Association between Escherichia coli (E. coli) contamination in household drinking water and risk of childhood diarrheal disease in Bangladesh.

Biostatistics

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Abstract:

In low-income nations, Escherichia coli (E. coli) is one of the most common etiological agents of moderate-to-severe diarrhea. In this study, we determine the association between Escherichia coli (E. coli) and risk of childhood diarrheal disease by applying a propensity score approach. Data were used from the Multiple Indicator Cluster Survey, 2019. To emulate a propensity score weighted population, we utilized propensity score weighting to reweight both unexposed (E. coli contamination level <1 CFU/100 ml) and exposed (E. coli contamination level 1–10 and > 10 CFU/100 ml) groups. The propensity scores for E. coli contamination were formulated using 14 covariates. Compared to the children from households with a low risk of E. coli contamination in drinking water, children from households with a moderate risk of E. coli contamination were 1.60 times (P=0.19) more likely to have diarrhea, which was 2.09 times (P=0.01) among children from households with a high risk of E. coli contamination. However, after applying the propensity score weighting approach, like the primary analysis, we observed 1.36 times (P=0.38) more likely to have diarrhea, which was 1.93 times (P=0.04) among children from households with a high risk of E. coli contamination. We found a similar strength of relationship in propensity score weighing as we did in survey weighting. The study's findings have important policy implications, including the need to maintain clean water supplies, enhance water management methods, and change hygiene behaviors to prevent childhood diarrhea.

Key Words: Escherichia coli, Drinking water contamination, Diarrhea, Under-5 children, propensity score approach

Introduction

Diarrhea is a symptom of infections caused by a host of bacterial, viral, and parasitic organisms, most of which are spread by, faces contaminated water (WHO, 2017). It is the condition of having at least three loose, liquid, or watery bowel movements each day. It often lasts for a few days and can result in dehydration due to fluid loss. Diarrhea may be acute, persistent, or chronic (Bellido-Blasco & Arnedo-Pena, 2011).

Diarrheal disease has been founded as one of the main reasons of childhood illness and mortality (Liu et al. 2012; Kotloff et al. 2013). Globally, there are nearly 1.7 billion cases of childhood diarrheal disease every year(A. R. Sarker et al., 2016). Diarrhea is a leading cause of malnutrition in children under five years old. Diarrhea is also a leading killer of children, accounting for approximately 8 percent of all deaths among children under age 5 worldwide in 2017. This means to over 1,400 young children dying per day, or about 525,000 children a year (UNICEF, 2021). According to WHO, diarrheal disease is the second leading cause of death in children under five years old. However, it is both preventable and treatable. Diarrheal disease can be prevented through safe drinking water and enough sanitation and maintaining hygiene (Diouf et al., 2014).

However, from diarrhea, a descending trend has been identified in under-5 children death diarrhea (Liu et al. 2016; Paulson et al. 2021). But still a long way to go, as stated in the SDG (3.2) (Paulson et al. 2021). To decrease the mortality rate from diarrhea, availability of diarrheal disease treatment and sufficient water and facilities of sanitation should be increased. Bangladesh Multiple Indicators Cluster Survey (MICS) 2019, stated that about 7% of the under-5 children affected by diarrhea in Bangladesh (Bangladesh Bureau of Statistics and UNICEF Bangladesh 2019). So, the total number of children affected by diarrhea is large, because of the large population of the country.

A prior study conducted in Bangladesh reported that an estimated $79 million was spent on treating diarrheal diseases in 2018 (Hasan et al. 2021). Furthermore, over 46% of households interviewed in that study had to expend a lot to treat diarrheal diseases (Hasan et al. 2021). One of the major causes of diarrhea is infection with Escherichia coli (E. coli)—this phenomenon was frst recognised in the mid-1940s (Hart et al. 1993). Escherichia coli (E. coli) is the one of most common etiological agents of moderate-to-severe diarrhea in low-income countries (WHO, 2017). E. coli is a rod-shaped bacterium of the Enterobacteriaceae family. E. coli was first suspected as being a cause of children's diarrhea in the 1940s when nursery epidemics of severe diarrhea were found to be associated with particular serotypes of E. coli (Qadri et al., 2005). It exists in the intestine of humans and other animal of mammals group (Kaper et al. 2004; Alam et al. 2006). At least six types of E. coli have been pointed out as the reason for diarrhea, dysentery and urinary tract infections (UTIs) (Kaper et al. 2004; Alam et al. 2006). Prestel et al identified the significant presence of different categories of E. coli in the sample of 150 children with diarrhea who were screened for different categories of E. coli (Presterl et al., 2003). Franzolin et al researched and reported the frequency of the different diarrheagenic Escherichia coli (DEC) categories isolated from children with acute endemic diarrhea in Salvador, Bahiawith. The E. coli isolates were investigated by colony blot hybridization. E. coli was suspected in 138 samples and 30 were found to contain diarrheagenic strains (i.e. 17.1% of all samples received, 21.7% of all samples tested for) (Franzolin et al., 2005). In another research in 2003 Ahrabi et al investigated E.coli with acute diarrhea in Tehranian children. Stool specimens of children with diarrhea (n=200) (Salmanzadeh-Ahrabi et al., 2005). Getaneh et al found that the prevalence of E. coli related diarrhea among under-five children is relatively high in Eastern Ethiopia (Getaneh et al., 2021). In another research researchers Qu et al screened 2524 patients, they identified the causes of 269 cases (10.7 %) as follows: diarrheagenic E.coli (4.6 %) (Qu et al., 2016).

Pathogens in contaminated water are harmful for human consumption. By consuming contaminated water, many water-borne diseases like diarrhea, typhoid, and dysentery can happen (Mead et al. 1999; Pande et al. 2018). In Bangladesh, Fecal contamination of water is very common. MICS 2012 and MICS 2019 reported respectably that 61.7% and 81.9% of the household population had drinking water at households polluted with germs such as E. coli (Bangladesh Bureau of Statistics and UNICEF Bangladesh 2014 and 2019). In a recent study in Bangladesh have identified the spatial risk distribution and determinates of household drinking water E. coli contamination (Khan and Bakar 2020). There are a few studies that have examined the relationship between E. coli in drinking water and diarrhea in under age five Bangladeshi children. Luby et al. (2015) found that E. coli polluted drinking water was associated with the severity of childhood diarrhea in Bangladesh, analyzing data of fifty villages in rural areas of Bangladesh (Luby et al. 2015).

Another study in Bangladesh found a link between E. coli-contaminated drinking water and childhood diarrhea (Ercumen et al. 2017). Children living in households with very high-risk levels of E. coli in their source drinking water were more likely to suffer diarrhea, according to a study done in Dhaka, Bangladesh's urban slums (Parvin et al. 2021). In Bangladesh, however, empirical research on association between E.coli and acute diarrhea in children under five with the comparison of different survey data is lacking. As a result, in order to fill this knowledge vacuum, the current study seeks to dissect the existing condition of E. coli contamination in household drinking water in Bangladesh and its link to childhood diarrhea. We sought to determine whether the E.coli, acute diarrhea and its associated factors changed in two consecutive Multiple Indicator Cluster Surveys (MICS) in Bangladesh. The results of this study will provide information that can help policymakers make decisions about how to manage Escherichia coli in drinking water and how frequently childhood diarrhea is seen in Bangladesh.

Material and methods

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

Data source

We used two reports from Bangladesh's Multiple Indicator Cluster Surveys (MICS), 2012 and 2019 (https://www.unicef.org/). This national survey followed a two-stage sampling procedure. First, a stratified random sampling procedure was used to select individuals. Then, the individuals were followed up to measure their opinions and experiences. Children are the final sampling unit in this study. The detailed survey technique is available in the final report of the 2012 and 2019 Bangladesh MICS survey. The 2012 dataset includes 51,895 households that participated in the survey, while the 2019 dataset includes 64,400 households. A randomly selected subset of these households was chosen for water quality testing. A questionnaire was designed to collect a variety of information, including sociodemographic characteristics and health conditions. We obtained data on environmental science and pollution research from sources that are internationally recognized. We also gathered information on household water quality using reliable methods. Our final sample for analysis consisted of 2232 children after we limited our sample to children for whom complete data on the outcome a

Outcome variables

Diarrhea among children beneath the age of 5 a long time was the outcome variable of intrigue. In this overview, diarrhea is defned as the mother’s or caregiver’s recognition of whether their child had a diarrheal scene within the 2 weeks going before the overview (Bangladesh MICS 2012 and 2019). The runs variable was coded as 1 when respondents answered ‘yes’, and ‘0’ something else.

Confounding variables

This study considered a range of child, mother, household and community-level variables as covariates (Table 1). The following child and mother level variables were included in the analysis based on existing evidence: child age (months), gender (male or female) and mother’s educational status (pre-primary incomplete or complete, primary incomplete or complete, secondary and higher secondary or plus). Several variables pertaining to household characteristics were considered, including household size, household head’s sex, household wealth status (poorest, poorer, middle, richer, richest). A principal component analysis was employed to calculate the household wealth index based on data from household assets and divided into five categories based on quintile (Bangladesh Bureau of Statistics and UNICEF Bangladesh 2019). This study also considered division, ethnicity of the household head, salt iodization and mass media. In addition, a set of household-level water and sanitation-related variables were included as covariates in this study: water source type (non-piped, piped), toilet facility type (improved, non-improved), shared toilet facility (no, yes), source water quality (100ml) (low, moderate, high). Identifying the water source type and toilet facility were created from the question about the main source of drinking water and toilet facility for household members, and multiple categories of responses were categorized into two groups. The risk of E. coli contamination in source water was determined using a source water sample E. coli test, similar to a household water sample test (Bangladesh Bureau of Statistics and UNICEF Bangladesh 2019). Source water E. coli CFU data were divided into three risk groups: low (1 CFU/100 ml), moderate (1–10 CFU/100 ml) and high (>10 CFU/100 ml). There were two community level variables: place of residence (rural, urban) and administrative division (Barisal, Chattogram, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur and Sylhet).

Exposure(Thik korte Hobe)

The concentration of E. coli in family water was the exposure variable of intrigue. Respondents were asked to serve a glass of water which they usually drink (Bangladesh Bureau of Statistics and UNICEF Bangladesh 2012 and 2019). It was tried for E. coli by brooding 100 ml of the test. Within the water quality test, look at was performed inside 30 min of collecting test and incubating was done for 24–48 h. E. coli colonies were numbered as colony-forming units (CFUs) per 100 ml of water (Bangladesh Bureau of Statistics and UNICEF Bangladesh 2012 and 2019). The 2019 Bangladesh MICS report contains a more descriptive depiction of the water quality test (Bangladesh Bureau of Statistics and UNICEF Bangladesh 2012 and 2019). The E. coli CFU information from family drinking water were gathered into different hazard segment concurring to the WHO criteria (World Wellbeing Organization, 1997):10 CFU/100 ml. Since of little number of perceptions. This research merged 11–100 CFU/100 ml and>100 CFU/100 ml risk groups into>10 CFU/100 ml group.

Statistical analysis

Graphic insights were performed to appear the dissemination of variables. The mean and standard deviation (SD) were utilized for persistent factors, whereas number and rate were utilized for categorical variables. We fitted the design-based logistic regression (Lumley and Scott 2017) to survey the affiliation between child diarrhea and E. coli defilement in family drinking water. For the balanced affiliation, the analysis was balanced for child age, sex, mother education status, household size, livestock ownership, household wealth status, water source type, toilet facility type, shared toilet facility, source water E. coli concentration risk, source of household water sample, water treatment, place of residence and division. The crude odds ratio(COR) and adjusted odds ratio (AOR) with the 95% confidence interval (CI) and p-values were detailed. All investigations were performed utilizing R adaptation 4.0.3. The strength of the discoveries from our fundamental examinations was surveyed utilizing the pr.

Table 1 Frequency distribution of the study sample by diarrhea (weighted1) prevalence in Bangladesh among children younger than 5 years of MICS 2019 and MICS 2012 data.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Characteristics | MICS 2019 | | | MICS 2012 | | |
| Diarrhea | | | Diarrhea | | |
|  | Yes | No | Total | Yes | No | Total |
| **Child Characteristics** | | | | | | |
| **Age** |  |  |  |  |  |  |
| 0-11 | 38 (7.96) | 438 (92.04) | 476 (20.40) | 21 (5.04) | 387 (94.96) | 407 (19.64) |
| 12-23 | 49 (10.88) | 398 (89.12) | 446 (19.14) | 25 (5.49) | 439 (94.51) | 464 (22.40) |
| 24-35 | 37 (7.79) | 440 (92.21) | 478 (20.48) | 13 (3.15) | 394 (96.85) | 407 (19.62) |
| 36-47 | 29 (6.17) | 443 (93.83) | 472 (20.23) | 9 (2.23) | 382 (97.77) | 391 (18.84) |
| 48-59 | 20 (4.35) | 440 (95.65) | 460 (19.74) | 6 (1.57) | 398 (98.43) | 404 (19.50) |
| **Sex** |  |  |  |  |  |  |
| Male | 91 (7.35) | 1152 (92.65) | 1244 (53.33) | 34 (3.17) | 1028 (96.83) | 1062 (51.21) |
| Female | 81 (7.48) | 1007 (92.52) | 1088 (46.67) | 40 (3.98) | 971 (96.02) | 1011 (48.79) |
| **Maternal Characteristics** | | | | | |  |
| **Education Status** |  |  |  |  |  |  |
| None/Primary incomplete | 28 (10.17) | 248 (89.83) | 276 (11.86) | 24 (3.30) | 690 (96.70) | 714 (34.42) |
| Primary Complete | 30 (5.59) | 513 (94.41) | 543 (23.31) | 12 (3.53) | 317 (96.47) | 329 (15.85) |
| Secondary | 91 (7.88) | 1059 (92.12) | 1150 (49.31) | 32 (4.40) | 704 (95.60) | 736 (35.50) |
| Secondary Complete/ Higher | 24 (6.52) | 338 (93.48) | 362 (15.53) | 6 (2.16) | 288 (97.84) | 295 (14.22) |
| **Household Characteristics** | | | | | | |
| **Household size** |  |  |  |  |  |  |
| <5 | 76 (7.89) | 884 (92.11) | 960 (41.18) | 47 (3.91) | 1165 (96.09) | 1213 (58.51) |
| 5/5+ | 97 (7.07) | 1275 (92.93) | 1372 (58.82) | 26 (3.07) | 834 (96.92) | 860 (41.49) |
| **Livestock ownership** |  |  |  |  |  |  |
| Yes | 102 (7.39) | 1276 (92.61) | 1378 (59.14) | 47 (3.98) | 1139 (96.02) | 1186 (57.31) |
| No | 71 (7.45) | 881 (92.55) | 952 (40.86) | 27 (3.02) | 857 (96.98) | 883 (42.69) |
| **Wealth status** |  |  |  |  |  |  |
| Poor | 90 (9.12) | 894 (90.88) | 984 (42.19) | 36 (3.81) | 903 (96.19) | 939 (45.28) |
| Middle | 23 (5.10) | 425 (94.90) | 448 (19.21) | 15 (3.56) | 398 (96.44) | 412 (19.90) |
| Rich | 60 (6.70) | 840 (93.30) | 900 (38.59) | 23 (3.25) | 698 (96.75) | 722 (34.82) |
| **Source water type** |  |  |  |  |  |  |
| Improved | 171 (7.47) | 2120 (92.53) | 2291 (98.27) | 73 (3.61) | 1944 (96.39) | 2017 (97.28) |
| Unimproved | 2 (3.77) | 39 (96.23) | 40 (1.73) | 1 (1.79) | 55 (98.21) | 56 (2.72) |
| **Toilet facility type** |  |  |  |  |  |  |
| Improved | 168 (7.44) | 2083 (92.56) | 2251 (96.54) | 69 (3.45) | 1915 (96.54) | 1984 (95.69) |
| Non-improved | 5 (6.43) | 76 (93.57) | 81 (3.46) | 5 (5.98) | 84 (94.02) | 89 (4.31) |
| **Toilet facility shared** |  |  |  |  |  |  |
| Yes | 58 (7.85) | 675 (92.15) | 733 (31.81) | 14 (2.67) | 514 (97.33) | 528 (25.77) |
| No | 115 (7.32) | 1456 (92.68) | 1571 (68.19) | 59 (3.86) | 1462 (96.14) | 1520 (74.23) |
| **Household water *E. coli* concentration2** |  |  |  |  |  |  |
| Low | 16 (4.25) | 369 (95.75) | 386 (16.54) | 13 (3.19) | 383 (96.81) | 396 (19.08) |
| Moderate | 31 (6.63) | 438 (93.37) | 469 (20.10) | 14 (3.88) | 359 (96.12) | 373 (18.00) |
| High | 125 (8.48) | 1352 (91.52) | 1477 (63.36) | 47 (3.59) | 1258 (96.41) | 1305 (62.92) |
| **Source of water** |  |  |  |  |  |  |
| Direct from source | 11 (7.37) | 134 (92.63) | 145 (6.21) | 3 (2.51) | 106 (97.49) | 108 (5.26) |
| Covered container | 117 (7.99) | 1346 (92.01) | 1463 (62.86) | 48 (3.70) | 1259 (96.30) | 1307 (63.35) |
| Uncovered container | 45 (6.28) | 675 (93.73) | 720 (30.93) | 23 (3.52) | 625 (96.48) | 648 (31.39) |
| **Source water *E. coli* concentration** |  |  |  |  |  |  |
| Low | 96 (7.25) | 1227 (92.75) | 1323 (57.37) | 49 (4.00) | 1186 (96.00) | 1235 (60.50) |
| Moderate | 39 (7.44) | 488 (92.56) | 527 (22.86) | 13 (2.67) | 476 (97.33) | 489 (23.98) |
| High | 38 (8.23) | 418 (91.76) | 456 (19.77) | 10 (3.24) | 307 (96.76) | 317 (15.52) |
| **Water treatment** |  |  |  |  |  |  |
| Yes | 58 (7.85) | 675 (92.15) | 733 (31.81) | 14 (2.67) | 514 (97.33) | 528 (25.77) |
| No | 115 (7.32) | 1456 (92.68) | 1571 (68.19) | 59 (3.86) | 1462 (97.14) | 1520 (74.23) |
| **Community characteristics** | | | | | | |
| **Place of residence** |  |  |  |  |  |  |
| Rural | 36 (7.49) | 438 (92.51) | 474 (20.33) | 18 (4.17) | 423 (95.82) | 441 (21.29) |
| Urban | 137 (7.39) | 1720 (92.61) | 1858 (79.67) | 55 (3.40) | 1576 (96.60) | 1632 (78.71) |
| **Division** |  |  |  |  |  |  |
| Barisal | 23 (17.34) | 108 (82.66) | 131 (5.62) | 2 (2.09) | 117 (97.91) | 119 (5.74) |
| Chattogram | 38 (7.18) | 496 (92.82) | 534 (22.92) | 20 (3.95) | 488 (96.05) | 508 (24.53) |
| Dhaka | 38 (7.00) | 500 (93.00) | 537 (23.04) | 19 (3.16) | 580 (96.84) | 598 (28.87) |
| Khulna | 15 (6.67) | 212 (93.33) | 228 (9.76) | 10 (4.43) | 211 (95.57) | 221 (10.64) |
| Mymensingh | 23 (12.56) | 158 (87.44) | 181 (7.77) | - | - | - |
| Rajshahi | 15 (5.26) | 278 (94.74) | 293 (12.58) | 6 (2.62) | 226 (97.38) | 232 (11.21) |
| Rangpur | 14 (5.68) | 235 (94.32 | 249 (10.67) | 11 (4.30) | 242 (95.70) | 253 (12.18) |
| Sylhet | 7 (3.69) | 172 (96.31) | 178 (7.64) | 6 (4.01) | 136 (95.99) | 142 (6.83) |

1 Frequencies are weighted using sample weight (the survey design that accounts for survey features such as strata, primary sampling unit and survey weights).

2 E. coli colonies were counted as CFUs per 100 ml of water and categorised as low (<1 CFU/100 ml), moderate (1–10 CFU/100 ml) and high (>10 CFU/100 ml).

Table 2 Association between household drinking water E. coli contamination and diarrhea among children in Bangladesh

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | MICS 2019 | | | | MICS 2012 | | | |
| Exposure of interest | Unadjusted model |  | Adjusted model1 |  | Unadjusted model |  | Adjusted model1 |  |
|  | COR (95% CI) | p-value | AOR (95% CI) | p-value | COR (95% CI) | p-value | AOR (95% CI) | p-value |
| Household water E. coli concentration |  |  |  |  |  |  |  |  |
| Low | Ref |  | Ref |  | Ref |  | Ref |  |
| Moderate | 1.60 (0.79 – 3.25) | 0.193 | 1.46 (0.71 – 3.01) | 0.301 | 1.23 (0.53 – 2.81) | 0.632 | 1.29 (0.54 – 3.10) | 0.562 |
| High | 2.09 (1.17 – 3.72) | 0.012 | 1.96 (1.06 – 3.63) | 0.032 | 1.13 (0.57 – 2.24) | 0.725 | 1.29 (0.62 – 2.69) | 0.496 |

COR crude odds ratio, AOR adjusted odds ratio, CI confidence interval, Ref. reference

1 The adjusted analysis using the design-based binary logistic regression, adjusted for child age, sex, mother education status, household size, livestock ownership, household wealth status, water source type, toilet facility type, shared toilet facility, source water E. coli concentration risk, source of household water sample, water treatment, place of residence and division in MICS 2019. Except mother education status and water source type in MICS 2012.

Table 3 Sensitivity analysis using the propensity score weighting approach to explore the association between household drinking water E. coli contamination and diarrhea among children in Bangladesh

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | MICS 2019 | | MICS 2012 | |
| Exposure of interest | Adjusted model |  | Adjusted model |  |
|  | AOR (95% CI) | p-value | AOR (95% CI) | p-value |
| Household water E. coli concentration |  |  |  |  |
| Low | Ref |  | Ref |  |
| Moderate | 1.46 (0.71 – 3.01) | 0.418 | 1.01 (0.45 – 2.28) | 0.981 |
| High | 1.96 (1.06 – 3.63) | 0.077 | 1.07 (0.53 – 2.16) | 0.847 |

|  |  |
| --- | --- |
| MICS 2019 | MICS 2012 |
| E:\Update - Ecoli\Rplot03.tiff | E:\Update - Ecoli\Rplot05.tiff |

Fig. 1 Absolute standardised mean differences (SMD) between low, moderate and high household water E. coli concentration in unweighted and propensity score (PS)–weighted samples

Strengths and limitations

This study basically based on recent MICS data in the context on developmental status of Bangladeshi children. We used a sufficiently large nationally representative dataset, which represents the respective children and women of Bangladesh. We considered a great variety of influencial factors that affect the dependent variable.

This study however is not devoid of some drawbacks. As the data was secondary data, the selection variables, quality of data, measurement of indicators were out of control. Moreover, the cross sectional data makes it difficult to establish the relationship between the exposure and the outcome variable. Our E-coli definition is not enough to differentiate the pathogenic and non-pathogenic E-coli. Finally, diarrhea can be caused by a variety of factors including bacterial infections and viral infections, food intolerance and food allergies, malnutrition, parasites that enter the body through food or water, and drug reactions, among others. However, we don’t get any potential contaminants other than E-coli bacteria that result in childhood diarrhea.

Diarrhoea is a leading cause of malnutrition in children under five years old. Malnutrition, which makes children more vulnerable to diarrhoea may worsen the immunity power of them and become the cause of death.

Recommendations

The findings of our study have some potential implications for our policy makers. Different government and non-government organizations, International agencies and public health professional who work for the betterment of children health can initiate awareness rising activities to make the people understand about the cause and prevention of E-coli contamination in drinking water. The awareness raising initiative should also focus on educating the people in using safe drinking water tested/checked by relevant authorities. The awareness rising activities should be implemented by the respective authorities. In Bangladesh it is found that high education level of parents have sense about the sanitation and hygiene of their children. The households access to electronic media can seek concern of public for childhood diarrhea. Specially, the young women are likely to be more exposed than older women can contribute for better health seeking behavior of younger mother. Department of environment (DoE) can take essential steps to keep water source such as tube wells from contaminants and the drinking water source can be tested for E-coli before consumption by the mass people.

Conclusion

Diarrhea is still an important public health issue in children younger than 5 years in Bangladesh. The present study documented a high level of E. coli contamination in drinking water and reported a significant association between E. coli contamination in drinking water and childhood diarrheal episodes. The findings suggest implementing interventions focusing on reducing faecal contamination at the drinking water source as well as in stored water. As the prevalence of diarrhea and behavior of mothers in Bangladesh is patterned by their age, wealth, educational status, ethnicity interventions should focused the mothers of low-income country like Bangladesh. Policymakers, public health practitioners and community-based organizations should focus on raising mass awareness on the use of safe drinking water. Relevant authorities should also ensure safe water supplies, improve drinking water management (e.g. handling procedures, treatment and storage), help modify personal hygiene behavior, improve health literacy and engaging community health workers in the prevention of diarrhea prevention, control and treatment.

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Ethical Consent

The MICS 2019 was carried out in collaboration with the Bangladesh Bureau of Statistics (BBS) and UNICEF. The protocol of this survey was approved by technical committee of the Government of Bangladesh lead by the BBS. This present study used publicly available secondary MICS 2012 & 2019 datasets. Before making the datasets public, all respondents were deidentified by survey authorities.

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Conflicting interest

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