**Learning environment at home and Primary school dropout status in Bangladesh: An analysis using Multiple Indicator Cluster Survey (MICS) data**

**Abstract:**

**Background:** Primary school dropouts worldwide present a serious concern. In Bangladesh, elementary education is greatly shaped by the home learning environment. This study aimed to investigate the causal relationship among the dropout of primary school children with the learning environment at home as well as its associated factors.

**Methods:** We analyzed cross-sectional data from Multiple Indicator Cluster Surveys (MICS) 2019, with a total sample size of 14,278 children aged 6-12. The outcome variable “dropout” is calculated as children admitted to primary school the previous year but not enrolled in the current year. We used bivariate analysis, crude and adjusted log-binomial model to assess the relationship between dropout and its associated factors such as child characteristics and discipline, parents’ characteristics, household financial wellbeing and learning environment at home.

**Findings:** Overall, 1.65% of students dropped out, with higher rates among male students and those who were admitted to primary school at a later age. Child labor is a concerning cause of dropout, where the risk is 1.57 times more than those who are not engaged in economic activities. In terms of geographical areas, Mymensingh shows the most alarming dropout situation, with a rate 3.82 times higher, while Dhaka has the lowest rate at 1.31 times higher than Barishal. Students from financially stable families have a higher dropout rate compared to the middle class in contrast to students from poor families. Compromised toilet facilities contribute to an alarming situation of student dropout from primary schools, at 1.40 times more than those with improved facilities. Students who do not read and lack support at home are 93% more likely to drop out compared to those who read books or are read to at home.

**Keywords?**

**Introduction**

Education is a key for economic growth, employment, poverty reduction, economic independence, and self-awareness about happiness [1-3]. Primary education has a substantial positive impact on economic growth, allowing citizens to live a stable life and supporting sustainable living [4,5]. The learning environment is the basis of a student's learning process and their decisions regarding their future workplaces. It is considered as a crucial element in determining the effectiveness of an efficient curriculum and the academic achievements of the students [6]. Therefore, it is necessary to understand why people decide to stop going to school in developing countries, particularly in low- and middle-income countries [7,8]**.** The term 'Dropout' is characterized as leaving the current step of instruction without completing the ongoing instructive program by an understudy who right now proceeds his/her education [9]. It may also allude either to clearing out school before passing any recognized exams or to clearing out unqualified to pursue employment opportunities of personal fulfillment [10]. Dropping out of school is a serious issue that affects not just the person, but also the community, the educational system and society.

The primary school dropout rate for millions of children continues to be a major concern in low- and middle-income nations. Sub-Saharan Africa has the highest dropout rate, at 42%, whereas the dropout rate in South and West Asia remains high, at 33% [11]. The evidence that there are an estimated 20.6 million lower secondary out-of-school children and 11.3 million elementary school age out-of-school kids in South Asia is supported by data gathered by UNDP [12].

An investigation turned to households with better learning environments are associated with higher child outcomes. Children who have supportive parents perform better academically and behaviorally [13]. Economic status, inter-related social, school and cultural factors are found to be the root causes of dropout [14]. The income and educational levels of parents have a detrimental effect on dropout rates [15]. Factors such as gender, religion, ethnicity, housework, wage labor, disability, low self-esteem among students, poverty, and a profanity in of education among students are recognized as major causes of school dropout with additional correlates such as late entry, grade repetition, mediocre educational objectives and a 9 percentage point rise in the likelihood of dropout linked to the loss of the family head's job [16-19].There is a significant relation between corporal punishment and school dropout rates that shows dropping out of school not only contributes to a cycle of violent victimization but also to long-term unemployment, poverty, poor health outcomes, continued reliance on public assistance, political and social apathy, and (juvenile) crime. However, the economic impact is significant on a worldwide scale; according to estimates, every school dropout costs the US economy at least $250,000 in lifetime due to less tax payments, a greater dependency on Medicaid, a higher likelihood of criminal activity, poorer health, and decreased productivity [20-27].

In Bangladesh, the Primary Cycle Dropout Rate is 14.15 per cent during 2021 [28]. Also, evidence suggests that the proportion of rich children who complete school is 22 percentage points greater than that of poor children [29]. Households in the richer and richest wealth groups have lower school dropout rates, whereas children living in a bigger family or having siblings have higher school dropout rates [30]. The risk that a daughter will drop out of school rises as fathers participate more in home decision-making [31]. Age, gender, and financial constraints are three of Bangladesh's top five predictors of dropout. Dropout continues to be strongly correlated with parental disengagement from their children's academics and absences from school [32]. Being from low-income families, the students (41%) had to take care of their homes, which included helping parents with household tasks (cooking or agricultural work) or raising a sibling or younger child [33]. However, a further study explores the factors contributing to school dropout in Bangladesh include persistent poverty, parental unwillingness, financial difficulties, biased social practices, poor school infrastructure, lack of quality education, geographic isolation, unequal access to education, and security issues for girls [34]. There is no existing study that has used Multiple Indicator Cluster Surveys to examine the association between primary school dropout and home learning environment in Bangladesh. Thus, this paper uses MICS indicators to discover how the home learning environment influences primary school dropout status in Bangladesh.

**Methods:**

**Data source**

We used the dataset of Multiple Indicator Cluster Survey (MICS) conducted in 2019. UNICEF conducts MICS, a large-scale, multidimensional household survey that is nationally representative. To gather data and important indicators about children, this survey employs standardized questionnaires. The main topics they address are child labor, violent discipline, parental involvement, education, and child development. A similar set of socioeconomic data about people and households is also gathered by MICS [35]. The public domain datasets were accessible to all [36].

**Sampling design and sample size**

The MICS survey uses a two-stage cluster sampling technique to randomly pick students between the ages of 5 and 17. The 2019 MICS is based on a sample of 40,617 mothers/caretakers who were surveyed, with 97.0% of them responding. Based on the expected sizes of the enumeration regions from the most recent Population Census, primary sampling units (PSUs) for the census were developed and chosen from each sample domain using systematic probability proportional to size (PPS) sampling processes. In Bangladesh's seven administrative divisions (Dhaka, Chittagong, Sylhet, Rajshahi, Rangpur, Barishal, and Khulna), MICS offers a thorough picture of children's education. The main sample strata for sample selection were determined to be districts at two stages [35]. 31,196 children who were admitted in the last year were included and the rest of the students who were not admitted in the last year were excluded. 15,639 children who were in primary school last year were included, while those who were not in primary school last year were excluded. 14,305 children who were aged 6 to 12 years were included and the rest of the children who were not aged 6 to 12 years were excluded. The final sample of 14,278 children who started school at age 6 or higher were included, while those who started school at below 6 years were excluded as the official primary school entrance age in Bangladesh is 6 years [28]. Figure 1 illustrates the schematic diagram of the analytic study sample.

A flowchart of a number of children

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**Figure 1. Schematic Diagram of the Analytic Study Sample.**

**Outcome variables**

For creating our outcome variable (Dropout status), we assigned a value of 1 to each child based on not attending school or early childhood program during current school year but was admitted last year indicated a “yes” response, otherwise 0 indicating “no”. Based on the frequencies of this outcome variable in 2019 MICS, 15,643 students were observed, and 323 children dropped out which is 2.06 percent and 15,320 were still in the class which is 97.94 percent according to 2019 MICS (Figure1).

**Covariates**

For identifying the possible factors associated with dropout status, some reliable variables are selected as the respondent. A set of covariates such as child’s age (6 to 8 years and 9 to 12 years), sex, age at beginning of school year (6 to 8 years and 9 to 12 years) [36], child’s functional difficulties, involvement in economic activities, children need to be physically punished to be brought up properly, severe physical punishment, mother's education (Pre-primary or none, Primary, Secondary and Higher secondary or above), mother’s functional difficulties and whether she has another child under 5, father's education (Pre-primary or none, Primary, Secondary and Higher secondary or above), area (urban and rural), division, gender of household head, ethnicity of household head (Bengali and others), religion (Islam, Hinduism, Christianity, Buddhism), household size (lowest through 4 and 4 or above) [37], household wealth index [38], household has electricity, household has internet, types of toilet facility (improved and unimproved), salt iodization, sources of water (improved and unimproved), child has 3 or more books to read at home, child reads books or are read to at home, child speaks same language at home and school.

Child’s involvement in economic activities is categorized “yes” if he/she worked or helped on garden, helped in family business, produced or sold articles and engaged in other activity for income otherwise “no”. A child faced severe physical discipline if he/she was hit or slapped on the face, head or ears or beaten up as hard as possible otherwise “no”. The types of toilet facility were categorized 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 unimproved (flash to open drain, pit latrine without slab, hanging toilet, bush/field) [39]. Salt iodization was categorized 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 [40]. Sources of water were categorized into improved (piped water, tubewell, rainwater, water kiosk) and unimproved (unprotected well, spring, river/pond) [41].

**Statistical analysis**

**Bivariate analysis**

Bivariate analysis using two-way cross-tabulation with Pearson's chi-squared test was performed to evaluate the association between dropout with other variates. We used the Svyset (declare data as survey data) command in Stata (StataCorp LP, College Station, Texas) to account for the complex survey design [42].

**Logistic Regression Model**

When the independent variables are discrete or continuous and the dependent variable is a dichotomy, a method for making predictions known as logistic regression, also known as the logit model or logistic model, can be used [43]. Here odds are typically used to explain the impact of independent variables in logistic regression since it computes the chance of an event occurring over the probability of it not occurring. In addition to comparing the magnitude of different risk factors for a given outcome, the odds ratio (OR), can be used to ascertain if a certain exposure is a risk factor for that result [44].

**Log-Binomial Regression Model**

The log-binomial model is a generalized linear model in which the distribution of the error is binomial, and the link function is the logarithm of the proportion under study. Although logistic regression uses odds ratios for point estimates of prevalence, log-binomial model has been suggested as a means of modeling the prevalences because logistic model overestimates risk ratio (RR) when the risk ratio exceeds 1 and lacks natural methods for pooled or adjusted effect estimates of the prevalence ratio (PR) when the stratifying variable relates to the outcome [45-50]. Logistic regression is not as appropriate for the analysis of cross-sectional studies with binary outcomes since the prevalence ratio is simpler for non-specialists to comprehend and explain than the odds ratio. Instead, log-binomial regression yields accurate estimates [51].

**Negative Binomial Regression Model**

Both Negative binomial regression and Poisson regression can be used not only for counted rates but also for binary outcome variables. Poisson regression of binary response data varies from logistic regression because it uses a log rather than logit (log odds) transformed regressand variable. It tends to provide better statistics. The negative binomial regression model, which may account for event rate overdispersion, may be a better fit for binary outcomes than Poisson regression models [52].

**Variable Selection**

Bivariable analysis was performed individually for each of the 26 variables. 17 variables were selected for inclusion in the crude model, using a significance level of 20%. Similarly, 15 variables were selected at the 20 % significance level for the adjusted model. Additionally, with a cut-off value of 5.00, we used the variance inflation factor (VIF) value to analyse multicollinearity in the final model [53]. All variables, except for the child’s age and age at the beginning of the school year, had VIF values less than 5.00. Therefore, the child’s age was dropped from the adjusted model to mitigate multicollinearity issues. ‌

**Model Assessment**

We used three models to assess for evaluating the causal association among dropout status and learning environment at home and associated factors. To find the best model, we used log-likelihood, AIC and BIC values to compare all models; the lowest value of AIC and BIC indicate a better fit of the data after accounting for model complexity (i.e. the number of model parameters) [54]. Using the best model, we reviewed the variability of the results from the models. A ROC curve with an AUC (Area Under the Curve) of 0.7 to 0.8 indicates that a model has acceptable discriminatory power distinguishing between the positive and negative classes [55].‌

**Results:**

### **Study Sample Characteristics**

About 236 children dropped out of school and the rest of them (14,042) did not drop out. In case of dropout, 198 children lived in rural areas and 38 lived in urban areas. 168 children who dropped out was male and 68 was female (Figure 2).

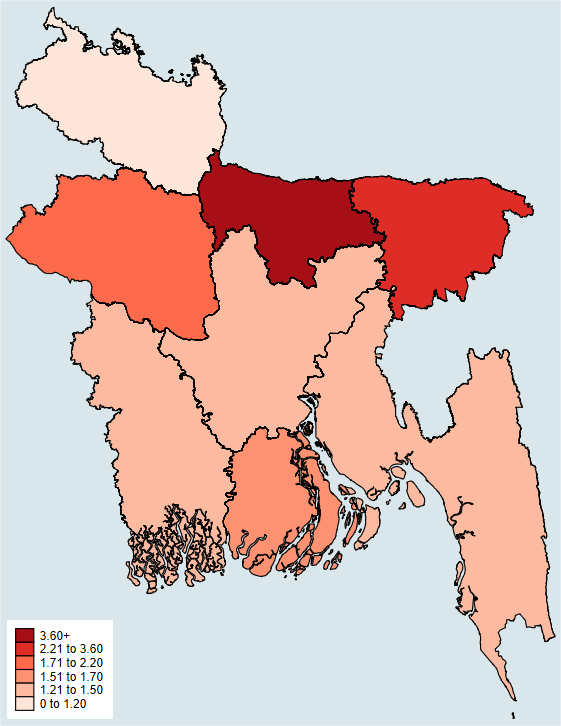
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**Figure 2. Distribution of Children and Primary School Dropouts by Gender.**

While analyzing the MICS (2019) data we have found that 2.01% of children who joined school at age 9 to 12 years dropped out whereas 1.01% of children who joined school at age 6 to 8 years dropped out. Children aged 6 to 8 years less dropped out (0.97%) than those aged 9 to 12 years (1.99%). Considering the sex of child, it is found that male students (2.38%) dropped out more compared to the female students (0.94%). Students who are involved in any sort of economic activities tend to have a dropout rate (3.03%) and the students who don’t have any involvement have 1.51% dropout. Also, it is seen that the dropout rate is highest in students with functional difficulties. Similarly, children who have been through severe physical discipline have a percentage of 1.63% of dropout and children who has not experienced severe physical discipline have 1.65% dropped out.

It is also seen that a parent’s education plays a significant role with respect to the student’s education. The dropout rate among children decreases as their mother’s level of education increases, with the lowest dropout rate observed among those with higher secondary education or above (0.67%), and the highest dropout rate observed among those with pre-primary education or none (2.45%). Similarly, children with fathers who have higher levels of education dropped out less (1.05%) compared to those with fathers educated only up to pre-primary level (2.21%). Dropout rate is found lower (0.95%) among the students where there is female household head compared to male household head (1.73%). Based on geographical area, the highest dropout (3.67%) rate is found among the students who belong to Mymensingh, and the lowest rate (1.19%) is seen on Rangpur division following the other divisions Sylhet (2.29%), Rajshahi (1.78%), Barishal (1.59%), Chattogram (1.47%), Dhaka (1.46%), Khulna (1.45%) (Figure 3).



**Figure 3. Geographic Variation in Primary School Dropout Rates (Percentage) in Bangladesh.**

While dealing with wealth index variable, an obvious insight has found that students who are financially privileged (Rich) are less dropped out (1.21%) compared to two other classes middle (1.64%) and poor (2.22%).It is also found that students with the home environment facilities like improved source of water, improved toilet facilities, internet connection and having iodized salt are less likely to drop out. Children with the habit of reading books or are read at home have lower dropout rate (1.02%) than who have not (13.88%). Children having 3 or more books at home are dropped out less (0.63%) compared to students who do not have books (1.72%) (Table 1).

From bivariate analysis using two-way cross-tabulation with Pearson's chi-squared test, seventeen variables showed a significant association with dependent variable (dropout) at 20% level of significance (child’s age, sex, age at the beginning of school year, child’s functional difficulties, child faces severe physical discipline, involvement in economic activities, mother's education, father’s education, division, sex of household head, household wealth index, household has internet, type of toilet facility, salt iodization, sources of water, child has 3 or more books at home, child reads books or are read to at home) in Table 1.

**Table 1.** Sample characteristics of children by dropout status, MICS 2019

|  |  |  |  |
| --- | --- | --- | --- |
| **Characteristics** | **Dropout** | | **P-Value** |
| **No** | **Yes** |
| **N (%)** | **N (%)** |
| **Total** | 14,042 (98.35) | 236 (1.65) |  |
| ***Child Characteristics*** | | | |
| **Child’s sex** | | | |
| Male | 6,904 (97.62) | 168 (2.38) | <0.001 |
| Female | 7,138 (99.06) | 68 (0.94) |
| **Child’s age** | | | |
| 6 to 8 years | 4,692 (99.03) | 46 (0.97) | 0.001 |
| 9 to 12 years | 9,350 (98.01) | 190 (1.99) |
| **Age at beginning of school year** | | |  |
| 6 to 8 years | 5,092 (98.99) | 52 (1.01) | 0.002 |
| 9 to 12 years | 8,950 (97.99) | 184 (2.01) |
| **Child has functional difficulties** | | | |
| Yes | 993 (97.35) | 27 (2.65) | 0.006 |
| No | 12,994 (98.43) | 207 (1.57) |
| **Child's involvement in economic activities** | | | |
| Yes | 1,345 (96.97) | 42 (3.03) | 0.001 |
| No | 12,672 (98.49) | 194 (1.51) |
|  | | | |
| ***Child Discipline*** | | | |
| **Child needs to be physically punished to be brought up properly** | | | |
| Yes | 3,473 (98.11) | 67 (1.89) | 0.588 |
| No | 6,521 (98.40) | 106 (1.60) |
| **Child experiences severe physical discipline** | | | |
| Yes | 4,235 (98.37) | 70 (1.63) | 0.181 |
| No | 9,805 (98.35) | 165 (1.65) |
|  | | | |
| ***Parent’s Characteristics*** | | | |
| **Mother's education** | | | |
| Pre-primary or none | 2,986 (97.55) | 75 (2.45) | 0.009 |
| Primary | 3,868 (97.82) | 86 (2.18) |
| Secondary | 5,993 (98.89) | 67 (1.11) |
| Higher secondary+ | 1,195 (99.33) | 8 (0.67) |
| **Mother has functional difficulties** | | | |
| Yes | 359 (97.82) | 8 (2.18) | 0.661 |
| No | 12,612 (98.45) | 199 (1.55) |
| **Mother has another child under 5** | | | |
| Yes | 5,269 (98.47) | 82 (1.53) | 0.974 |
| No | 8,773 (98.27) | 154 (1.73) |
| **Father's education** |  |  |  |
| Pre-primary or none | 3,457 (97.79) | 78 (2.21) | 0.071 |
| Primary | 3,503 (97.99) | 72 (2.01) |
| Secondary | 3,324 (98.84) | 39 (1.16) |
| Higher secondary+ | 1,513 (98.95) | 16 (1.05) |
|  | | | |
| ***Household Characteristics*** | | | |
| **Area** | | | |
| Urban | 2,620 (98.57) | 38 (1.43) | 0.546 |
| Rural | 11,422 (98.30) | 198 (1.70) |
| **Division** |  |  |  |
| Barishal | 1,365 (98.41) | 22 (1.59) | 0.006 |
| Chattogram | 2,542 (98.53) | 38 (1.47) |
| Dhaka | 2,764 (98.54) | 41 (1.46) |
| Khulna | 2,242 (98.55) | 33 (1.45) |
| Mymensingh | 734 (96.33) | 28 (3.67) |
| Rajshahi | 1,706 (98.22) | 31 (1.78) |
| Rangpur | 1,750 (98.81) | 21 (1.19) |
| Sylhet | 939 (97.71) | 22 (2.29) |
| **Household head’s sex** | | | |
| Male | 12,577(98.27) | 222(1.73) | 0.004 |
| Female | 1,465(99.05) | 14(0.95) |
| **Ethnicity of household head** | | | |
| Bengali | 13,704 (98.34) | 232 (1.66) | 0.247 |
| Other | 338 (98.83) | 4 (1.17) |
| **Religion** | | | |
| Islam | 12,458 (98.22) | 226 (1.78) | 0.252 |
| Hinduism | 1,240 (99.44) | 7 (0.56) |
| Christianity | 71 (100.00) | 0 (0.00) |
| Buddhism | 273 (98.91) | 3 (1.09) |
| **Household size** | | | |
| Lowest through 4 | 7,083 (98.48) | 109 (1.52) | 0.677 |
| 4+ | 6,959 (98.21) | 127 (1.79) |
| **Household wealth index** | | | |
| Poor | 3,428 (97.78) | 78 (2.22) | 0.013 |
| Middle | 5,994 (98.36) | 100 (1.64) |
| Rich | 4,565 (98.79) | 56 (1.21) |
| **Household has electricity** | | | |
| Yes | 12,635 (98.33) | 214 (1.67) | 0.649 |
| No | 1,407 (98.46) | 22 (1.54) |
| **Household has internet** | | | |
| Yes | 4,551 (98.83) | 54 (1.17) | 0.016 |
| No | 9,488 (98.12) | 182 (1.88) |
| **Type of toilet facility** | | | |
| Improved | 11,662 (98.55) | 172 (1.45) | 0.001 |
| Unimproved | 2,380 (97.38) | 64 (2.62) |
| **Salt iodization** | | | |
| Yes | 10,206 (98.45) | 161 (1.55) | 0.134 |
| No | 3,835 (98.08) | 75 (1.92) |
| **Sources of water** |  |  |  |
| Improved | 13,729 (98.36) | 229 (1.64) | 0.196 |
| Unimproved | 313 (97.81) | 7 (2.19) |
|  | | | |
| ***Learning Environment at home*** | | | |
| **Child has 3 or more books to read at home** | | | |
| Yes | 470 (99.37) | 3 (0.63) | 0.197 |
| No | 13,098 (98.28) | 229 (1.72) |
| **Child reads books or are read to at home** | | | |
| Yes | 12,350 (98.98) | 127 (1.02) | <0.001 |
| No | 360 (86.12) | 58 (13.88) |
| **Child speaks same language at home and school** | | | |
| Yes | 13,824 (98.35) | 232 (1.65) | 0.488 |
| No | 218 (98.20) | 4 (1.80) |

Table 2 shows the value of goodness of fit of logistic regression model, negative binomial regression model, log-binomial regression model. The lower AIC and BIC values indicate a better fitting the model. For log-binomial regression model, the AIC, BIC estimates (AIC = 1439.431, BIC = 1636.221) showed a lower value than the Logistic regression model (AIC = 1440.337, BIC = 1637.127) and negative binomial regression model (AIC = 1453.771, BIC = 1650.560). Moreover, a higher log-likelihood indicates a better fit. In this case, the log-binomial regression model has a higher log-likelihood of -692.716, which is better fitted than logistic regression (log-likelihood of -693.169) and negative binomial regression model (log-likelihood of -699.885).

**Table 2: Goodness of fit of models**

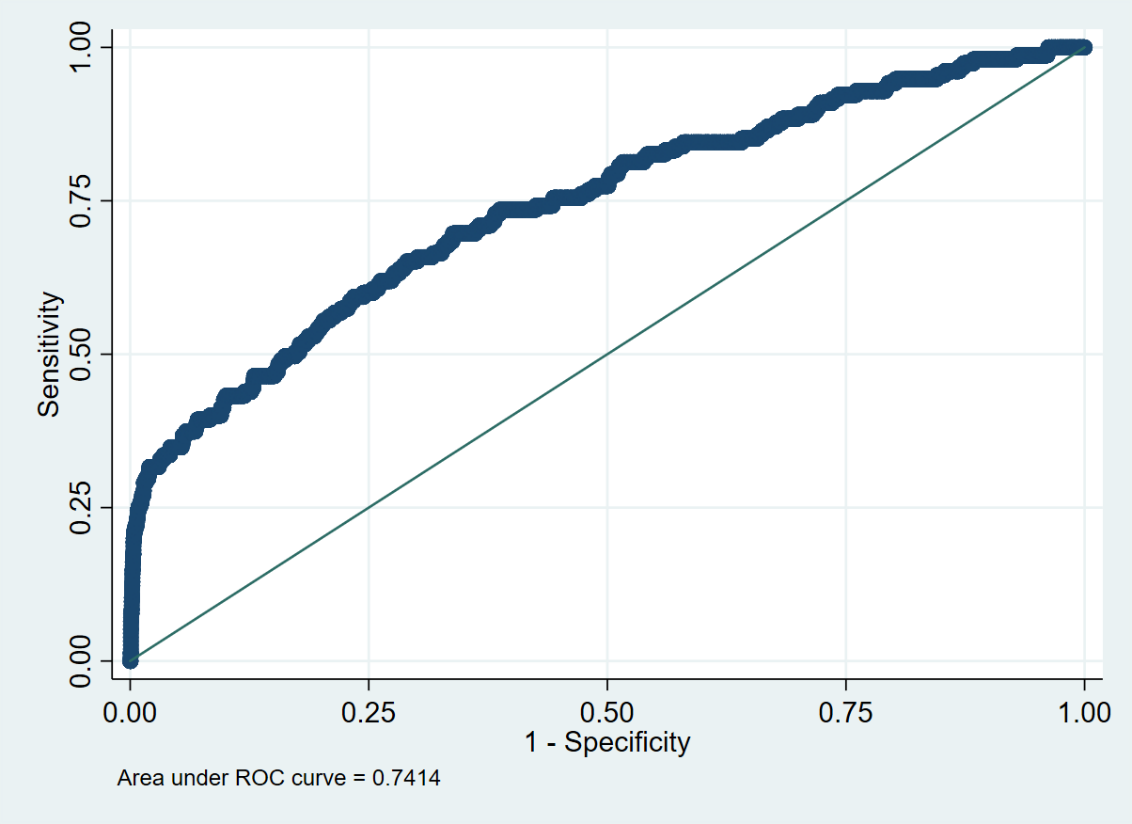
|  |  |  |  |
| --- | --- | --- | --- |
| **Model** | **Log-Likelihood** | **AIC** | **BIC** |
| Log-Binomial Regression | -692.716 | 1439.431 | 1636.221 |
| Logistic Regression | -693.169 | 1440.337 | 1637.127 |
| Negative Binomial Regression | -699.885 | 1453.771 | 1650.560 |

Table 3 presents the findings of the univariate analysis and the multivariate analysis exploring the relationship between outcome and each explanatory variables using the log-binomial regression crude model. From the univariate analysis, fifteen variables showed a significant association with dependent variable (dropout) at 20% level of significance and VIF< 5.00 (child’s age, sex, age at the beginning of school year, child’s functional difficulties, child faces severe physical discipline, involvement in economic activities, mother's education, father’s education, division, sex of household head, household wealth index, household has internet, type of toilet facility, salt iodization, sources of water, child reads books or are read to at home).

The results of the log-binomial regression adjusted model showed that the risk of dropping out for females is significantly reduced by 59% relative to the male group (RR = 0.41, CI = [0.27, 0.61], p-value <0.001). The age at the beginning of school between 9 to 12 years has 1.83 times higher risk of dropping out while considering age 6 to 8 as our reference group (RR = 1.83, CI = [1.15, 2.93], p-value = 0.012). The risk of dropping out of school is 1.57 times higher (RR = 1.57, CI = [0.97, 2.53], p-value = 0.066) among the students involved in various kinds of economic activities than those who are not. It is seen that students from Mymensingh, which has the highest dropout rate, are 3.82 times more likely to drop out (RR=3.82, CI= [1.59, 9.18], p-value=0.003) compared to students from Barishal division. Similarly, students from Chattogram are 2.26 times higher (RR=2.26, CI= [0.96, 5.36], p-value=0.063), and those from Rangpur are 1.86 times more likely (RR=1.86, CI= [0.76, 4.56], p-value=0.172) to drop out. Conversely, students from Dhaka, which has the lowest dropout rate, are 1.31 times more at risk of dropping out (RR=1.31, CI= [0.59, 2.91], p-value=0.514) compared to those from Barishal division. Students from rich family backgrounds, which have the highest dropout rate, have 1.78 times higher tendency (RR=1.78, CI= [0.97, 3.28], p-value=0.063) to drop out, while middle-class students are 1.21 times more likely (RR=1.21, CI= [0.75, 1.97], p-value=0.433) to drop out, compared to students from poor family backgrounds. Students from households with unimproved toilet facilities have a 1.40 times higher chance of dropout than those with the improved toilet facility (RR=1.40, CI= [0.92, 2.14], p-value=0.12). Children who read books at home have a 93% lower risk (RR = 0.07, CI = [0.04, 0.11], p-value < 0.001) of dropping out from school compared to students who do not read at home (Table 3). The area under ROC curve of the adjusted log-binomial regression model is 0.74, indicating that the model can differentiate between the two groups of dropouts with acceptable discriminatory power (Figure 4).

**Table 3:** Factors associated with the dropout status of children

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Characteristics** | **Log-Binomial Regression** | | | |
| **Crude**  **RR (95% C.I)** | **P-value** | **Adjusted**  **RR (95% C.I)** | **P-value** |
| **Child’s sex** | | | | |
| Male | Reference | - | Reference | - |
| Female | 0.33 (0.24, 0.47) | <0.001 | 0.41 (0.27, 0.61) | <0.001 |
| **Child’s age** | | | | |
| Age 6 to 8 | Reference | - |  |  |
| Age 9 to 12 | 1.92 (1.30, 2.82) | 0.001 |  |  |
| **Age at beginning of school year** | | | | |
| Age 6 to 8 | Reference | - | Reference | - |
| Age 9 to 12 | 1.78 (1.23, 2.58) | 0.002 | 1.83 (1.15, 2.93) | 0.012 |
| **Child has functional difficulties** | | | | |
| No | Reference | - | Reference | - |
| Yes | 1.92 (1.20, 3.05) | 0.006 | 1.41 (0.78, 2.53) | 0.254 |
| **Child's involvement in economic activities** | | | | |
| No | Reference | - | Reference | - |
| Yes | 1.94 (1.33, 2.84) | 0.001 | 1.57 (0.97, 2.53) | 0.066 |
| **Child experiences severe physical discipline** | | | | |
| No | Reference | - | Reference | - |
| Yes | 1.26 (0.90, 1.75) | 0.182 | 1.19 (0.81, 1.76) | 0.382 |
| **Mother's education** | | | | |
| Pre-primary or none | Reference | - | Reference | - |
| Primary | 0.96 (0.67, 1.38) | 0.843 | 0.97 (0.65, 1.44) | 0.874 |
| Secondary | 0.58 (0.39, 0.87) | 0.008 | 0.95 (0.55, 1.65) | 0.867 |
| Higher secondary+ | 0.42 (0.17, 1.01) | 0.053 | 1.05 (0.33, 3.33) | 0.933 |
| **Father's education** | | | | |
| Pre-primary or none | Reference | - | Reference | - |
| Primary | 0.91 (0.63, 1.31) | 0.603 | 1.06 (0.72, 1.56) | 0.759 |
| Secondary | 0.58 (0.37, 0.91) | 0.017 | 0.91 (0.51, 1.60) | 0.736 |
| Higher secondary+ | 0.62 (0.33, 1.17) | 0.137 | 0.79 (0.35, 1.80) | 0.572 |
| **Division** | | | | |
| Barishal | Reference | - | Reference | - |
| Chattogram | 1.12 (0.60, 2.08) | 0.721 | 2.26 (0.96, 5.36) | 0.063 |
| Dhaka | 0.90 (0.50, 1.64) | 0.733 | 1.31 (0.59, 2.91) | 0.514 |
| Khulna | 0.96 (0.50, 1.87) | 0.912 | 1.66 (0.67, 4.14) | 0.274 |
| Mymensingh | 2.39 (1.25, 4.58) | 0.009 | 3.82 (1.59, 9.18) | 0.003 |
| Rajshahi | 1.05 (0.56, 1.97) | 0.881 | 1.37 (0.57, 3.30) | 0.483 |
| Rangpur | 0.86 (0.42, 1.76) | 0.686 | 1.86 (0.76, 4.56) | 0.172 |
| Sylhet | 1.23 (0.63, 2.40) | 0.546 | 1.71 (0.69, 4.28) | 0.249 |
| **Household head’s sex** | | | | |
| Male | Reference | - | Reference | - |
| Female | 0.42 (0.23, 0.77) | 0.005 | 0.28 (0.04, 2.12) | 0.219 |
| **Household wealth index** | | | | |
| Poor | Reference |  | Reference | - |
| Middle | 0.71 (0.50, 1.02) | 0.065 | 1.21 (0.75, 1.97) | 0.433 |
| Rich | 0.56 (0.37, 0.83) | 0.004 | 1.78 (0.97, 3.28) | 0.063 |
| **Household has internet** | | | | |
| Yes | Reference | - | Reference | - |
| No | 1.55 (1.08, 2.21) | 0.017 | 1.37 (0.80, 2.33) | 0.250 |
| **Type of toilet facility** | | | | |
| Improved | Reference | - | Reference | - |
| Unimproved | 1.75 (1.26, 2.45) | 0.001 | 1.40 (0.92, 2.14) | 0.120 |
| **Salt iodization** | | | | |
| No | Reference | - | Reference | - |
| Yes | 0.79 (0.57, 1.08) | 0.135 | 0.93 (0.60, 1.43) | 0.731 |
| **Sources of water** | | | | |
| Improved | Reference | - | Reference | - |
| Unimproved | 1.80 (0.73, 4.41) | 0.199 | 1.53 (0.53, 4.39) | 0.431 |
| **Child has 3 or more books to read at home** | | | | |
| No | Reference | - |  |  |
| Yes | 0.43 (0.12, 1.61) | 0.212 |  |  |
| **Child reads books or are read to at home** | | | | |
| No | Reference | - | Reference | - |
| Yes | 0.07 (0.05, 0.10) | <0.001 | 0.07 (0.04, 0.11) | <0.001 |



**Figure 4. Area Under ROC Curve of Adjusted Log-Binomial Regression Model**

**Discussion:**

In this study, we used the MICS6 (2019) data to study the association between primary school dropout and the learning environment at home in Bangladesh. Out of all the children who start school, one in four drops out before finishing in several countries in Sub-Saharan Africa and South and West Asia [56]. In Cambodia, the dropout rates for grades 1–6 in primary education were 3.5%–6.8% [57]. Less than 10% of students drop out of school in the U.A.R., China, and Japan, while more than 70% do so in Kenya, Rhodesia, Zambia, Honduras, India, and Pakistan [58]. The incidence of students dropping out of school in Uganda is palpable in primary six and primary five which is 34.9 percent and 22.1 percent respectively [59].

In the child characteristic segment, we have found that child’s sex, child’s age at the beginning of school year, functional difficulties, involvement in economic activities have a significant impact on the outcome variable. According to our research, male children had a higher primary school dropout rate than female children. The results coincided with research conducted in Cambodia, China [60]. Hirakawa et al. also found that boys were more likely to drop out of primary school than girls [61]. We also observed that children who started primary school late were more likely to drop out, which is consistent with research from Cambodia [62] and Mozambique [63].

Compared to children who experienced functional difficulties, we found that children without such difficulties had a lower primary school dropout rate. Miller et al. discovered that students with certain disabilities dropped out at a higher rate than those without disabilities [64]. According to a study, children in Cambodia, Colombia, Gambia, Maldives, Uganda, and Yemen who had disabilities were, on average, more than twice as likely to drop out of school than children without disabilities [65].

Our findings showed that children who engaged in economic activities had a higher probability of dropping out of primary school compared to their non-participating peers. The outcomes were consistent with earlier research in India [66] and Lao PDR [67]. Further research by Nnaemeka et al. revealed that the leading cause of primary school students drop out is child labour [68].

In the segment of parent’s and household characteristics, we have also found that mother's education, sex of household head, household wealth index, type of toilet facility, child reads books or are read to at home have been linked to the outcome variable.

Our findings showed that mother’s education level and primary school dropout has found an inverse relationship as we can see that dropout rate is lower among the students whose mothers are highly educated. To support our statement, we have found from a China Family Panel Studies which states - mother's education increases adolescents’ school enrollment, math test scores, college aspiration, and internal locus of control related to education as well as in developed countries like USA it is found that parental education has reduced the incidence of grade repetition focusing on children age 7-15 which have similarities with our findings [69, 70].

Another finding shows the tendency of dropping out among primary school students is less when there is female household head compared to male household head. Some studies also show that children living in female-headed households are more likely to enroll and stay in school compared to those living in male-headed households [71, 72, 73].

Moreover, dropout rates are significantly impacted by the household wealth index, especially for the wealthier groups. The findings show that there is a significant difference between the wealthiest and other wealth categories, and that higher household wealth is linked to lower attrition rates. This emphasizes the role that socioeconomic status plays in determining educational results and emphasizes the necessity for focused interventions to bridge gaps in students' access to and success in school [74,30].

Sanitation plays a vital role in primary school dropouts as per the finding shows that good sanitation leads to less chances of dropping out rather than compromised toilet facilities.

Another key factor would be the lack of proper study at home which has similarities to our finding which shows children reading books at home have a lower possibility of dropping out than the children who do not [75].

**Strengths and limitations:**

We used a variety of statistical models, including logistic, negative binomial, and log-binomial models, to evaluate the relationship between primary school dropout and other factors. Indeed, this is one of our study's major strengths. The optimal model, Log-binomial regression, was then applied to the data for interpretation. However, there are certain limitations to our study. The MICS 2019 study only provided data for one year. Time series data can be used for more thorough investigations. We can gain a better understanding of quitting trends and reasons by merging secondary and upper secondary education levels data. As the data was secondary, therefore we had no control over its quality.

**Recommendations:**

Based on our findings, individuals, governments, and non-governmental organizations (NGOs) should prioritize initiatives that increase maternal education and support systems for children with mental health issues. Policies and programs that minimize child labour and enhance hygiene at home can also help to reduce primary school dropout rates. Additionally, establishing a reading culture at home should be prioritized to improve educational engagement and retention. By addressing the major characteristics highlighted in our research, stakeholders can collaborate to build environments favourable to academic success while reducing the likelihood of non-completion among primary school children.

**Conclusion:**

To investigate the overall dropout rates of children in primary school and the associated factors, we conducted a thorough study based on the MICS 2019 datasets from Bangladesh. Our study finds that children who read books at home are less likely to drop out of primary school. Additionally, primary school dropout rates are influenced by gender, late school entry, functional difficulties, child labour, maternal education level, household headship, household wealth, access to the internet, and sanitation facilities. These findings will aid in initiatives to reduce dropout rates among primary school students.

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**Supplementary Table 1:** Factors associated with the dropout status of children

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Characteristics** | **Logistic Regression** | | **Negative Binomial Regression** | |
| **Adjusted**  **OR (95% CI)** | **P value** | **Adjusted**  **RR (95% CI)** | **P value** |
| **Child's sex** |  |  |  |  |
| Male | Reference | - | Reference | - |
| Female | 0.37 (0.25, 0.56) | <0.001 | 0.39 (0.27, 0.58) | <0.001 |
| **Age at beginning of school year** | | | | |
| Age 6 to 8 | Reference | - | Reference | - |
| Age 9 to 12 | 1.87 (1.13, 3.09) | 0.015 | 1.77 (1.12, 2.82) | 0.015 |
| **Child has functional difficulties** | | | | |
| No | Reference | - | Reference | - |
| Yes | 1.43 (0.72, 2.87) | 0.310 | 1.40 (0.75, 2.62) | 0.291 |
| **Child's involvement in economic activities** | | | | |
| No | Reference | - | Reference | - |
| Yes | 1.37 (0.85, 2.19) | 0.192 | 1.36 (0.89, 2.07) | 0.154 |
| **Child experiences severe physical discipline** | | | | |
| No | Reference | - | Reference | - |
| Yes | 1.29 (0.85, 1.95) | 0.228 | 1.25 (0.86, 1.83) | 0.247 |
| **Mother's education** |  |  |  |  |
| Pre-primary or none | Reference | - | Reference | - |
| Primary | 1.01 (0.63, 1.62) | 0.964 | 1.00 (0.66, 1.53) | 0.993 |
| Secondary | 0.97 (0.56, 1.68) | 0.901 | 0.97 (0.59, 1.61) | 0.907 |
| Higher secondary+ | 1.01 (0.33, 3.09) | 0.986 | 1.00 (0.35, 2.87) | 0.996 |
| **Father's education** |  |  |  |  |
| Pre-primary or none | Reference | - | Reference | - |
| Primary | 1.14 (0.72, 1.80) | 0.574 | 1.13 (0.74, 1.71) | 0.571 |
| Secondary | 0.85 (0.48, 1.50) | 0.568 | 0.85 (0.50, 1.44) | 0.543 |
| Higher secondary+ | 0.77 (0.31, 1.92) | 0.579 | 0.79 (0.33, 1.86) | 0.584 |
| **Division** |  |  |  |  |
| Barishal | Reference | - | Reference | - |
| Chattogram | 2.33 (0.92, 5.87) | 0.073 | 2.16 (0.93, 5.00) | 0.073 |
| Dhaka | 1.36 (0.57, 3.27) | 0.490 | 1.34 (0.60, 3.00) | 0.481 |
| Khulna | 1.73 (0.65, 4.58) | 0.271 | 1.61 (0.65, 3.98) | 0.299 |
| Mymensingh | 5.10 (1.91, 13.57) | 0.001 | 4.29 (1.78, 10.34) | 0.001 |
| Rajshahi | 1.46 (0.56, 3.82) | 0.444 | 1.39 (0.57, 3.36) | 0.468 |
| Rangpur | 1.95 (0.75, 5.12) | 0.173 | 1.84 (0.76, 4.46) | 0.177 |
| Sylhet | 1.80 (0.66, 4.87) | 0.250 | 1.73 (0.69, 4.35) | 0.240 |
| **Household head’s sex** |  |  |  |  |
| Male | Reference | - | Reference | - |
| Female | 0.28 (0.03, 2.34) | 0.239 | 0.30 (0.04, 2.34) | 0.252 |
| **Household wealth index** | | | | |
| Poor | Reference | - | Reference | - |
| Middle | 1.05 (0.64, 1.74) | 0.834 | 1.07 (0.68, 1.69) | 0.760 |
| Rich | 1.67 (0.88, 3.19) | 0.117 | 1.63 (0.90, 2.96) | 0.107 |
| **Household has internet** |  |  |  |  |
| Yes | Reference | - | Reference | - |
| No | 1.35 (0.76, 2.39) | 0.299 | 1.34 (0.78, 2.28) | 0.288 |
| **Type of toilet facility** |  |  |  |  |
| Improved | Reference | - | Reference | - |
| Unimproved | 1.45 (0.93, 2.27) | 0.104 | 1.40 (0.93, 2.09) | 0.105 |
| **Salt iodization** |  |  |  |  |
| No | Reference | - | Reference | - |
| Yes | 0.86 (0.55, 1.33) | 0.485 | 0.87 (0.58, 1.30) | 0.505 |
| **Sources of water** |  |  |  |  |
| Improved | Reference | - | Reference | - |
| Unimproved | 1.67 (0.48, 5.85) | 0.421 | 1.63 (0.52, 5.17) | 0.404 |
| **Child reads books or are read to at home** | | | |  |
| No | Reference | - | Reference | - |
| Yes | 0.06 (0.03, 0.09) | <0.001 | 0.07 (0.05, 0.11) | <0.001 |