**Early childhood developmental status and its associated factors in Bangladesh: a comparison of two multiple indicator cluster surveys**

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**Abstract**

**Introduction**

Child cognitive and social development begins within the early years of their life. The lacking of this development creates physical and mental disorder including childhood autism. Considering this, we conducted a comparison study in Bangladesh using two multiple indicator cluster surveys (MICS) to assess the early childhood developmental (ECD) status and its associated factors.

**Methods**

We used the nationally representative MICS 2012 and 2019 survey data. Altogether, 17494 [8148 from MICS 2012 and 9346 from MICS 2019] children aged 36 to 59 months were included in the study. We applied Chi-square association test, univariate and multivariable logistic regression model to evaluate the ECD status and its associated factors.

**Results**

The overall ECD status improved from 2012 (65.46%) to 2019 (74.86%). The child literacy-numeracy [28.8% vs 21.2%], physical [98.4% vs 92.2%], social-emotional [72.7% vs 68.4%] and approaches to learning [91.4% vs 87.5%] indicators were found an increasing trend in 2019 comparing to 2012. The multivariable result from 2012 and 2019 MICS data, child age of 4 years had 62% and 80% higher chance of developmentally on track than the age of 3. According to child sex, when all other variables adjusted, the developmentally on track status had 1.42 times and 1.41 times higher chance for female child than the male child respectively in both datasets. Mother’s with secondary complete or higher educational attainment had a higher chance of developmentally on track than their primary incomplete counterparts. Children with father and other stimulation had a higher chance of developmentally on track. Children raise with adequate supervision had 29% higher chance of developmentally on track. There was a significant increase in ECD on track status among the children with family has books and toys. Similarly, children mother or caretaker mass media access also plays significant role for early childhood development.

**Conclusion**

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, rich families, low disease infected children, adequate supervision child, pre-school attending children and child without punishment. This study will facilitate public health efforts to address early childhood development and education as social determinants of health.

**Introduction**

The early years of a child's life play a key role in their cognitive development, social and emotional abilities1. 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 2. Early adversity (for example, maternal depression, domestic violence, drug abuse, having a single caregiver and poverty) influences genetic expression (phenotypes), which, in turn, affects brain structure and cognitive function and child development. The effects of these risk factors are moderated by the intensity, timing and duration of adversity, as well as a child’s reactivity to these factors and associated with developmental delays and chronic health problems, such as coronary heart disease, diabetes and depression later in life 3. Compared with children with non-autistic, children with autism have been described as less likely to demonstrate early social-communicative behaviours such as making eye contact, response to parents or others, offering and giving objects, showing and pointing to objects, raising arms to be picked up, less likely to play, imitating, using non-verbal vocalizations communicatively, and more likely to prefer to be alone, which push them to developmental delays 4–6.

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,7 which allows them to stay focused, understand and follow directions, communicate with others, and solve increasingly complex problems 1. 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 8. 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 9.

Since the turn of the twenty-first century, the interest in ECD has become popular worldwide. Developed countries suggest that population-based measures may help measure ECD and predict later life wellness1. Yet, despite the practical importance of the ECD, population-based measures have not been readily available to low-and middle-income countries (LMICs) 10. Using the data from United Nations Children’s Fund (UNICEF) and the World Bank, the Lancet 2016 child development series concluded that 43 percent or an estimated 250 million children under five fail to achieve their developmental potential each year, living in low- and middle-income countries (LMICs) are at risk of suboptimal development due to poverty and stunting 11. The series confirms the links between poverty and inequality in childhood development that are mediated through biological factors, including intrauterine growth restriction, child malnutrition, microbial deficiencies, infectious diseases, environmental exposure, and psychological factors 12.

In Bangladesh, government and non-government organizations are working with many developmental facilities for the child, child parents, and child care-takers to ensure all kinds of rights they deserved 13. 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 Early Childhood Development. UNICEF continues to popularize the concept of ECD, demonstrate policies, strengthen networks and partnerships, and provide technical assistance and support 14. However, there is a lack of empirical evidence of the mechanisms of the factors associated with early childhood development in Bangladesh. Thus, this paper aims to draw the relationship among factors related to early childhood development in Bangladesh, and we try to show the child's developmental status in Bangladesh.

**Methods**

**Data source and study variables**

We used two waves of 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. Mostly, 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 households15,16. Datasets were open access for the public domain 17.

**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 stages15,16. 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.

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.

N1 = 20903 & N2 = 23101

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

n1 = 15282 & n2 = 15340

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

n1 = 8148 & n2 = 9346

MICS 2019 data contains with

Rural = 1735 & Urban = 7611

Male 4823 & Female 4523

MICS 2012 data contains with

Rural = 1293 & Urban = 6855

Male 4234 & Female 3914

The Early Childhood Development Index (ECDI) primary objective is to inform public policy on children's development status in Bangladesh. To measure early childhood development, UNICEF made a significant contribution by developing the ECDI questionnaire. The ECDI began to materialize when UNICEF, working with countries and partners, designed indicators to assess the quality of a child’s home environment and access to early childhood care and education (ECCE). From UNICEF’s the ECDI was 1st initiated in 2009 during the 4th round of MICS (2012 MICS) and has been available in the following survey. It includes ten dichotomous (yes/no) items in four early developmental domains: Literacy-numeracy (3 items), physical (2 items), social-emotional (3 items), and approaches to learning (2 items). The MICS includes questions in the ECD module for children under five and is addressed to mothers (or caregivers) of children ages 3 and 4 10.

For creating the outcome variable (ECD status), for each ECDI domain, a score of 1 was assigned to every child depends on the number of items to which the mother indicated a ‘yes’ response, otherwise 0. ECDI variable then constructed based on the summation of these scores and used as the outcome variable. This had a possible range of 0 to 4, whereby at least three of these four domains or scores greater than or equals to three were indicated developmentally ‘on track’. The rest scores were treated as to fall in the category of developmentally ‘on delay’ 15,16.

**Covariates**

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, 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 18. 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). Mother's educational level was also 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) 19. 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 2 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” 15,16. 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 supervision15,16. Salt iodization were categorised into “yes” if iodine level was between 0 and 15 ppm or above 15 ppm and “no” if iodine level was 0 ppm or no salt in the house. Child punishment measured if a children 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 (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 to show the degree of factors influence and adjusted associations. To account for the complex survey design, we used the Svyset command in Stata (StataCorp LP, College Station, Texas). The Svyset command helps us use design elements such as the primary sampling unit, strata, cluster, and sample weight 20.

**Variable selection**

Bivariate logistic regression was conducted separately for each of the 26 variables, and their unadjusted odds ratio (OR) was examined. In this stage, 19 variables were found to be significant at the 20% significance level. A multivariable full 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. In this stage all variables were included in the model because of the VIF values of each variable were less than 4.00.

**Ethical considerations**

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.

**Results**

**Socio-demographic Characteristics**

This study included 8148 in 2012 and 9346 in 2019 nationally representative children 3 to 4 months of age in Bangladesh. 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) (Figure-2).

|  |
| --- |
|  |
| **Fig 2.** Distribution of developmental status of children by different survey years. |

For both study, the represented sample of age 3 were 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%) MICS 2019. 4234 (51.96%) in MICS 2012 and 4823 (51.60%) in MICS 2019 of the respondent child were male and 3914 (48.04%) in MICS 2012 and 4523 (48.40%) in MICS 2019 of the respondent child were female. Based on residence status 6855 (84.13%) in MICS 2012 and 7611 (81.44%) in MICS 2019 of the respondent were from rural and 1293 (15.87%) in MICS 2012 and 1735 (18.56%) in MICS 2019 of the respondent child were from urban. The distribution of developmentally on track status of child age of 3 years is 59.46% according to 2012 MICS whereas it is increased to 68.72% in 2019 MICS and child age of 4 years 71.40% was 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, 71.51% and 78.46% were male and female developmentally on track. The children from rural 72.17% in 2012 MICS and 78.15% in 2019 MICS were more developmentally on track than the urban 63.72% in 2012 MICS and 73.99% in 2019 MICS children [Figure 3].

|  |  |
| --- | --- |
|  |  |
| **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. |
|  |  |
| **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. |

The comparison of ECD on-track status for indicated domains between the years 2012 and 2019 was assessed [Table 1]. Prevalence of these 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.

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 |

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 highly educated mother (Secondary complete or Higher) is 79.46% according to 2012 MICS whereas it is increased to 81.27% in 2019 MICS and 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 but 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 respectively richest and poorest developmentally on track status. 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 child who attend in early childhood programs is 78.93% according to 2012 MICS whereas it is increased to 85.99% in 2019 MICS, 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 he get punishment is 49.01% on track status in 2012 MICS whereas that increased to 64.80% in 2019 MICS.







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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Characteristics** | 2012 | |  | 2019 | |  |
| **Developmentally on track** | | **P-value** | **Developmentally on track** | | **P-value** |
| **Yes** | **No** | **Yes** | **No** |
| **N (%)** | **N (%)** | **N (%)** | **N (%)** |
| ***Age of child*** | | | | | | |
| 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) | <0.001 | 552 (67.8) | 269 (32.20) | <0.001 |
| 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) | 895 (73.07) | 409 (26.93) |
| 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) | <0.001 | 847 (68.56) | 389 (31.44) | <0.001 |
| Primary complete | 772 (62.73) | 447 (37.27) | 1590 (69.38) | 727 (30.62) |
| Secondary incomplete | 1800 (70.01) | 760 (29.99) | 3363 (76.88) | 1143 (23.12) |
| 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) | <0.001 | 3026 (69.84) | 1331 (30.16) | <0.001 |
| Middle | 1839 (66.06) | 886 (33.94) | 2574 (75.65) | 904 (24.35) |
| 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 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) | 0.010 | 1276 (77.02) | 428 (22.98) | 0.027 |
| 20-34 | 2991 (68.18) | 1444 (31.82) | 3035 (73.85) | 1148 (26.15) |
| 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 programs*** | | | | | | |
| 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) |
| ***Books*** | | | | | | |
| 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) |

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 association with the ECD status. Among all predictor variables 9 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 age of 4 years 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 developmentally on track than the age of 3. According to child sex, when all other variables adjusted, the developmentally on track status 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 for female child 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 survey, 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) of developmentally on track compared to primary incomplete or uneducated mothers’. In both survey, the child growing in rich families were found 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 developmentally on track than the poor family. Early childhood education programs plays a positive role to early childhood development. In both survey, the child who attended in early childhood education program were found 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 developmentally on track than the children who were not attend in early childhood education program. Early mother stimulation were found 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] of developmentally on track than the children without mother stimulation. Unfortunately, in multivariable model mother stimulation shows 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 other stimulation had a higher chance of developmentally on track.

Supervision also plays a key role in ECD, compared with inadequate supervision children raise with adequate supervision had a higher chance of developmentally on track was observed in both surveys, but 2012 MICS survey result was not significant. For example, children raise with adequate supervision had 29% higher chance of developmentally on track. There was a significant increase in ECD on track status among the children with family has books and toys. Similarly, children mother or caretaker mass media access also plays significant role for early childhood development.

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

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Characteristics** | **MICS- 2012** | | | | **MICS- 2019** | | | |
| **Univariate** | | **Multivariable** | | **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 | 2.71 (2.14-3.43) | <0.001 | 1.77 (1.28-2.44) | <0.001 | 2.26 (1.82-2.79) | <0.001 | 1.36 (1.05-1.78) | 0.021 |
| Secondary incomplete | 1.64 (1.43-1.87) | <0.001 | 1.24 (1.03-1.50) | 0.023 | 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 | 0.97 (0.78-1.21) | 0.809 | 1.04 (0.88-1.23) | 0.651 | 0.94 (0.78-1.14) | 0.540 |
| Primary incomplete | Reference | - | Reference | - | Reference | - | Reference | - |
| ***Wealth Index*** |  |  |  |  |  |  |  |  |
| Rich | 2.27 (1.85-2.79) | <0.001 | 1.33 (0.98-1.79) | 0.063 | 2.28 (1.93-2.69) | <0.001 | 1.75 (1.40-2.19) | <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 |
| Poor | 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 |
| 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 | - | - |
| Yea | 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 | 2.17 (1.79-2.64) | <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*** | | | | | | | | |
| Yes | 1.30 (1.10-1.53) | 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 | 1.12 (0.99-1.26) | 0.079 | 0.97 (0.83-1.12) | 0.644 | 1.18 (1.07-1.31) | <0.001 | 1.28 (1.13-1.44) | < 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 | - | - |
| ***Books*** | | | | | | | | |
| 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*** | | | | | | | | |
| Yes | 0.49 (0.36-0.67) | <0.001 | 0.70 (0.49-0.99) | 0.044 | 1.67 (1.36-2.05) | <0.001 | 1.53 (1.19-1.97) | < 0.001 |
| No | Reference | - | Reference | -- | Reference | - | Reference | -- |

**Discussion**

We investigated the ECD status among children of Bangladesh. We observed that a large portion of children (74.86%) had developmentally on track. This finding is in line with the previous MICS reports in 2012 and 2019 15,16. However, this percentage is lower in Pakistan (Balochistan) and higher in Vietnam 21. Moreover, this figure varying 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 Belize 21. We also found a substantial impact on 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 22. 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 23.

Child from the wealthiest family had a higher chance of overall development compared to their poorest counterparts. Because early childhood programs may exacerbate existing developmental inequalities if uptake of promoted activities is more significant in higher socio-economic groups with already comparatively better growth and development24. 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 25. 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 23. Poverty and adverse childhood experiences have long-term physiological and epigenetic effects on brain development and cognition 26.

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 27.

According to our study, early childhood diseases and lack of nutrition children had high risk of developmental delays. Children who are undernourished or frequently ill are at high risk for developmental problems, emphasising the urgency of developing coordinated early childhood development programmes in collaboration with the health and nutrition sectors28.

Early childhood programs are a critical outlet for fostering the mental and physical development of young children29. 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 development30,31.

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 28. Local versions of the educational television programme Sesame Street reach children in over 150 countries 32. In Bangladesh, almost 50% of 3–5 year-old children watched television daily, and among television watchers, 83% of urban and 58% of rural preschoolers watched Sesame Street 33. A metaanalysis 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 34.

It was found that, child punishment makes a children 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 age35.

**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 full 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.

**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 mother’s, 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 frequent of health complexity of children are one of the major risk factor for developmental delay, we should more careful about this problem. Lack of nutrition of a children interrupt 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 a good results in 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 most effectively ensure that children in Bangladesh reach full developmental potential. Additional research is needed to increase the evidence base for what can successfully impact the effects of childhood development and education on health outcomes and disparities. This additional evidence will facilitate public health efforts to address early childhood development and education as social determinants of health.

**Recommendations:**

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.

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**Ethical consent**

Our study was wholly based on an analysis of existing public domain health survey datasets obtained from the MICS 2012 and 2019 which is freely available online with all personal identifying information removed. The MICS procedures were reviewed and approved by the Bangladesh Bureau of Statistics (BBS) and UNICEF. Informed consent was obtained from participants while interviewing them. Because this study involved the analysis with secondary data thus, it did not require the ethical approval of the respective institution.

**Disclosure statement**

No potential conflict of interest was reported by the authors.

References:

1. McCoy, D. C. *et al.* Early Childhood Developmental Status in Low- and Middle-Income Countries: National, Regional, and Global Prevalence Estimates Using Predictive Modeling. *PLOS Med.* **13**, e1002034 (2016).

2. WHO. Early child development. https://www.who.int/maternal\_child\_adolescent/topics/child/development/en/ (2017).

3. Rao, N. *et al.* *Early childhood development and cognitive development in developing countries: A rigorous literature review. Department for International Development.* http://r4d.dfid.gov.uk/andtheEPPI-Centrewebsite:http://eppi.ioe.ac.uk/ (2014).

4. Wimpory, D. C., Hobson, R. P., Williams, J. M. G. & Nash, S. Are infants with autism socially engaged? A study of recent retrospective parental reports. *J. Autism Dev. Disord.* **30**, 525–536 (2000).

5. Cohen-Ophir, M., Castel-Deutsh, T. & Tirosh, E. Autism in Early Childhood: An Unusual Developmental Course—Three Case Reports. *Case Rep. Psychiatry* **2012**, 1–4 (2012).

6. Loynes, F. The Impact of Autism on Child Development. 1–7 (2001).

7. Junek, W. The Development of the Person: The Minnesota Study of Risk and Adaptation from Birth to Adulthood. *J. Can. Acad. Child Adolesc. Psychiatry* **16**, 180 (2007).

8. Currie, J. & Vogl, T. *Early-Life Health and Adult Circumstance in Developing Countries*. http://www.nber.org/papers/w18371.pdf (2012) doi:10.3386/w18371.

9. Heckman, J. J. The economics, technology, and neuroscience of human capability formation. *Proc. Natl. Acad. Sci. U. S. A.* **104**, 13250–13255 (2007).

10. UNICEF. Development of the Early Childhood Development Index in MICS surveys. 1–53 (2017).

11. Richter, L. M. *et al.* Advancing Early Childhood Development: from Science to Scale. An Executive Summary for the Lancet’s Series. *Lancet* 1–8 (2016).

12. Walker, S. P. *et al.* Inequality in early childhood: Risk and protective factors for early child development. *The Lancet* vol. 378 1325–1338 (2011).

13. Policy Brief: The situation of children in Bangladesh. *Unicef* (2020).

14. UNICEF Bangladesh. *Early care for growth and development*. https://www.unicef.org/bangladesh/en/early-care-growth-and-development.

15. Progotir Pathey. Bangladesh multiple indicator cluster survey 2012–2013 Key findings. (2014).

16. Progotir Pathey. Bangladesh multiple indicator cluster survey 2019 Key findings. (2019).

17. UNICEF MICS. Surveys - UNICEF MICS. *MICS Surveys* https://mics.unicef.org/surveys (2018).

18. WHO. The WHO Child Growth Standards. https://www.who.int/tools/child-growth-standards/standards (2021).

19. Martel, P. *Review of Options for Reporting Water, Sanitation and Hygiene Coverage By Wealth Quintile*. *MICS Methodological Papers* http://mics.unicef.org/files?job=W1siZiIsIjIwMTcvMDYvMTUvMTYvMzMvMzAvMzE2L01JQ1NfTWV0aG9kb2xvZ2ljYWxfUGFwZXJfNC5wZGYiXV0&sha=adfd855d58aa27ea (2016).

20. Survey Data Analysis in Stata. https://stats.idre.ucla.edu/stata/seminars/svy-stata-8/.

21. Miller, A. C., Murray, M. B., Thomson, D. R. & Arbour, M. C. How consistent are associations between stunting and child development? Evidence from a meta-analysis of associations between stunting and multidimensional child development in fifteen low- and middle-income countries. *Public Health Nutr.* **19**, 1339–1347 (2016).

22. Donald, K. A. *et al.* Risk and protective factors for child development: An observational South African birth cohort. *PLOS Med.* **16**, e1002920 (2019).

23. Centre for Disability Research and Policy, U. of S. *The Wellbeing of Children with Developmental Delay in Bangladesh, Bhutan, Laos, Nepal, Pakistan and Vietnam: An Analysis of Data from UNICEF ’s Multiple Indicator Cluster Surveys*. https://www.researchgate.net/publication/320403879\_The\_wellbeing\_of\_children\_with\_developmental\_delay\_in\_Bangladesh\_Bhutan\_Laos\_Nepal\_Pakistan\_and\_Vietnam\_An\_analysis\_of\_data\_from\_UNICEF’s\_multiple\_indicator\_cluster\_surveys (2016).

24. Bhopal, S. *et al.* Impact of adversity on early childhood growth & development in rural India: Findings from the early life stress sub-study of the SPRING cluster randomised controlled trial (SPRING-ELS). *PLoS One* **14**, e0209122 (2019).

25. Brennan, L. M. *et al.* Indirect effects of the Family Check-Up on school-age academic achievement through improvements in parenting in early childhood. *J. Educ. Psychol.* **105**, 762–773 (2013).

26. Luby, J. L. Povertys most insidious damage: The developing brain. *JAMA Pediatrics* vol. 169 810–811 (2015).

27. (US), N. R. C. & (US), I. of M. Influences on Children’s Health. (2004).

28. Black, M. M. *et al.* Early childhood development coming of age: science through the life course. *The Lancet* vol. 389 77–90 (2017).

29. Anderson, L. M. *et al.* The effectiveness of early childhood development programs: A systematic review. *American Journal of Preventive Medicine* vol. 24 32–46 (2003).

30. Noble, K. G. *et al.* Family income, parental education and brain structure in children and adolescents. *Nat. Neurosci.* **18**, 773–778 (2015).

31. Bradley, R. H. & Putnick, D. L. Housing quality and access to material and learning resources within the home environment in developing countries. *Child Dev.* **83**, 76–91 (2012).

32. Cole CF, Richman BA, Mcc. B. S. ‘G’ is for growing: thirty years of research on children and Sesame Street. *Choice Rev. Online* **39**, 39-0448-39–0448 (2001).

33. Lee, J. H. The educational and cultural impact of Sisimpur. *Televizion* **20**, 51–53 (2007).

34. Mares, M. L. & Pan, Z. Effects of Sesame Street: A meta-analysis of children’s learning in 15 countries. *J. Appl. Dev. Psychol.* **34**, 140–151 (2013).

35. Noble, K. G., McCandliss, B. D. & Farah, M. J. Socioeconomic gradients predict individual differences in neurocognitive abilities. *Developmental Science* vol. 10 464–480 (2007).