.

$N_1 = 20903$ & $N_2 = 23101$

Children under 3 years of age were omitted from both the survey data.

$n_1 = 15282$ & $n_2 = 15340$

The children with age 36 months to 59 months were selected from both the survey

$n_1 = 8148$ & $n_2 = 9346$

MICS 2012 data contains with

Rural = 1293 & Urban = 6855

Male 4234 & Female 3914

MICS 2019 data contains with

Rural = 1735 & Urban = 7611

Male 4823 & Female 4523

Fig. 1. Schematic diagram of the analytic study sample

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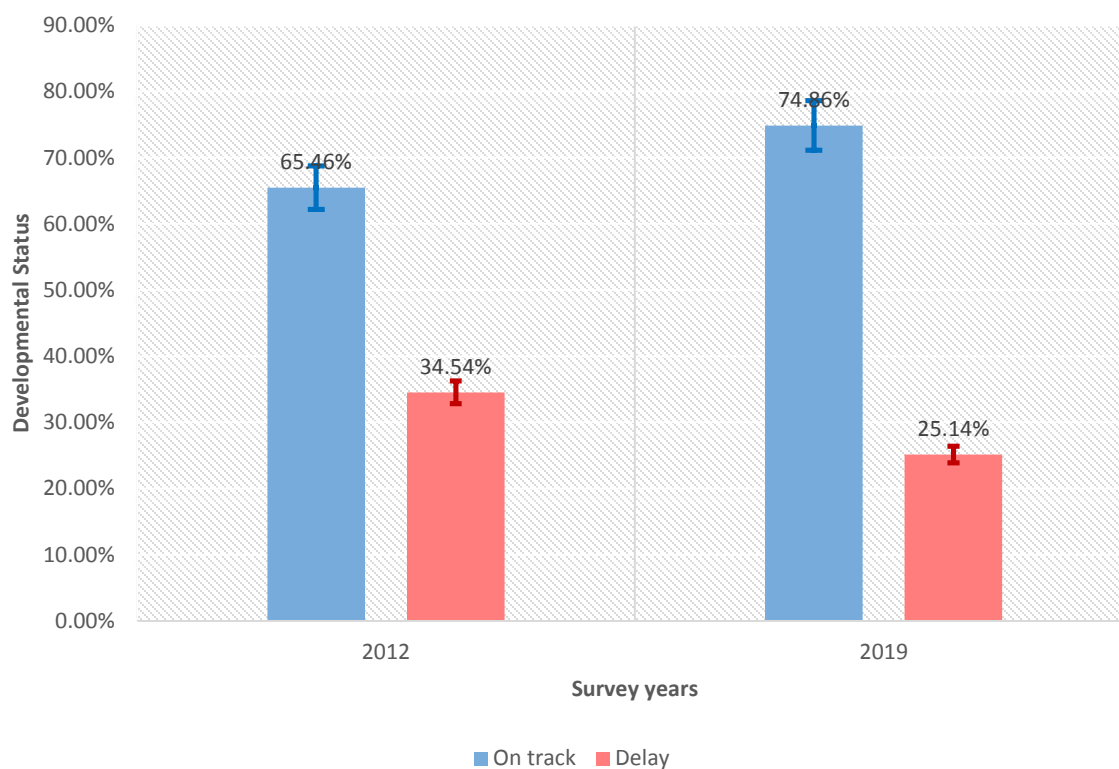
Fig. 2. Distribution of developmental status of children by different survey years.
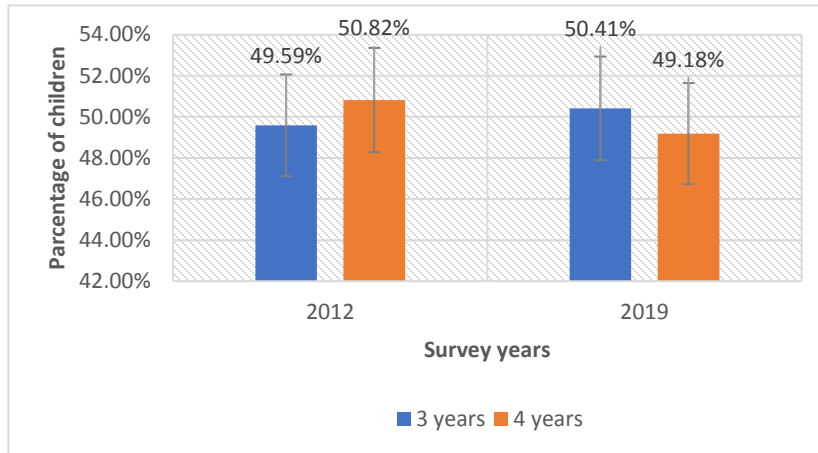
Fig. 3a. Distribution of children by age and different survey years.
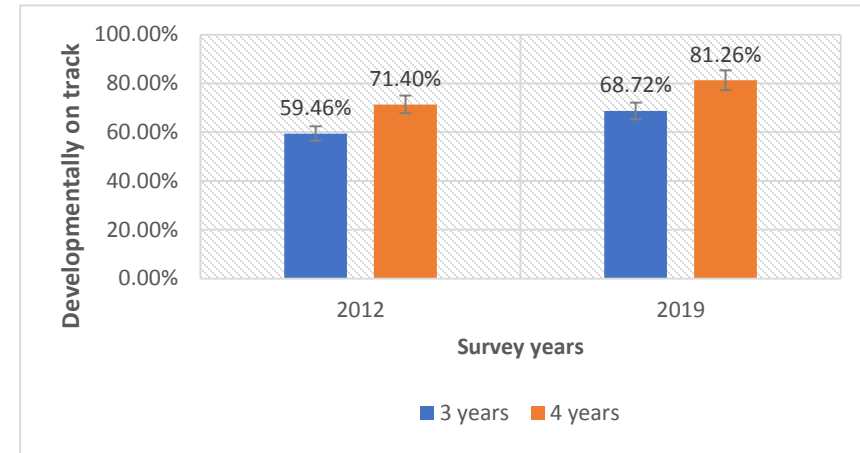
Fig. 3b. Distribution of developmentally on track status of children by age and different survey years.
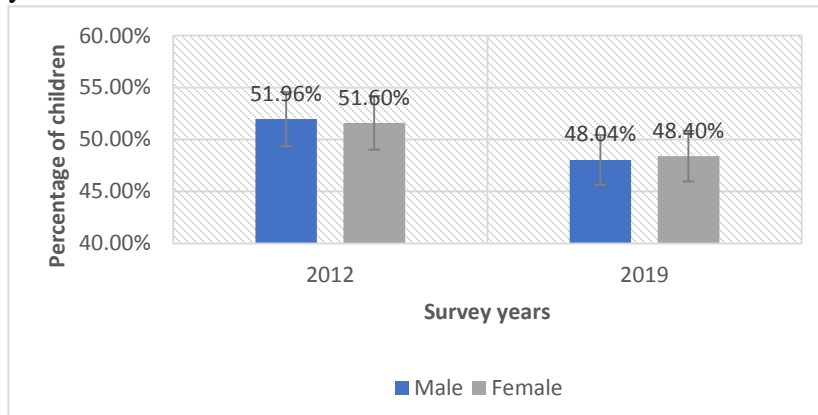
Fig. 3c. Distribution of children by sex and different survey years.
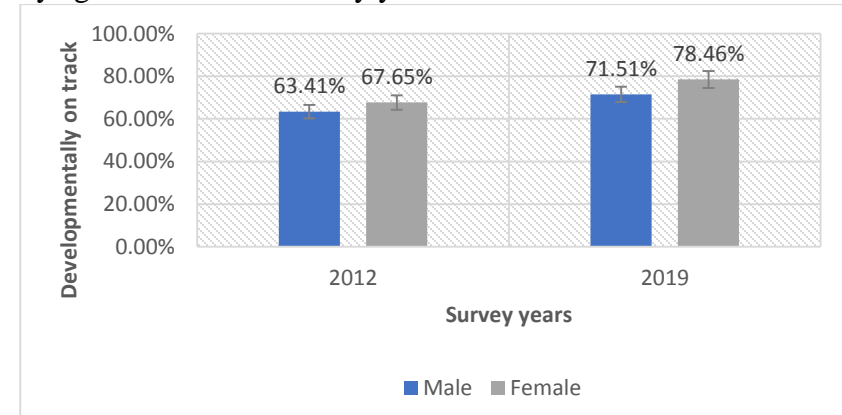
Fig. 3d. Distribution of developmentally on track status of children by sex and different survey years.

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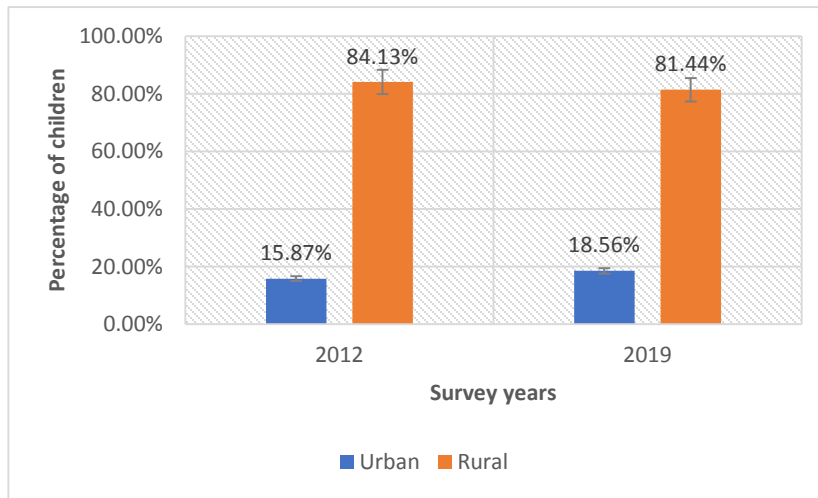
Fig. 3e. Distribution of children by place of residence and different survey years.
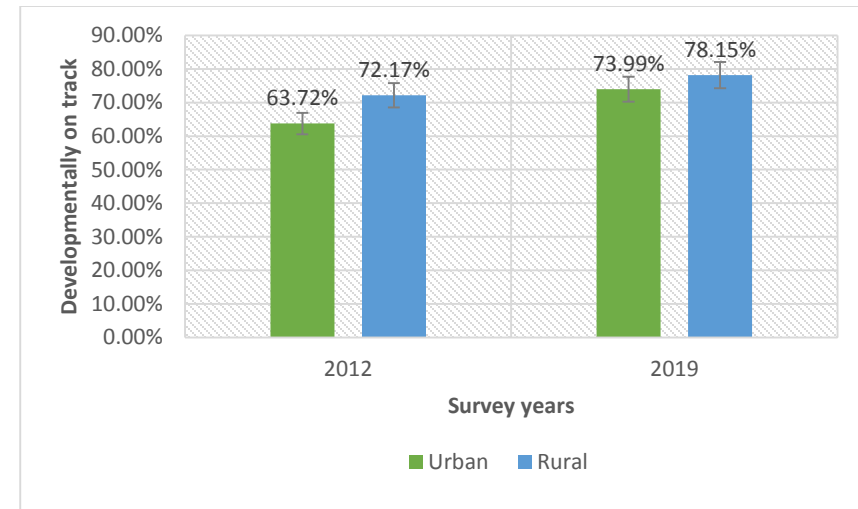
Fig. 3f. Distribution of developmentally on track status of children by place of residence and different survey years.

Table 1 Comparison of the developmentally on-track status for indicated domains between two consecutive MICS survey.

Domains	2012 MICS (%)	2019 MICS (%)
Literacy-numeracy	21.2	28.8
Physical	92.2	98.4
Social-Emotional	68.4	72.7
Approaches to learning	87.5	91.4

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Table 2 Sample characteristics of children by developmental status, MICS 2012 and 2019**.**

Characteristics	MICS 2012			MICS 2019		
	Developmentally on track			Developmentally on track		
	Yes	No	P-value	Yes	No	P-value
	N (%)	N (%)		N (%)	N (%)	
Age of child (in years)						
3	2392 (59.46)	1649(40.54)	<0.001	3166 (68.72)	1584 (31.28)	<0.001
4	2909 (71.40)	1198 (28.60)		3680 (81.26)	916 (18.74)	
Child's sex						
Male	2669 (63.41)	1565 (36.59)	0.002	3383 (71.51)	1440 (28.49)	<0.001
Female	2632 (67.65)	1282 (32.35)		3463 (78.46)	1060 (21.54)	
Place of residence						
Urban	4388(63.72)	2467 (36.28)	<0.001	5541 (73.99)	2070 (26.01)	<0.001
Rural	913 (72.17)	380 (27.83)		1305 (78.15)	430 (21.85)	
Division						
Barishal	526 (67.86)	262 (32.14)		552 (67.8)	269 (32.20)	
Chattogram	940 (55.04)	682 (44.96)		1479 (78.26)	470 (21.74)	
Dhaka	1286 (67.45)	674 (32.55)		1453 (81.85)	343 (18.15)	
Khulna	740 (71.70)	326 (28.30)	<0.001	895 (73.07)	409 (26.93)	<0.001
Mymensingh	-	-		347 (61.26)	209 (38.74)	
Rajshahi	527 (66.76)	263 (33.24)		720 (69.57)	307 (30.43)	
Rangpur	866 (78.38)	262 (21.62)		896 (83.71)	207 (16.29)	
Sylhet	416 (54.15)	378 (45.85)		504 (61.73)	286 (38.27)	
Mother's Education						
Primary incomplete	2076 (58.80)	1462 (41.20)		847 (68.56)	389 (31.44)	
Primary complete	772 (62.73)	447 (37.27)		1590 (69.38)	727 (30.62)	
Secondary incomplete	1800 (70.01)	760 (29.99)	<0.001	3363 (76.88)	1143 (23.12)	<0.001
Secondary complete or Higher	653 (79.46)	178 (20.54)		1046 (83.11)	241(16.89)	
Wealth Index						
Poorest	2621 (60.36)	1696 (39.64)		3026 (69.84)	1331 (30.16)	
Middle	1839 (66.06)	886 (33.94)	<0.001	2574 (75.65)	904 (24.35)	<0.001
Richest	841 (77.55)	265 (22.45)		1246 (84.05)	264 (15.95)	

Religion						
Islam	4486 (66.08)	2384 (33.92)	0.044	5518 (74.97)	2025 (25.03)	0.658
Others	534 (61.42)	321 (38.58)		908(74.26)	325(25.74)	
Household Head's Sex						
Male	4411 (65.67)	2348 (34.33)	0.852	5500 (75.12)	1996 (24.888)	0.254
Female	609 (65.26)	357 (34.74)		926 (73.42)	354 (26.58)	
Ethnicity of the household head						
Bengali	4865 (65.58)	2620 (34.42)	0.798	6684 (74.89)	2438 (25.11)	0.474
Others	155 (66.60)	85 (33.40)		162 (72.70)	62 (27.30)	
Mother's Age at the Survey Time						
15 – 19	190 (68.00)	86 (32.00)		1276 (77.02)	428 (22.98)	
20-34	2991 (68.18)	1444 (31.82)	0.010	3035 (73.85)	1148 (26.15)	0.027
35+	883 (62.75)	536 (37.25)		2009 (74.83)	751 (25.17)	
Early Childhood Diseases						
Yes	1262 (64.63)	712 (35.37)	0.494	1895 (73.84)	738 (26.16)	0.205
No	4035 (65.72)	2132 (34.28)		4940 (75.24)	1761 (24.76)	
Underweight						
Yes	1660 (61.12)	1047 (38.88)	<0.001	1591 (71.86)	667 (28.14)	<0.001
No	3308 (68.11)	1618 (31.89)		5038 (75.97)	1732 (24.03)	
Stunned						
Yes	2037 (59.86)	1355 (40.14)	<0.001	1749 (70.34)	802 (29.66)	<0.001
No	2860 (70.83)	1240 (29.17)		4824 (76.79)	1572 (23.21)	
Wasted						
Yes	444 (65.59)	239 (34.41)	0.989	647 (74.34)	238 (25.66)	0.721
No	4516 (65.63)	2415 (34.37)		5905 (74.96)	2134 (25.04)	
Overweight						
Yes	407 (64.98)	219 (35.02)	0.832	395 (76.0)	158 (24.0)	0.544
No	4894 (65.50)	2628 (34.50)		6451 (74.78)	2342 (25.22)	
Sanitation						
Improved	4819 (65.17)	2575 (34.83)	0.348	6218 (74.83)	2279 (25.17)	0.712
Unimproved	201 (61.09)	128 (38.91)		207 (76.0)	71 (24.0)	
Early childhood education programs						

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Yes	936 (78.93)	246 (21.07)	<0.001	1498 (85.99)	269 (14.01)	<0.001
No	4364 (63.31)	2599 (36.69)		5348 (72.19)	2231 (27.81)	
Mother Stimulation						
Yes	4619 (66.26)	2422 (33.74)	0.002	5696 (75.86)	1949 (24.14)	<0.001
No	682 (60.2)	425 (39.8)		1150 (70.2)	551 (29.8)	
Father Stimulation						
Yes	3035 (66.49)	1613 (33.51)	0.078	3024 (73.11)	1151 (26.89)	<0.001
No	2266 (64.02)	1234 (35.98)		3822 (76.29)	1349 (23.71)	
Other Stimulation						
Yes	4356 (66.5)	2282 (33.5)	0.003	3646 (74.15)	1344 (25.85)	0.118
No	945 (61.19)	565 (38.81)		3200 (75.68)	1156 (24.32)	
Inadequate Supervision						
Yes	542 (62.96)	306 (37.04)	0.343	590 (68.92)	279 (31.08)	<0.001
No	4754 (65.74)	2538 (34.26)		6256 (75.41)	2221(24.59)	
Salt Iodization						
Yes	3600 (64.441)	2075 (35.59)	0.004	5172 (74.65)	1894 (25.35)	0.400
No	1420 (69.03)	629 (30.97)		1251 (75.77)	456 (24.23)	
Child education Book at home						
Yes	3325 (72.13)	1251 (27.87)	<0.001	3837 (80.65)	1017 (19.35)	<0.001
No	1976 (55.8)	1596 (44.2)		3008 (68.58)	1483 (31.42)	
Toys						
Yes	4084 (68.18)	2053 (31.82)	<0.001	5645 (74.69)	2081 (25.31)	0.465
No	1217 (57.41)	794 (42.59)		1201 (75.67)	419 (24.33)	
Mass Media						
Yes	2038 (71.38)	838 (28.62)	<0.001	3830 (74.69)	1411 (25.31)	0.803
No	2024 (61.88)	1228 (38.12)		2490 (74.95)	916 (25.05)	
Child Punishment						
Yes	137 (49.01)	145 (50.99)	<0.001	321 (64.8)	165 (35.2)	<0.001
No	5164 (66.13)	2702 (33.87)		6525(75.42)	2335 (24.58)	

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Table 3 Factors associated with the developmental status of children, MICS 2012 and 2019.

Characteristics	MICS- 2012 Univariate			Multivariable			MICS- 2019 Univariate			Multivariable		
	Unadjusted OR (95% CI)		P-value	Adjusted OR (95% CI)		P-value	Unadjusted OR (95% CI)		P-value	Adjusted OR (95% CI)		P-value
Age of Child												
4	1.70	(1.52-1.90)	<0.001	1.62	(1.39-1.87)	<0.001	1.97 (1.77-2.20)		<0.001	1.80 (1.59-2.03)		<0.001
3	Reference		-	Reference		-	Reference		-	Reference		-
Child's Sex												
Female	1.21	(1.07-1.36)	0.002	1.42	(1.23-1.63)	<0.001	1.45 (1.31-1.61)		<0.001	1.41 (1.26-1.59)		<0.001
Male	Reference		-	Reference		-	Reference		-	Reference		-
Place of residence												
Rural	1.48	(1.21-1.79)	<0.001	1.09	(0.88-1.36)	0.408	1.26 (1.09-1.44)		<0.001	0.88 (0.75-1.03)		0.105
Urban	Reference		-	Reference		--	Reference		-	Reference		-
Division												
Chattogram	0.58	(0.48-0.71)	<0.001	0.59	(0.45-0.76)	<0.001	1.71 (1.43 - 2.05)		<0.001	1.47 (1.19-1.83)		<0.001
Dhaka	0.98	(0.81-1.19)	0.851	0.99	(0.78-1.27)	0.981	2.14 (1.77 - 2.60)		<0.001	1.89 (1.51-2.35)		<0.001
Khulna	1.20	(0.97-1.48)	0.089	1.03	(0.79-1.33)	0.838	1.29 (1.07-1.55)		<0.01	0.99 (0.80-1.23)		0.930
Mymensingh	-		-	-		-	0.75 (0.59 - 0.95)		0.017	0.81 (0.62-1.06)		0.125
Rajshahi	0.95	(0.76-1.19)	0.664	0.88	(0.65-1.17)	0.374	1.09 (0.88-1.33)		0.430	0.97 (0.77-1.23)		0.817
Rangpur	1.72	(1.39-2.11)	<0.001	1.89	(1.44-2.48)	<0.001	2.44 (0.62-0.95)		<0.001	2.66 (2.11-3.35)		<0.001
Sylhet	0.56	(0.45-0.70)	<0.001	0.63	(0.46-0.85)	0.003	0.77 (0.62-0.95)		0.015	0.76 (0.59-0.97)		0.031

Barishal	Reference	-	Reference		Reference	-	Reference	-
Mother's Education								
Secondary complete or Higher	2.26 (1.82-2.79)	<0.001	1.74 (1.26-2.40)	<0.001	2.26 (1.82-2.79)	<0.001	1.40 (1.07-1.82)	<0.05
Secondary incomplete	1.64 (1.43-1.87)	<0.001	1.20 (1.00-1.45)	<0.05	1.53 (1.31-1.78)	<0.001	1.18 (0.98-1.42)	0.078
Primary complete	1.18 (0.99-1.40)	0.059	0.95 (0.79-1.15)	0.620	1.04 (0.88-1.23)	0.651	0.94 (0.78-1.14)	0.540
Primary incomplete	Reference	-	Reference	-	Reference	-	Reference	-
Wealth Index								
Richest	2.27 (1.85-2.79)	<0.001	1.33 (0.98-1.79)	0.063	2.28 (1.93-2.69)	<0.001	1.71 (1.37-2.14)	<0.001
Middle	1.28 (1.13-1.44)	<0.001	1.02 (0.87-1.21)	0.794	1.34 (1.20-1.50)	<0.0001	1.12 (0.98-1.29)	0.094
Poorest	Reference	-	Reference	-	Reference	-	Reference	-
Religion								
Islam	0.95 (0.77-1.17)	0.652			1.04 (0.88-1.23)	0.659	-	-
Others	Reference	-			Reference	-	-	-
Household's Head Sex								
Male	1.01 (0.77-1.31)	0.960			1.09 (0.94-1.27)	0.254	-	-
Female	Reference	-			Reference	-	-	-
Ethnicity								
Bengali	0.89 (0.64-1.25)	0.512			1.12 (0.82-1.53)	0.474	-	-
Others	Reference	-			Reference	-	-	-
Mother's Age								
15 – 19	1.26 (0.90-1.77)	0.182	1.21 (0.82-1.78)	0.345	1.12 (0.97-1.31)	0.121	1.15 (0.97-1.36)	0.102

	OR (CI)	p	OR (CI)	p	OR (CI)	p	OR (CI)	p
20 – 34	1.27 (1.09-1.49)	0.003	1.15 (0.96-1.38)	0.127	0.95 (0.84-1.07)	0.406	0.95 (0.84 – 1.09)	0.480
35+	Reference	-	Reference	-	Reference	---	Reference	--
Early Childhood Diseases								
No	1.05 (0.91-120)	0.492	-	-	1.08 (0.96-1.21)	0.205	-	-
Yes	Reference	-	-	-	Reference		-	-
Underweight								
No	1.36 (1.19-1.55)	<0.001	1.11 (0.93-1.35)	0.237	1.24 (1.10-1.39)	< .001	1.01 (0.87-1.17)	0.908
Yes	Reference	-	Reference	-	Reference	-	Reference	-
Stunned								
No	1.63 (1.44-1.84)	<0.001	1.17 (0.98-1.39)	0.080	1.40 (1.25-1.56)	< .001	1.08 (0.94-1.24)	0.299
Yes	Reference	-	Reference	-	Reference	-	Reference	-
Wasted								
No	1.01 (0.81-1.23)	0.989			1.03 (0.86-1.23)	0.721	-	-
Yes	Reference	-			Reference		-	-
Overweight								
Yes	0.98 (0.79-1.21)	0.831			1.07 (0.86-1.32)	0.544	-	-
No	Reference	-			Reference		-	-
Sanitation								
Unimproved	1.33 (1.14-1.55)	<0.001	0.92 (0.74-1.14)	0.440	1.06 (0.76-1.48)	0.711	-	-
Improved	Reference	-	Reference	-	Reference	-	-	-
Early childhood education programs								
Yes	2.37 (2.00-2.79)	<0.001	1.44 (1.14-1.82)	0.002	2.37 (2.00-2.79)	< .001	1.59 (1.32-1.92)	< 0.001
No	Reference	-	Reference	-	Reference	-	Reference	-
Mother Stimulation								

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	Model 1		Model 2		Model 3		Model 4	
Yes	1.33 (1.17-1.52)	0.002	0.97 (0.77-1.24)	0.832	1.33 (1.17-1.52)	< .001	0.99 (0.85-1.18)	0.993
No	Reference	-	Reference	-	Reference	-	Reference	-
Father Stimulation								
Yes	0.84 (0.76-0.93)	<0.001	0.97 (0.83-1.12)	0.644	1.18 (1.07-1.31)	<0.001	0.77 (0.68-0.87)	< 0.001
No	Reference	-	Reference	-	Reference	-	Reference	-
Others Stimulation								
Yes	1.26 (1.08-1.46)	0.002	1.33 (1.10-1.61)	0.004	1.09 (0.98-1.20)	0.118	1.16 (1.03-1.30)	0.016
No	Reference	-	Reference	-	Reference	-	Reference	-
Inadequate Supervision								
No	1.13 (0.88-1.45)	0.344			1.38 (1.16-1.64)	< .001	1.29 (1.06-1.58)	0.011
Yes	Reference	-			Reference	-	Reference	-
Salt Iodization								
Yes	Reference	-	Reference	-	Reference	-	-	-
No	0.79 (0.70-0.90)	<0.001	0.99 (0.84-1.17)	0.936	1.06 (0.92-1.22)	0.400	-	-
Child education Book at home								
Yes	2.05 (1.83-2.30)	<0.001	1.50 (1.26-1.77)	<0.001	1.91 (1.72-2.13)	< 0.001	1.53 (1.34-1.73)	< 0.001
No	Reference	-	Reference	--	Reference	-	Reference	-
Toys								
Yes	1.59 (1.37-1.84)	<0.001	1.54 (1.29-1.84)	<0.001	1.05 (0.91-1.22)	0.309	-	-
No	Reference	-	Reference	--	Reference	-	-	--
Mass Media								
Yes	1.54 (1.34-1.76)	<0 .001	1.13 (0.95-1.34)	0.179	Reference	-	-	-
No	Reference	-	Reference	--	1.01 (0.91-1.13)	0.803	-	-
Child Punishment								

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Yes	0.49 (0.36-0.67)	<0.001	0.70 (0.49-0.99)	0.043	0.60 (0.49-0.74)	<0.001	0.67 (0.52-0.86)	< 0.005
No	Reference	-	Reference	--	Reference	-	Reference	--

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