The Effects of Household Water, Sanitation, and Hygiene (WASH) on Early Childhood Education Enrollment in Bangladesh

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**Abstract:**

**Introduction:**

The cognitive, social, emotional, and motor development of children in early years of life is referred to as early childhood development. During this time, children grow and develop quickly, and a major factor in neurological or brain development is the learning that occurs throughout childhood [1]. Target 4.2.2 of SDGs aims to ensure, by 2030, children’s participation in an organized learning programme, including early childhood education, in the year prior to the official starting age of primary school [2]. Early childhood education (ECE) refers to group programs for young children that follow a defined curriculum, are provided by certified workers, and are intended to support children's development and learning [3]. ECE is a joyful educational program designed to help kids under the age of five become more acclimated to their future learning environment and less afraid of school [4]. It is seen as crucial for children since it is the first step toward both a healthy and happy life in the realm of knowledge [5]. Early childhood education has been found to positively influence a child’s early childhood development [6]. Despite its importance, only 4 in 10 children attend early childhood education programs worldwide [7]. Bangladesh performs below average among South Asian countries and lags significantly behind upper-middle-income and high-income countries in terms of ECE participation rate [8].

Improving health, human growth, and development depends on having access to water, sanitation, and hygiene (WASH) services, which is a fundamental human right. SDG Goal 6 aims to ensure the availability and sustainable management of drinking water, handwashing facilities, and sanitation for all by 2030 [9]. The health of people and communities is directly correlated with access to WASH services. Reducing the global illness burden could be possible if everyone had access to clean drinking water, proper sanitation, and hygienic behaviors [10]. It is well-established that enhancing water quality, sanitation, and hygiene benefits social, economic, and health aspects [11]. A vital element of a healthy lifestyle and a high standard of living is having access to better WASH facilities [12]. Globally, 82% of people have access to improved water sources, while 78% have access to improved sanitation [13]. Improved education, infrastructure, and community water and sanitation improvements are necessary for optimal WASH practices; these factors are all reflected in the socioeconomic standing of the households [14, 15]. Compared to the poor households, wealthier households had better access to clean drinking water and sanitation facilities [16].

Research shows that there is a significant relationship between early childhood education participation and child, maternal and household risk factors [17]. In Malayasia, risk factors such as age, ethnicity, household access of books, and maternal employment status influence ECE attendance [18]. Mother’s education and wealth status play an important role in attending early learning programs. Mothers with higher education levels and from wealthy backgrounds increase the probability of attending ECE [19]. Moreover, the risks of acute and chronic infections, inadequate nutrition, food insecurity, abuse and neglect, and stress are all increased in poverty [20]. In Kenya, the study shows that paternal involvement, education level, attitudes, and occupation have an impact on the participation of children in ECE [21]. Gender and urbanicity were also linked with higher attendance in ECE [22]. In Bangladesh, child’s health factors, parental awareness, mother’s education have a key role in increasing of ECE participation [23].

Studies reveal that childhood diseases significantly affect early childhood education (ECE) enrollment [24]. WASH helps to reduce major childhood killers such as diarrhea and severe respiratory infections. It also aids in disease control and minimizes the harmful impact of infections on growth, lowering mortality rates in malnourished children [25]. According to a study, the low epidemic areas respondents reported significantly more information about better sanitary and sewage systems, water treatment, cleaner water sources for drinking and residential use, and filters [26]. However, there has been limited study into how household WASH services affect ECE participation. The aim of this paper is to investigate how (water, sanitation, and hygiene) WASH services provided at home influence enrollment in early childhood education (ECE) programs.

**Methods:**

**Data source**

The study used nationally representative cross-sectional survey data from the 2022 Bangladesh Demographic and Health Survey (BDHS). The National Institute of Population Research and Training (NIPORT) administered the survey. This survey was carried out from June 2022 to December 2022. It provides key demographic and health indicators on a national scale, including fertility, family planning, maternal and child health, mortality, and nutrition [27].

**Sampling design and sample size**

The BDHS used a two-stage stratified sampling design. The sampling frame was based on the 2011 population census enumeration areas (EAs), provided by the Bangladesh Bureau of Statistics (BBS), covering both urban and rural regions across Bangladesh’s eight administrative divisions (Barishal, Chattogram, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur, and Sylhet). A total of 30,018 households were interviewed, with an overall response rate of 99.1% [27]. In total, 132,463 household members were identified. 5,866 members were eliminated to keep solely the de facto population, and further, 124,103 members were excluded because their age at the beginning of the school year was not 5 years. The final sample size consisted of 2,494 de facto children aged 5 at the beginning of the school year (Figure 1) [28].

Number of household members

in BDHS 2022

(n = 132,463)

De jure household members

were excluded

(n = 5,866)

Number of de facto household

members

(n = 126,597)

Age at beginning of school year

was not five years were excluded

(n = 124,103)

Children joined ECE program

(n = 1,244)

Children did not join ECE program

(n = 1,250)

Number of de facto members

aged 5 at the beginning of

the school year

(n = 2,494)

**Figure 1: Sampling Flow Chart and Sample Size**

**Outcome variable**

The study used a dichotomous outcome variable, which is whether a child had participated in any "Early Childhood Education (ECE) Programs." We assigned a value of '1' (yes) to children who joined an ECE program and a value of '0' (no) to those who did not participate.

**Explanatory variables**

A list of explanatory variables such as type of handwashing facility, type of handwashing place, type of toilet facility, whether household share toilet with others or not, sources of water, treatment of household drinking water, area of residence (rural or urban), division, mother’s education, religion, wealth index status, household size, household head’s sex, access to mass media, child’s sex, and birth order were used in this study.

The type of handwashing facility was classified as basic if both water and soup/detergent were available at the handwashing place, limited if neither was available [29]. The type of handwashing place was categorized as fixed (such as sink with tap and tube with outlets) or mobile (Tippy tap, raised bucket with tap or outlet, two suspended buckets, suspended bottle or bag with outlet/hole/pop-up stopper, and foot pump sink) [30]. The type of toilet facility was categorized as improved if toilet facilities include flush to piped sewer system, flush to septic tank, flush to pit latrine, ventilated improved pit latrine (vip), pit latrine with slab, and unimproved if toilet facilities include pit latrine without slab/open pit, bucket toilet, hanging toilet [31]. Sources of water were classified as improved, which included piped water source, public tap, tube well, protected well, spring, bottled water, rainwater, tank truck, and unimproved, which included unprotected well, unprotected spring, river, or canal [31]. The treatment method of household drinking water was classified as yes if treatment method (such as boiling, adding bleach or chlorine, straining through cloth, ceramic, sand or other filter, solar disinfection, letting it stand and settling) was applied to household drinking water, otherwise no [32]. Mother education was classified into four categories: no education, primary, secondary, and higher [33]. Religion was classified as Islam and others [34]. Wealth index status was classified as poor, middle, and rich [35]. Household size was categorized as ‘1- 4’ and ‘5 and above’ [36]. Access to mass media was categorized as yes if the household had access to radio and television, otherwise no. The child’s birth order was categorized as 1st birth, 2nd – 3rd, and 4th and above [35].

**Statistical analysis**

A bivariate analysis using the chi-square test was applied to assess the relationship between each explanatory variable and the outcome variable, which is whether a child joined an early childhood education program. Then, we performed both crude and adjusted logistic regression models. In the adjusted model, we included variables with a p-value <0.20 in the crude model. Both models reported odds ratios (OR) with 95% confidence intervals (CI) to determine the strength and precision of the associations.

The analysis was conducted using Stata 17, incorporating the survey design through the svyset command to account for the complex sampling design.

**Results**

This study included 2494 children aged 5 years, living in the usual residence. It showed a comprehensive picture of various demographic, socio-economic and cultural factors. Among the children, 49.77% were enrolled in early childhood education programs, also known as organized learning, while 50.23% were not. Most households (56.43%) have basic hand-washing facilities, with 91.77% having fixed hand-washing places. Access to improved toilet facilities is high at 79.08%, though 28.31% of households share toilet facilities. Nearly all households (99.28%) have access to improved water sources, but only 11.11% treat their drinking water.

**Table 1:** Descriptive Statistics of ECE and WASH variables

|  |  |
| --- | --- |
|  | **Percentage** |
| **Early Childhood Education** | |
| No | 50.23 |
| Yes | 49.77 |
| **Hand Washing Facility** | |
| Basic | 56.43 |
| Limited | 43.57 |
| **Hand Washing Place** | |
| Fixed | 91.77 |
| Mobile | 8.23 |
| **Toilet Facility** | |
| Improved | 79.08 |
| Unimproved | 20.92 |
| **Toilet Share** | |
| No | 71.69 |
| Yes | 28.31 |
| **Source of Water** |  |
| Improved | 99.28 |
| Unimproved | 0.72 |
| **Treatment of Household Drinking Water** |  |
| Yes | 11.11 |
| No | 88.89 |

Ten variables were found to have a significant relation with dependent variable early childhood education programs at the 20% significance level, based on the bivariate analysis using two-way cross tabulation with Pearson’s chi-square test. The result showed that 54.89% of children enrolled in early childhood education programs where the households had basic handwashing facilities, and 44.49 % of children enrolled whose family had limited facilities. Children in ECE programs predominantly belonged to households with fixed hand-washing places (50.59%), whereas those with mobile setups (41.9%) were less likely to be enrolled. There was a lower tendency in children to enroll in early childhood programs where household sanitation services were unimproved (43.09%), while those with improved sanitation services had a higher enrollment (51.58%). Sharing toilets was more frequent in households of non-enrolled children (53.18%), whereas households with exclusive toilet access had a higher percentage of ECE-enrolled children (51.06%). Children enrolled in ECE were more likely to come from households that treated their drinking water (58.8%) compared to non-enrolled ones (41.2%). The likelihood of children being enrolled in early childhood education programs differs notably depending on the division. Participation in early childhood education programs was highest in Rangpur, with 58.31% of children enrolled, followed by Khulna (56.59%) and Rajshahi (56.44%). In contrast, Chattogram and Sylhet had the lowest enrollment rates, with 43.66% and 41.86% of children enrolled, respectively. Children whose mothers had higher education levels were more likely to be enrolled in early childhood education programs (58.19%), compared to only 38.54% of children whose mothers had no education. Among the poor households, 45.32% of children were enrolled in early childhood education, while 55.37% were enrolled from rich households. Regarding access to mass media, 53.94% of children were enrolled in early childhood education when their families had access, whereas only 46.34% were enrolled if there was no access to mass media. The likelihood of enrollment in early childhood education programs was highest for first-born children (54.13%) and lowest for those with a birth order of 4 or more (44.23%) (table-2).

**Table 2:** Sample characteristics of WASH and household factors by ECE enrollment status

|  |  |  |  |
| --- | --- | --- | --- |
| **Characteristics** | **Early Childhood Education** | | |
| **No** | **Yes** | **P-value** |
| N (%) | N (%) |
| 1250 (50.23%) | 1244 (49.77%) |
| **Handwashing facility** | | | |
| Basic | 590 (45.11) | 718 (54.89) | <0.001 |
| Limited | 584 (55.51) | 468 (44.49) |
| **Handwashing place** | | | |
| Fixed | 1123 (49.41) | 1150 (50.59) | 0.035 |
| Mobile | 122 (58.10) | 88 (41.90) |
| **Toilet facility** | | | |
| Improved | 947 (48.39) | 1010 (51.61) | 0.006 |
| Unimproved/no facility | 303 (56.42) | 234 (43.58) |
| **Toilet share** | | | |
| No | 875 (48.94) | 913 (51.06) | 0.010 |
| Yes | 368 (53.18) | 324 (46.82) |
| **Source of water** | | | |
| Improved | 1240 (50.18) | 1231 (49.82) | 0.510 |
| Unimproved | 10 (43.48) | 13 (56.52) |
| **Treatment of household drinking water** | | | |
| Yes | 110 (41.20) | 157 (58.80) | 0.024 |
| No | 1140 (51.19) | 1087 (48.81) |
| **Area of residence** | | | |
| Urban | 419 (48.55) | 444 (51.45) | 0.449 |
| Rural | 831 (50.95) | 800 (49.05) |
| **Division** | | | |
| Barisal | 149 (53.79) | 128 (46.21) | 0.001 |
| Chattogram | 231 (56.34) | 179 (43.66) |
| Dhaka | 173 (50.29) | 171 (49.71) |
| Khulna | 112 (43.41) | 146 (56.59) |
| Mymensingh | 147 (48.68) | 155 (51.32) |
| Rajshahi | 115 (43.56) | 149 (56.44) |
| Rangpur | 123 (41.69) | 172 (58.31) |
| Sylhet | 200 (58.14) | 144 (41.86) |
| **Mother's education** | | | |
| No education | 126 (61.46) | 79 (38.54) | <0.001 |
| Primary | 350 (53.60) | 303 (46.40) |
| Secondary | 520 (46.89) | 589 (53.11) |
| Higher | 148 (41.81) | 206 (58.19) |
| **Religion** | | | |
| Islam | 1021 (49.20) | 1054 (50.80) | 0.926 |
| Others | 123 (50.20) | 122 (49.80) |
| **Wealth Index** | | | |
| Poor | 572 (54.68) | 474 (45.32) | <0.001 |
| Middle | 229 (51.81) | 213 (48.19) |
| Rich | 449 (44.63) | 557 (55.37) |
| **Household members** | | | |
| Less than equal 4 | 488 (49.80) | 492 (50.20) | 0.428 |
| Greater 4 | 762 (50.33) | 752 (49.67) |
| **Household head’s sex** | | | |
| Male | 1086 (50.51) | 1064 (49.49) | 0.386 |
| Female | 164 (47.67) | 180 (52.33) |
| **Access to mass media** | | | |
| No | 659 (53.66) | 569 (46.34) | <0.001 |
| Yes | 538 (46.06) | 630 (53.94) |
| **Child's sex** | | | |
| Male | 585 (48.99) | 609 (51.01) | 0.612 |
| Female | 559 (49.60) | 568 (50.40) |
| **Birth order** | | | |
| 1 | 417 (45.87) | 492 (54.13) | 0.062 |
| 2-3 | 582 (50.52) | 570 (49.48) |
| 4+ | 145 (55.77) | 115 (44.23) |

In the crude logistic regression model, children from households with a fixed handwashing facility had 41% higher odds of being enrolled in early childhood education programs compared to those from households with a mobile handwashing facility (OR = 1.41, 95% CI: 1.02–1.94). Children from households with improved toilet facilities had 36% more likelihood of being enrolled in early childhood education programs compared to those from households with unimproved or no toilet facilities (OR = 1.36, 95% CI: 1.09–1.69, p = 0.006). Also, this study showed that children from households that did not share toilet facilities had 30% higher odds of being enrolled in early childhood education programs compared to those from households that shared toilet facilities (OR = 1.30, 95% CI: 1.06–1.59, p=0.010).

In the adjusted logistic regression model, several independent variables showed a significant relation with early childhood education programs enrollment. Children from households with basic hand washing facilities were 34% more likely to be enrolled compared to those with limited hand washing facilities (RR = 1.34, 95% CI: 1.07-1.67, p-value =0.012). The odds ratio (OR) for households that treat their drinking water is 1.33, meaning children in these households are 33% more likely to participate in an ECE program compared to those in households that do not treat their drinking water. In terms of divisional discrepancies, children from the Rangpur division were 102% more likely to be enrolled compared to those from Barishal (RR = 2.02, 95% CI: 1.35-3.03, p-value =0.001). Also, children from Mymensingh and Rajshahi had the same 41% higher odds of enrollment with (RR = 1.41, 95% CI: 0.98-2.03, p-value =0.063) and (RR = 1.41, 95% CI: 0.94-2.11, p-value =0.096) respectively, Khulna had 42% higher odds of enrollment (RR=1.42, 95% CI=0.98-2.07, p-value=0.067) compared to Barishal. Mother's education also played a vital role, with children whose mothers had higher education being 1.77 times more likely to be enrolled (OR= 1.77, 95% CI= 1.13-2.8, p-value= 0.014) and whose mother had primary education had 56% more likely to be enrolled (OR= 1.56, 95% CI= 1.09-2.24, p-value= 0.016) in ECE program compared to those whose mothers had no education (Table 3).

**Table 3:** Factors associated with ECE enrollment status

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Characteristics** | **Logistic Regression** | | | |
| **Crude OR (95% C.I)** | **P-value** | **Adjusted OR (95% C.I)** | **P-value** |
| **Hand washing facility** | | | | |
| Limited | Ref. |  |  |  |
| Basic | 1.64 (1.36, 1.97) | <0.001 | 1.34 (1.07, 1.67) | 0.012 |
| **Hand washing place** | | | | |
| Mobile | Ref. |  |  |  |
| Fixed | 1.41 (1.02, 1.94) | 0.035 | 1.10 (0.78, 1.56) | 0.592 |
| **Toilet facility** | | | | |
| Unimproved/no facility | Ref. |  |  |  |
| Improved | 1.36 (1.09, 1.69) | 0.006 | 1.15 (0.89, 1.48) | 0.295 |
| **Toilet share** | | | | |
| Yes | Ref. |  |  |  |
| No | 1.30 (1.06, 1.59) | 0.010 | 1.15 (0.92, 1.44) | 0.226 |
| **Source of water** | | |  |  |
| Improved | Ref. |  |  |  |
| Unimproved | 1.38 (0.53, 3.63) | 0.512 |  |  |
| **Treatment of household drinking water** | | | | |
| No | Ref. |  |  |  |
| Yes | 1.48 (1.05, 2.09) | 0.024 | 1.33 (0.91, 1.95) | 0.143 |
| **Area of residence** | | | | |
| Rural | Ref. |  |  |  |
| Urban | 1.08 (0.88, 1.33) | 0.449 |  |  |
| **Division** | | | | |
| Barishal | Ref. |  |  |  |
| Chattogram | 0.98 (0.71, 1.33) | 0.877 | 0.99 (0.70, 1.41) | 0.971 |
| Dhaka | 1.24 (0.90, 1.71) | 0.189 | 1.07 (0.74, 1.56) | 0.713 |
| Khulna | 1.63 (1.17, 2.29) | 0.004 | 1.42 (0.98, 2.07) | 0.067 |
| Mymensingh | 1.27 (0.92, 1.77) | 0.150 | 1.41 (0.98, 2.03) | 0.063 |
| Rajshahi | 1.51 (1.06, 2.16) | 0.023 | 1.41 (0.94, 2.11) | 0.096 |
| Rangpur | 1.73 (1.21, 2.47) | 0.002 | 2.02 (1.35, 3.03) | 0.001 |
| Sylhet | 0.93 (0.67, 1.28) | 0.653 | 0.97 (0.66, 1.41) | 0.860 |
| **Mother's education** | | | | |
| No education | Ref. |  |  |  |
| Primary | 1.52 (1.05, 2.19) | 0.025 | 1.42 (0.98, 2.06) | 0.066 |
| Secondary | 1.94 (1.39, 2.71) | <0.001 | 1.56 (1.09, 2.24) | 0.016 |
| Higher | 2.59 (1.72, 3.89) | <0.001 | 1.77 (1.13, 2.8) | 0.014 |
| **Religion** | | | | |
| Others | Ref. |  |  |  |
| Islam | 1.01 (0.75, 1.36) | 0.925 |  |  |
| **Wealth** | | | | |
| Poor | Ref. |  |  |  |
| Middle | 1.10 (0.86, 1.40) | 0.456 | 0.85 (0.64, 1.13) | 0.253 |
| Rich | 1.54 (1.25, 1.90) | <0.000 | 1.05 (0.79, 1.41) | 0.734 |
| **Household members** | | | | |
| Less than equal 4 | Ref. |  |  |  |
| Greater 4 | 1.08 (0.90, 1.29) | 0.428 |  |  |
| **Household head’s sex** | | | | |
| Male | Ref. |  |  |  |
| Female | 1.12 (0.86, 1.46) | 0.386 |  |  |
| **Access to mass media** | | | | |
| No | Ref. |  |  |  |
| Yes | 1.47 (1.22, 1.76) | <0.001 | 1.13 (0.91, 1.4) | 0.281 |
| **Child's sex** | | | | |
| Female | Ref. |  |  |  |
| Male | 1.05 (0.87, 1.26) | 0.612 |  |  |
| **Birth order** | | | |  |
| 4+ | Ref. |  |  |  |
| 1 | 1.40 (1.03, 1.90) | 0.031 | 1.12 (0.79, 1.58) | 0.518 |
| 2-3 | 1.19 (0.88, 1.61) | 0.259 | 1.02 (0.74, 1.41) | 0.906 |

Model evaluation

**Discussion:**

Our findings show that the presence of handwashing facilities is inextricably linked to early childhood education, with a critical function in promoting a positive learning environment. Bowen et al. showed that encouraging handwashing during early childhood dramatically enhanced child development outcomes. Children who received home-based handwashing interventions had global developmental quotients more than 6 points higher than those in the control group, with consistent gains across the adaptive, personal-social, communicative, cognitive, and motor domains [37].

Mwapasa et al. suggest that caregivers' lack of understanding, combined with insufficient facilities and poor hygiene procedures, exposes children to significant health risks [38]. Early et al. find that education, along with accessible and practical hand hygiene items (such as hand wipes), can result in a long-term increase in handwashing frequency among elementary school children [39].

According to Wagner and Samuelsson, there is compelling evidence that early childhood education and WASH for school-aged children benefit individual children, families, and societies [40]. Nesti and Goldbaum found that children at daycare or preschool are 2-3 times more likely to become infected, contributing to health problems and the spread of diseases across the community. This risk is associated with the daycare setting, but it can be reduced through preventive measures such as proper handwashing, standard precautions, hygienic diaper-changing routines, cleaning and disinfecting contaminated areas, using disposable tissues for nasal hygiene, separating food handling areas, reporting infectious diseases, and training workers and parents [41].

Our analysis reveals that geographic divisions exhibit a significant relationship with early childhood education, indicating substantial regional disparities in developmental outcomes for children. Hasan et al. found that the association between geographic divisions and early childhood education indicates significant variations in early childhood development outcomes across regions [42].

We discovered that a mother's degree of education had a profound and statistically significant impact on early childhood schooling results. Mothers with higher levels of education are more likely to prioritize and invest in their children's early education, creating an atmosphere that promotes learning and growth. Educated mothers are more aware of the long-term benefits of early education and are better prepared to participate in educational activities, provide learning materials, and foster a supportive home environment. Greenburg clarifies maternal education has a substantial impact on children's participation in early childhood education and care programs. It emphasizes that children of better-educated moms are more likely to attend formal, high-quality care settings, such as center-based care [43]. Cuartas suggested that maternal education has a positive causal effect on children's development, with more years of schooling resulting in increased maternal engagement in stimulating activities, higher attendance at early childhood education programs, and less use of harsh physical punishment [44]. Crosnoe et al. shown that a mother's educational level has a substantial impact on the educational opportunities of her children [45]. Harding et al. emphasize the positive association between mother education and children's academic performance, recognizing that greater maternal education levels are linked to enhanced language production, cognitive achievement, and academic success throughout childhood and adolescence [46]. Findings show that improvements in mother education were favorably associated with children's cognitive skills, as measured by standardized cognitive scores [47]. Lakshman et al. demonstrates that maternal education plays an important role in child development, although the nature of this relationship differs by nation and socioeconomic circumstance [48].

**Conclusion:**

This research highlights a clear association between household Water, Sanitation, and Hygiene (WASH) factors and enrollment in Early Childhood Education (ECE) programs in Bangladesh. Key findings indicate that improved WASH facilities like basic handwashing facilities, fixed handwashing places, and treated drinking water positively influence children's participation in ECE. Additionally, regional disparities play an important role, with divisions like Rangpur and Khulna showing higher enrollment rates. Maternal education comes out as a crucial factor, with higher educated mothers strongly linked to increased ECE participation.

This study indicates the significance of acknowledging WASH-related challenges and improving maternal educational qualification to enhance ECE enrollment. These findings align with the Sustainable Development Goals, particularly Goal 4 (Quality Education) and Goal 6 (Clean Water and Sanitation), emphasizing the need for integrated policies that combine health, education, and infrastructural development. By focusing these areas, policymakers can promote equitable access to quality early education, laying a foundation for lifelong learning and development for children across Bangladesh.

**Reference**

1. Rashid, R., & Akkari, A. (2020). A review of Early Childhood Education (ECE) in Bangladesh: status and impact. International Journal of Education, 12(1), 59-74.
2. SDG Goal 4: Quality Education - UNICEF DATA. (2023, September 20). UNICEF DATA. https://data.unicef.org/sdgs/goal-4-quality-education/
3. Akbari, E., McCuaig, K., & Mehta, S. (2024). *Early Childhood Education Report 2023*. Ontario Institute for Studies in Education/University of Toronto.
4. Haque, M. N., Nasrin, S., Yesmin, M. N., & Biswas, M. H. A. (2013). Universal pre-primary education: a comparative study. American Journal of Educational Research, 1(1), 31-36.
5. Yasmin, S., Rumi, M. A., & Robert, S. (2020). Impact of pre-primary education on children in Bangladesh: A study on government primary schools in Sylhet city. American Journal of Educational Research, 8(5), 251-258.
6. Hasan, M. N., Babu, M. R., Chowdhury, M. a. B., Rahman, M. M., Hasan, N., Kabir, R., & Uddin, M. J. (2023). Early childhood developmental status and its associated factors in Bangladesh: a comparison of two consecutive nationally representative surveys. *BMC Public Health, 23(1)*. https://doi.org/10.1186/s12889-023-15617-8
7. UNICEF. (2024, November 4). *Early childhood education.* UNICEF DATA. https://data.unicef.org/topic/early-childhood-development/early-childhood-education/
8. World Bank. (2020). *The landscape of early childhood education in Bangladesh*.
9. *SDG Goal 6: Clean water and sanitation - UNICEF DATA*. (2023, September 19). UNICEF DATA. https://data.unicef.org/sdgs/goal-6-clean-water-sanitation/
10. Desye, B., Keleb, A., Berhanu, L., Ebrahim, A. M., Natnael, T., Wagaye, B., ... & Adane, M. (2023). Access to basic water, sanitation, and hygiene (WASH) facilities and associated factors in Ethiopia: evidence from demographics and health surveys. Journal of Water, Sanitation and Hygiene for Development, 13(1), 39-49.
11. Aboah, M., & Miyittah, M. K. (2022). Estimating global water, sanitation, and hygiene levels and related risks on human health, using global indicators data from 1990 to 2020. Journal of Water and Health, 20(7), 1091-1101.
12. He, Z., Bishwajit, G., Zou, D., Yaya, S., Cheng, Z., & Zhou, Y. (2018). Burden of common childhood diseases in relation to improved water, sanitation, and hygiene (WASH) among Nigerian children. International journal of environmental research and public health, 15(6), 1241.
13. Dhital, S. R., Chojenta, C., Evans, T. J., Acharya, T. D., & Loxton, D. (2022). Prevalence and correlates of Water, Sanitation, and Hygiene (WASH) and spatial distribution of unimproved WASH in Nepal. International journal of environmental research and public health, 19(6), 3507.
14. Ngure, F. M., Reid, B. M., Humphrey, J. H., Mbuya, M. N., Pelto, G., & Stoltzfus, R. J. (2014). Water, sanitation, and hygiene (WASH), environmental enteropathy, nutrition, and early child development: making the links. Annals of the new York Academy of Sciences, 1308(1), 118-128.
15. Raihan, M. J., Farzana, F. D., Sultana, S., Haque, M. A., Rahman, A. S., Waid, J. L., ... & Ahmed, T. (2017). Examining the relationship between socio-economic status, WASH practices and wasting. PloS one, 12(3), e0172134.
16. Adams, E. A., Boateng, G. O., & Amoyaw, J. A. (2016). Socioeconomic and demographic predictors of potable water and sanitation access in Ghana. Social Indicators Research, 126, 673-687.
17. Candia, D. A. Factors Associated with Attendance of Early Childhood Education Programmes by Children Less Than 5 Years in Uganda. *Sri Lankan Journal of Applied Statistics*, *20*, 1.
18. Sooryanarayana, R., Ganapathy, S. S., Manaf, R. A., Mohammad, N. M., Wong, N. I., Ahmad, N. A., ... & Aris, T. (2021). Factors Associated with Attendance to Early Childhood Education Programs in Malaysia: Results from The National Health and Morbidity Survey (Maternal and Child Health) 2016. *Malaysian Journal of Public Health Medicine*, *21*(1), 356-366.
19. Nonoyama‐Tarumi, Y., Loaiza, E., & Engle, P. (2009). Inequalities in attendance in organized early learning programmes in developing societies: findings from household surveys. *Compare: A Journal of Comparative and International Education*, *39*(3), 385–409. https://doi.org/10.1080/03057920701712833
20. Tofail, F., Fernald, L. C., Das, K. K., Rahman, M., Ahmed, T., Jannat, K. K., ... & Luby, S. P. (2018). Effect of water quality, sanitation, hand washing, and nutritional interventions on child development in rural Bangladesh (WASH Benefits Bangladesh): a cluster-randomised controlled trial. The Lancet Child & Adolescent Health, 2(4), 255-268.
21. Kamau, G. M. (2015). *Impact of Parental socio-economic status on participation of children in ECE centres in Ruiru District, Kiambu county, Kenya* (Doctoral dissertation, University of Nairobi).
22. Yang, H., Rao, N., & Pearson, E. (2023). Inequality in access to early childhood care and education programs among 3- to 4-year-olds: Trends and variations across low- and middle-income countries. *Early Childhood Research Quarterly*, *66*, 234–244. https://doi.org/10.1016/j.ecresq.2023.10.013
23. Alam, A. T. M., Hasan, M. N., Emon, M. N. I., Akash, R. I., Chowdhury, M. A. B., & Uddin, M. Effect of Children's Socio-Economic and Health Status in Early Childhood Education Programs in Bangladesh: A Cross-Sectional Study of Mics-2019.
24. Murugi, O. J., Wafula, R., & Walumoli, L. A. (2018). Factors Influencing participation of children in early childhood development and education programme In Bungoma south sub-county, Bungoma county–Kenya.
25. Russell, F., & Azzopardi, P. (2019). WASH: a basic human right and essential intervention for child health and development. *The Lancet Global Health*, *7*(4), e417.
26. Al-Sakkaf, K., Bahattab, A., & Basaleem, H. (2020). Cholera knowledge, socioeconomic and WaSH characteristics in Aden-Yemen, 2017: a community-based comparative survey. Journal of preventive medicine and hygiene, 61(3), E392.
27. National Institute of Population Research and Training (NIPORT) & ICF. (2024). *Bangladesh Demographic and Health Survey 2022*: Final Report. NIPORT and ICF.
28. Croft, T., Allen, C., & Zachary, B. (2023). *Guide to DHS statistics*. ICF.
29. World Health Organization (WHO) & United Nations Children’s Fund (UNICEF). (2017). *Progress on Drinking Water, Sanitation and Hygiene (A. Grojec, Ed.)*. https://iris.who.int/bitstream/handle/10665/258617/9789241512893-eng.pdf?sequence=1
30. Endalew, M., Belay, D. G., Tsega, N. T., Aragaw, F. M., Gashaw, M., & Asratie, M. H. (2022). Limited handwashing facility and associated factors in sub-Saharan Africa: pooled prevalence and multilevel analysis of 29 sub-Saharan Africa countries from demographic health survey data. *BMC Public Health, 22(1).* https://doi.org/10.1186/s12889-022-14390-4
31. Omidakhsh, N., & Von Ehrenstein, O. S. (2021). Improved Water, Sanitation and Utilization of Maternal and Child Health Services in South Asia—An Analysis of Demographic Health Surveys. *International Journal of Environmental Research and Public Health, 18(14)*, 7667. https://doi.org/10.3390/ijerph18147667
32. Geremew, A., Mengistie, B., Mellor, J., Lantagne, D. S., Alemayehu, E., & Sahilu, G. (2018). Appropriate household water treatment methods in Ethiopia: household use and associated factors based on 2005, 2011, and 2016 EDHS data. *Environmental Health and Preventive Medicine, 23(1)*. https://doi.org/10.1186/s12199-018-0737-9
33. Akinyemi, J. O., Solanke, B. L., & Odimegwu, C. O. (2018). Maternal Employment and Child Survival During the Era of Sustainable Development Goals: Insights from Proportional Hazards Modelling of Nigeria Birth History Data. *Annals of Global Health, 84(1)*, 15. https://doi.org/10.29024/aogh.11
34. Yaya, S., & Bishwajit, G. (2019). Burden of Acute Respiratory Infections Among Under-Five Children in Relation to Household Wealth and Socioeconomic Status in Bangladesh. *Tropical Medicine and Infectious Disease, 4(1),* 36. https://doi.org/10.3390/tropicalmed4010036
35. Islam, M. M., Noor, F. M., Uddin, M., & Hasan, M. (2022). Risk Factors for Under-Five Child Mortality: Evidence from Bangladesh Multiple Indicator Cluster Survey (MICS) 2019. *European Journal of Medical and Health Sciences*, 79–90. https://doi.org/10.34104/ejmhs.022.079090
36. Ahmed, M. S., Islam, M. I., Das, M. C., Khan, A., & Yunus, F. M. (2021). Mapping and situation analysis of basic WASH facilities at households in Bangladesh: Evidence from a nationally representative survey. *PLoS ONE, 16(11)*, e0259635. https://doi.org/10.1371/journal.pone.0259635
37. Bowen, A., Agboatwalla, M., Luby, S., Tobery, T., Ayers, T., & Hoekstra, R. M. (2012). Association between intensive handwashing promotion and child development in Karachi, Pakistan: a cluster randomized controlled trial. *Archives of pediatrics & adolescent medicine*, *166*(11), 1037-1044.
38. Mwapasa, T., Chidziwisano, K., Lally, D., & Morse, T. (2023). Hygiene in early childhood development centres in low-income areas of Blantyre, Malawi. *International Journal of Environmental Health Research*, *33*(8), 751-767.
39. Tofail, F., Fernald, L. C., Das, K. K., Rahman, M., Ahmed, T., Jannat, K. K., ... & Luby, S. P. (2018). Effect of water quality, sanitation, hand washing, and nutritional interventions on child development in rural Bangladesh (WASH Benefits Bangladesh): a cluster-randomised controlled trial. *The Lancet Child & Adolescent Health*, *2*(4), 255-268.
40. Wagner, J. T., & Pramling Samuelsson, I. (2019). WASH from the START: water, sanitation and hygiene education in preschool. *International Journal of Early Childhood*, *51*, 5-21.
41. Nesti, M. M., & Goldbaum, M. (2007). Infectious diseases and daycare and preschool education. *Jornal de pediatria*, *83*, 299-312.
42. Hasan, M. N., Babu, M. R., Chowdhury, M. A. B., Rahman, M. M., Hasan, N., Kabir, R., & Uddin, M. J. (2023). Early childhood developmental status and its associated factors in Bangladesh: a comparison of two consecutive nationally representative surveys. *BMC Public Health*, *23*(1), 687.
43. Greenberg, J. P. (2011). The impact of maternal education on children's enrollment in early childhood education and care. *Children and Youth Services Review*, *33*(7), 1049-1057.]
44. Cuartas, J. (2022). The effect of maternal education on parenting and early childhood development: An instrumental variables approach. *Journal of Family Psychology*, *36*(2), 280.
45. Crosnoe, R. L., Johnston, C. A., & Cavanagh, S. E. (2021). Maternal education and early childhood education across affluent English-speaking countries. *International journal of behavioral development*, *45*(3), 226-237.
46. Harding, J. F., Morris, P. A., & Hughes, D. (2015). The relationship between maternal education and children's academic outcomes: A theoretical framework. *Journal of Marriage and Family*, *77*(1), 60-76.
47. Harding, J. F. (2015). Increases in maternal education and low-income children’s cognitive and behavioral outcomes. *Developmental psychology*, *51*(5), 583.
48. Lakshman, R., Zhang, J., Zhang, J., Koch, F. S., Marcus, C., Ludvigsson, J., ... & Sobko, T. (2013). Higher maternal education is associated with favourable growth of young children in different countries. *J Epidemiol Community Health*, *67*(7), 595-602.