RESEARCH

Ethnicity and access to water, sanitation, and hygiene in Bangladesh: a study using MICS data and policy reviews

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Abstract

Introduction Safe drinking water, sanitation, and hygiene (WASH) are crucial to human health. Reducing inequalities and ensuring universal access to WASH are essential to achieving the agenda of sustainable development. We aimed to measure access to WASH among ethnic minority populations in Bangladesh and understand the situation and factors affecting WASH practices among them. Additionally, we reviewed policy related to WASH to highlight the inequality faced by ethnic minority populations.

Methodology We utilized data from the multiple indicator cluster survey-2019. We used the chi-square test for bivariate analysis and multilevel mixed-effect logistic regression analyses to identify the effect of ethnicity on WASH in Bangladesh after controlling selected covariates. Furthermore, we systematically reviewed Bangladesh's WASH-related policies and programs.

Findings While 98.5% of Bengalis had access to basic drinking water services, the percentage is 60.6% for the ethnic minority population. For improved sanitation facilities not shared with others, the difference between Bengali and ethnic populations was 22.3% (64.6% vs. 42.3%). On the other hand, 75% of the Bengali population had a handwashing facility with water and soap, and 50% of the ethnic population had them. Ethnicity appeared to be a statistically significant predictor of every component of WASH. Compared to Bengali, the ethnic population had 87%, 45%, 31%, and 45% less access to water (aOR = 0.13, $p \leq 0.001$), sanitation (aOR = 0.55, $p \leq 0.001$), and handwashing (aOR = 0.69, $p \leq 0.05$), and WASH facilities aOR = 0.55, $p \leq 0.001$), respectively. Among the policies of Bangladesh, only one identified action for WASH rights of ethnic minorities.

Conclusion The government should identify the issues of WASH among ethnic minorities and represent them adequately in policies to achieve the aim of 'leaving none behind' of sustainable development goals.

Keywords WASH, Water, Sanitation, Hygiene, Ethnic minority, Ethnicity, Structural inequality, Bangladesh

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Introduction

Safe drinking water, sanitation, and hygiene (WASH) are critical to human health and well-being [1]. Eradicating disparities in access to WASH is fundamental to achieving the sustainable development goal (SDG) six: *ensure availability and sustainable management of water and sanitation for all.* It is also indirectly related to other goals, including goal three: *good health and well-being,* and goal ten: *reduced inequalities among and within countries* [2, 3]. Moreover, WASH is also a part of

universal human rights irrespective of individuals' age, social class, economic status, and ethnic identities [1, 4]. In this instance, reducing inequalities in access and quality of WASH facilities is crucial.

However, the actual circumstances of WASH are far from ideal. Progress has been unequal, and existing data highlights inequality among and within countries. Worldwide, 2.2 billion people still lack access to safe drinking water [5]. At the same time, more than half of the global population does not have access to safe sanitation, and three billion people lack hand washing facilities with soap [5]. Differences exist between rural and urban areas, poor and rich, and between vulnerable groups and the general population [6–8]. The UN's commitment to 'leaving no one behind' in WASH facilities will only be achieved when the needs of the most vulnerable and marginalized populations are understood and addressed. Furthermore, targeted actions are adopted to tackle the specific barriers faced by those deprived of access to water and sanitation [2].

Bangladesh has made notable improvements towards providing water supply and sanitation in the last two decades [9–11]. However, the WASH situation is poor for indigenous groups in Bangladesh [9, 12]. According to the 2022 Population and Housing Census, the indigenous population constitutes approximately 1.0% (1.65 million) of the total population of Bangladesh [13]. However, they claim their population is approximately 5 million [14]. Most of them live in the plains districts of the country, and the rest in the Chittagong Hill Tracts (CHT) [15]. There are 11 distinct indigenous peoples in the CHT, while the indigenous peoples of the regions outside the CHT, referred to as the "plains," comprise 21 Adibashi/ Adivasi groups [15]. Article 23A of Bangladesh's constitution states, "The state shall take steps to protect and develop the unique local culture and tradition of the tribes, minor races, ethnic sects and communities" [16].

National Health Policies, Strategies, and Plans (NHPSPs) play an essential role in defining a country's vision, policy directions, and strategies for ensuring the health of its population [17]. World Health Organization (WHO) framework for NHPSPs entails that health policies must go beyond the boundaries of health systems, addressing the social determinants of health and the interaction between the health sector and other sectors in society for sustainable development goals [17, 18]. Existing literature about indigenous people shows that ethnic minority people are not adequately recognized and defined in the strategies and policies of the government in Bangladesh [12, 19]. Their participation in decision-making is inadequate at the divisional and national levels. While there are decentralized government institutions in CHT, the situation is worse for ethnic minorities in the "plains." A large proportion of the indigenous population in Bangladesh is living in an unfavorable situation and facing issues like landlessness, illiteracy, discrimination, land extortion, prejudice, ill health, and nutritional conditions [12, 14]. They have incompetently been represented in the data, an act of discrimination [12, 15, 19]. These issues can be an underlying determinant for their disadvantageous position in access to WASH.

Inadequate access to WASH affects all aspects of their lives and will affect their inclusiveness in achieving sustainable development goals. In this instance, more public and private attention is required to explore the reason behind their demeaning position in access to WASH. For this reason, this study aims to understand the situation and factors affecting WASH practices among the ethnic minority population in Bangladesh. This study will help to gain policymakers' attention regarding ethnic minorities and their WASH practices and take appropriate actions to improve their distressing situation.

Data and methods
Data source
To highlight the inequality in WASH among ethnic minority populations, we used a mixed-methods research design, incorporating quantitative data and reviewing policy documents related to WASH. Creswell described it as the 'Concurrent Embedded Approach' [20]. Quantitative data extracted from the Bangladesh Multiple Indicator Cluster Survey (MICS) was utilized to explore access to WASH [9]. Additionally, we reviewed the policy documents related to WASH as part of the qualitative data.

The MICS was a cross-sectional survey conducted by the Bangladesh Bureau of Statistics (BBS) with support from UNICEF. Data was collected from January to June 2019. The sample for the MICS provides estimates at the national level for urban and rural areas for eight divisions and sixty-four districts of Bangladesh. The number of primary sampling units (PSU) was 3220, where 61,242 households were sampled with members of 260,959. The response rate for this survey was 99.4 percent for the household. The primary sampling strata were based on urban and rural areas within each district. Within each stratum, a specific number of census enumeration areas (EA) were selected with probability proportional to size. Subsequently, a systematic sample of 20 households was drawn in each sample PSU. The details of sample design, questionnaires, data collection, editing, and analysis are available elsewhere in the report [9].

Policy reviews

Table 5 reviews Bangladesh's policies and programs regarding WASH and related issues. The policy review explored what was mentioned about ethnic minorities in the existing policies. The policies were reviewed thoroughly to identify whether there were any specific objectives and/or discussions regarding WASH explicitly for ethnic minorities.

Variables of the study

Dependent variables

The dependent variables of the study were the use of basic drinking water services (BDWS), the improved sanitation facilities not shared with others (ISFS), the handwashing facilities with water and soap (HWFWS), and the improved water, sanitation, and hygiene (WASH) facilities. WASH for SDGs was calculated by combining three variables (BDWS, ISFS, and HWFWS). For measuring a different combination of WASH indicators, three variables were transformed into one with eight categories: no WASH, only water, only sanitation, only hygiene, water & sanitation, water & hygiene, sanitation & hygiene, and WASH.

The operational definition of dependent variables used in the study is described below:

- Use of basic drinking water services (SDG target 1.4.1 [21]): Use of basic drinking water services is defined as the percentage of household members using improved sources of drinking water either in their dwelling/yard/plot or within 30 min of round trip collection time.
- Improved sanitation facilities (SDG target 3.8.1): Percentage of household members using improved sanitation facilities not shared with others. An improved sanitation facility hygienically separates human excreta from human contact. Improved sanitation facilities include flush or pour-lush to piped sewer systems, septic tanks or pit latrines, ventilated improved pit latrines, pit latrines with slabs, and composting toilets.
- Handwashing facilities (SDG targets 1.4.1 & 6.2.1): Percentage of household members with a handwashing facility where water and soap or detergent were present.
- Improved water, sanitation, and hygiene (SDG target 1.4.1, 3.8.1 & 6.2.1): In this indicator, we have combined the three variables of improved water, sanitation, and hygiene. It measures the percentage of the population with access to all SDG WASH indicators described above. We have combined 'none,' 'only water,' 'only sanitation,' 'only hygiene,' 'water & sanita-

tion,' 'water & hygiene,' and 'sanitation & hygiene' to get the 'WASH' value in Table 2.

Independent variables and other covariates

The independent variable in this study was the ethnicity status of the household head with two subgroups: Bengali and Others. Other covariates of the study were the place of residence, regions of Bangladesh, sex, religion, and education of the household head, household wealth, number of rooms in the household, the main material of the dwelling floor, roof, and exterior wall, and whether the household owned any bank account. The place of residence was categorized as urban and rural. The regions were the eight administrative divisions of Bangladesh: Barishal, Chattogram, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur, and Sylhet. The education of the household head indicates the highest level of education of the household head categorized as pre-primary or none, primary, secondary, and higher than secondary. MICS 2019 measured household wealth by analyzing a household's possessions with the first component of the principal component analysis. Finally, the religion of the household head was divided into Muslim and other, as most of the respondents are Muslims in Bangladesh. The main material of the dwelling floor, roof, and exterior wall were categorized as furnished vs other.

Statistical analysis

We first analyzed sample characteristics by ethnicity status (Table 1 and STable 1), where *p*-values were from Rao, and Scott corrected Chi-square tests [22]. For binary outcomes from cross-sectional data, logistic regression was better fitted and extensively used in the literature. MICS data has a hierarchical structure with different levels (multiple levels): individuals nested within the cluster (enumeration area), and individuals within a cluster might be more similar than individuals in the rest of the country. It implies that we should consider variability between clusters (multilevel modeling), as standard regression may produce incorrect variance. Mixed-effects regression accounts for the potential correlation of regression outcomes within clusters and allows for partitioning residual variability within and between cluster components. Therefore, design-based multilevel (random intercept) logistic regression was used, indicating a random intercept at the cluster (PSU) level. The intraclass correlations (ICC) are available for random-intercept or random-coefficients models conditional on random-effects covariates equal to 0. In the design-based analyses, household weight was used as the first-stage weight, and due to the unavailability of weight in the 2nd stage (PSU/EA level), we assumed it was similar for all.

Table 1 Selected sample characteristics (%) of the respondents by ethnicity

Characteristics	Ethnicity of household head		Total ($n=260,959$)	Chi-Square
	Bengali ($n=257795$)	Ethnic minorities ($n=3164$)		
Place of residence (Area)				*< 0.001*
Urban	21.8	17.9	21.7	
Rural	78.2	82.1	78.3	
Division (Regions)				*< 0.001*
Barishal	5.8	0.4	5.7	
Chattogram	18.7	79.8	19.4	
Dhaka	24.6	0.5	24.3	
Khulna	11.6	0.6	11.4	
Mymensingh	7.4	3.4	7.3	
Rajshahi	13.1	4.7	13.0	
Rangpur	11.3	7.4	11.2	
Sylhet	7.6	3.1	7.5	
Education of household head				*< 0.001*
Pre-primary or none	35.2	44.0	35.3	
Primary	27.3	25.7	27.2	
Secondary	25.4	25.5	25.4	
Higher secondary +	12.1	4.8	12.1	
Household wealth quintile				*< 0.001*
Poorest	19.5	64.7	20.0	
Poorer	20.1	10.6	20.0	
Middle	20.1	10.7	20.0	
Richer	20.1	8.8	20.0	
Richest	20.2	5.2	20.0	
Religion				*< 0.001*
Muslim	91.3	1.7	90.2	
Others	8.7	98.3	9.8	
Total	100.0	100.0	100.0	

We performed three models for each dependent variable: null/intercept only model, crude model/ ethnicity only model, and adjusted model. We checked the multicollinearity using linear regression models with variance inflation factor (VIF) and found no multicollinearity (VIF < 2.0). Final models were selected using the lowest AIC and BIC from standard logistic regression analyses. The probability value (*p*-value) of the chi-square test and logistic regression analyses were provided. The odds ratio (OR) with a 95% confidence interval (CI) of logistic regression analyses was produced. We used SPSS 27.0 and Stata 18.0 for the analyses.

Results

Characteristics of the respondent

Table 1 represents the demographic and socioeconomic characteristics of the respondents by ethnicity. Regarding place of residence, 78.2% of the Bengali population lived in rural areas, while 82.1% of the ethnic minority population. Whereas all other divisions predominantly consisted of the Bengali population, the indigenous groups were the majority in the Chattogram division. The situation of educational achievement was not satisfactory among the ethnic minority population, as 44% of them belonged to the primary and none category. Likewise, poverty highly affected them, with 64.7% being in the poorest wealth quintile. Finally, most ethnic minority groups were from religions other than Muslim. However, sample characteristics at the household level are provided in STable 1. As per the supplementary table, the main material of the dwelling floor was furnished for around 39% of households, which was 38.8% for Bengali and 20.1 for other ethnic minorities. The situation for exterior walls was also similar. Almost all households had furnished roofs. However, only 20.1% of Bengalis relied primarily on clean fuels and technologies for cooking, 6.5% of other ethnic populations. More than 65% of any household member had a bank account, which was

higher for the ethnic minority groups (80.5%). The mean number of rooms used for sleeping was slightly higher for Bengali than others.

Access to water, sanitation, and hygiene

Figure 1 presents the proportion of the population with access to a separate and different combination of WASH facilities by ethnicity. The proportion of people with no water, sanitation, and hygiene was very high among ethnic populations (23.8%), while the number is only 0.4% for Bengali. The population with access to only water, sanitation, and hygiene was 13.1%, 5.6%, and 6.6% among the ethnic population, respectively. Only 26% of the ethnic population had access to all the components of WASH, which was 51% of the Bengali population.

Table 2 presents the situation of the WASH facilities based on other socioeconomic characteristics. The ethnic minority population faced disadvantages in every indicator of WASH. Regarding basic drinking water services, 98.5% of the Bengalis had access, while it was 60.6% of the ethnic population (Table 3). For improved sanitation facilities not shared with others, the difference between Bengali and ethnic populations was 22.3% (64.6% vs. 42.3%). On the other hand, 75% of the Bengali population had a handwashing facility with water and soap, and 50% of the ethnic population had them.

Table 3 presents the situation of WASH among the ethnic population by selected characteristics in Bangladesh. The ethnic minority population of the Chattogram division had the lowest access to water (50.9%), the access to sanitation was highest in the Khulna division (89.5%), and the Rajshahi (21.9%) division had the lowest access to handwashing. Education and wealth played a crucial role

in access to WASH among the ethnic minority population. The Indigenous population with more than higher secondary level education had higher access to WASH than those with primary or none. The pattern was the same with the household wealth quintile: the poorest quintile had substantially less access to WASH than the richest.

The results from multilevel mixed effects logistic regression analyses are provided in Table 4 (correlates of ethnicity and WASH using multiple logistic regression analyses at the individual level are provided in STable 2). Ethnicity appeared to be a statistically significant predictor of every component of WASH. According to the final model (adjusted model), compared to Bengali, the ethnic population had 87%, 45%, and 31% less access to water (aOR = 0.13, $p \leq 0.001$), sanitation (aOR = 0.55, $p \leq 0.001$), and handwashing facilities (aOR = 0.69, $p \leq 0.05$), respectively. Regarding the combined indicator for SDGs, the ethnic population had 45% less access to WASH (aOR = 0.55, $p \leq 0.001$) than Bengali.

Insights from policy review

Table 5 presents the policy analysis of the WASH facilities among the ethnic minority population. It is evident from the table that, in Bangladesh, most policies did not identify the issue of a lack of WASH among ethnic groups. The policies did not even use 'ethnic minority' or 'indigenous' terms. Most studies addressed them among the 'vulnerable' and/or 'hard-to-reach' population [11, 23–26]. However, the National Hygiene Promotion Strategy for water, supply, and sanitation [27] only addressed the issue and suggested actions based on that.
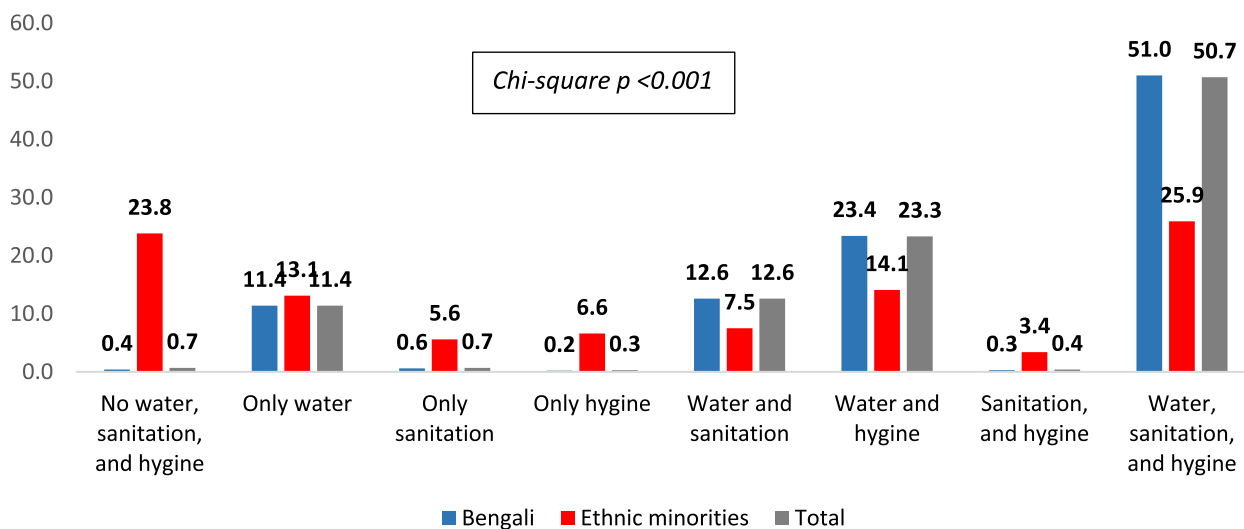

Fig. 1 Combinations (%) of access to water, sanitation, and hygiene by ethnicity

Table 2 Percentage of population with access to separate and combined WASH facilities

Characteristics	Water	Sanitation	Handwashing	Combination water, sanitation, and handwashing (%)							
				None	Only Water	Only Sanitation	Only Hygiene	Water & Sanitation	Water & Hygiene	Sanitation & Hygiene	WASH
Place of residence											
Urban	99.2	64.7	86.9	0.1	7.1	0.2	0.2	5.6	27.8	0.2	58.6
Rural	97.7	64.3	71.3	0.8	12.6	0.8	0.3	14.5	22.0	0.4	48.6
P-value	*<0.001*	*0.052*	*<0.001*								*<0.001*
Division											
Barishal	97.6	65.8	46.4	1.0	20.7	1.0	0.1	30.8	12.4	0.3	33.7
Chattogram	96.5	66.3	68.8	2.0	12.8	0.7	0.5	15.8	18.4	0.3	49.5
Dhaka	99.7	60.8	88.1	0.0	5.9	0.0	0.2	5.9	33.1	0.1	54.8
Khulna	93.8	72.4	74.5	1.1	7.5	2.9	0.5	14.0	18.4	1.6	53.8
Mymensingh	99.5	57.3	62.7	0.2	20.6	0.1	0.1	16.4	21.8	0.2	40.6
Rajshahi	99.6	62.0	68.5	0.2	16.3	0.1	0.1	15.0	21.5	0.1	46.9
Rangpur	100.0	66.3	85.0	0.0	8.0	0.0	<0.01	7.0	25.7	0.0	59.4
Sylhet	95.8	65.5	75.1	1.0	12.1	1.5	0.7	10.2	20.7	0.9	52.8
P-value	*<0.001*	*<0.001*	*<0.001*								*<0.001*
Education of h. head											
Pre-primary or none	97.5	57.4	66.4	1.0	16.4	0.8	0.3	15.4	24.9	0.3	40.8
Primary	97.6	59.9	72.0	0.8	12.4	0.8	0.3	14.1	26.5	0.5	44.6
Secondary	98.5	69.3	81.1	0.4	7.8	0.5	0.2	10.3	22.3	0.4	58.1
Higher secondary+	99.2	84.5	91.7	0.1	2.2	0.3	0.1	5.6	13.1	0.3	78.2
P-value	*<0.001*	*<0.001*	*<0.001*								*<0.001*
Household wealth											
Poorest	93.4	46.5	44.2	3.0	28.7	2.2	0.8	22.0	21.0	0.6	21.7
Poorer	98.6	56.9	66.2	0.3	14.9	0.6	0.2	18.0	27.7	0.2	38.0
Middle	99.2	66.9	78.2	0.1	7.8	0.3	0.1	13.7	25.1	0.4	52.6
Richer	99.1	69.0	88.0	<0.01	4.6	0.2	0.1	7.1	26.2	0.5	61.2
Richest	99.6	82.5	96.8	0.0	1.0	0.0	0.1	2.1	16.3	0.2	80.2
P-value	*<0.001*	*<0.001*	*<0.001*								*<0.001*
Religion											
Muslim	98.6	64.4	75.2	0.4	11.4	0.6	0.2	12.5	23.6	0.3	51.1
Others	92.8	63.6	70.3	3.4	11.4	1.6	1.1	13.4	20.4	1.1	47.5
P-value	*<0.001*	*<0.001*	*<0.001*								*<0.001*
Total	**98.0**	**74.8**	**64.4**	**0.7**	**11.4**	**0.7**	**0.3**	**12.6**	**23.3**	**0.4**	**50.7**

Table 3 Access (%) to WASH among the Bengali and ethnic minorities population by selected characteristics

Characteristics	Water		Sanitation		Handwashing		All (WASH)	
	Bengali	Ethnic	Bengali	Ethnic	Bengali	Ethnic	Bengali	Ethnic
Place of residence								
Urban	99.2	93.1	64.7	63.1	87.0	73.8	58.7	49.4
Rural	98.2	53.6	64.6	37.8	71.6	44.9	48.9	20.8
Division								
Barishal	97.6	100.0	65.9	30.8	46.4	69.2	33.7	30.8
Chattogram	98.9	50.9	67.7	40.4	70.1	43.6	51.0	21.8
Dhaka	99.7	100.0	60.8	56.3	88.1	100.0	54.8	56.3
Khulna	93.8	100.0	72.4	89.5	74.5	89.5	53.8	78.9
Mymensingh	99.5	98.1	57.3	47.7	62.5	93.5	40.6	43.0
Rajshahi	99.6	100.0	62.2	23.3	68.7	21.9	47.0	11.3
Rangpur	100.0	100.0	66.3	61.7	85.0	90.2	59.4	53.2
Sylhet	95.8	96.0	65.5	58.0	75.0	96.0	52.8	54.5
Education of household head								
Pre-primary or none	98.3	50.9	57.8	28.3	66.8	38.5	41.3	12.3
Primary	98.1	54.2	60.2	40.1	72.2	48.0	44.8	23.8
Secondary	98.8	78.5	69.4	61.6	81.3	64.2	58.3	42.3
Higher secondary +	99.2	90.0	84.5	80.7	91.7	92.0	78.2	74.7
Household wealth quintile								
Poorest	95.5	41.8	47.2	27.6	44.6	33.6	22.2	9.6
Poorer	98.7	90.5	56.9	52.7	66.3	60.7	38.1	32.1
Middle	99.2	94.7	66.9	64.6	78.2	79.6	52.6	45.9
Richer	99.1	98.9	69.0	84.6	88.0	92.8	61.1	77.4
Richest	99.6	100.0	82.5	86.7	96.8	100.0	80.1	86.7
Total	98.5	60.6	64.6	42.3	75.0	50.0	51.0	25.9

Discussion

This study has estimated the particular and different combinations of indicators of access to WASH facilities among the ethnic minority population. Combining all three indicators of WASH, the indigenous population has almost halved access to WASH compared to the Bengalis. Globally, studies suggested that sanitation and water services coverage levels were low among Indigenous people [30–34]. For improved sanitation facilities not shared with others, the difference between Bengali and ethnic populations was 22.3%. One study using a Demographic and Health Survey of Nepal found that differences in access to WASH were primarily mediated by caste, religion, and ethnic identity, and the supply was lower for historically disadvantaged communities [31].

Again, the percentage of the population with handwashing facilities with soap and facilities was higher for Bengali than the ethnic minority population. A regional synthesis of South Asia described ethnic minorities as 'the forgotten millions' [32]. Ethnicity appeared to be a statistically significant predictor of every component of WASH in our study. An anthropological study of Nigeria indicated that cultural understanding of water affects the hygiene practices of ethnic minorities [33]. Studies showed that the indigenous population's access to water was in the worst situation and often caused conflicts among different groups [30, 35]. One systematic review of Europe's largest ethnic community concluded that Roma communities faced more challenges than the majority population concerning access to WASH [36]. Hence, ethnicity was a crucial factor in individuals' access to WASH.

Furthermore, the study's findings presented that ethnic identity was an essential predictor for access to WASH. At the same time, ethnicity has the highest predictive value on sanitation and the lowest for access to water. Though the UN set an ambitious goal of achieving access to adequate and equitable sanitation and hygiene for all and ending open defecation, achieving the goal is alarmingly off track [37–39]. UN identified marginalized and most vulnerable populations suffering from this inequality more than others, which is consistent with our findings [37]. In addition to education, multiple studies have found physical location, sex of the household head, aging, and religiosity to be associated with access to water, sanitation, and hygiene among ethnic minorities [31, 34].

Table 4 Correlates of ethnicity and WASH using multilevel logistic regression analyses

	Null model [a]	Crude model (cOR) [b]	Adjusted model (aOR) [c]
DV: Water			
Ethnicity			
Bengali	[RC]		
Other		0.13 (0.04, 0.39)***	0.13 (0.04, 0.44)***
Random Intercept	29.8 (25.8, 34.3)	25.6 (22.2, 29.4)	12.4 (8.5, 18.1)
ICC	0.90 (0.89, 0.91)	0.89 (0.87, 0.90)	0.79 (0.72, 0.84)
Model selection [d]			
AIC	15,455.2	13,021.4	11,386.2
BIC	15,464.3	13,039.5	11,476.4
DV: Sanitation			
Ethnicity			
Bengali	[RC]		
Other		0.47 (0.35, 0.62)***	0.55 (0.42, 0.72)***
Random Intercept	0.75 (0.68, 0.83)	0.74 (0.67, 0.81)	0.57 (0.51, 0.63)
ICC	0.19 (0.17, 0.20)	0.18 (0.17, 0.20)	0.15 (0.13, 0.16)
Model selection [d]			
AIC	81,209.8	80,953.4	70,115.6
BIC	81,218.8	80,971.4	70,296.1
DV: Handwashing			
Ethnicity			
Bengali	[RC]		
Other		0.41 (0.28, 0.61)***	0.69 (0.52, 0.92)*
Random Intercept	1.77 (1.64, 1.90)	1.74 (1.62, 1.87)	0.92 (0.85, 1.01)
ICC	0.35 (0.33, 0.37)	0.35 (0.33, 0.36)	0.21 (0.19, 0.22)
Model selection [d]			
AIC	73,960.5	73,537.4	61,983.6
BIC	73,969.5	73,555.6	62,164.1
DV: WASH			
Ethnicity			
Bengali	[RC]		
Other		0.39 (0.28, 0.54)***	0.55 (0.41, 0.73)***
Random Intercept	0.85 (0.77, 0.93)	0.83 (0.76, 0.91)	0.61 (0.55, 0.68)
ICC	0.20 (0.19, 0.22)	0.20 (0.19, 0.22)	0.16 (0.14, 0.17)
Model selection [d]			
AIC	84,690.4	84,353.9	70,555.0
BIC	84,699.4	84,371.9	70,735.4

DV Dependent variable, *cOR* Crude odds ratio, *aOR* Adjusted odds ratio

*** $= P \leq 0.001$

* $= P \leq 0.05$; *RC* Reference category

[a] Intercept only model

[b] Crude model with key independent variable

[c] Adjusted models with different control variables including place of residence, education, religion, and sex of household head, and number of rooms per household. For the Water model, household wealth scores were included. Division, the main material of the dwelling floor and exterior wall, and whether the household owned any bank account were also included in all other models. A 95% CI in the parenthesis

Inequalities in WASH had a distinctive pattern within ethnic communities, where people with low education had lower access to WASH. Education has been a crucial determinant of health [40, 41]. Bangladesh has observed a triadic connection between education, health, and life expectancy; a positive relationship exists between them [42]. Studies also presented how access to safe water had a two-way relationship with educational attainment. A study in Vietnam demonstrated that household heads with the highest academic levels are more likely to have

Table 5 A chronological policy review of the WASH facilities for the ethnic minority population

Name of the policy	Objectives of the policy	Existence of ethnic minority populations in the policy
Bangladesh National Health Policy 2011 [23]	The Bangladesh Health Policy 2011 was prepared with the vision of ensuring every citizen has the fundamental right to adequate healthcare as indicated in the constitution 15 [A]	Did not mention inequality among indigenous people
National Hygiene Promotion Strategy for Water Supply and Sanitation Sector in Bangladesh 2012 [27]	The national hygiene promotion strategy aims to promote sustainable use of improved water supply and sanitation infrastructures and create an enabling environment ensuring comprehensive hygiene promotion and practices to reduce water and sanitation-related diseases	It enforced the hill councils in Chittagong Hill Tracts (CHT) as responsible for planning and implementing WASH promotion activities, creating effective community partnerships, and effectively collaborating with NGOs/CBOs and private sector, business enterprises, and individuals
National Hygiene Promotion Strategy for Water Supply and Sanitation Sector in Bangladesh 2012 [27]	The objective of the national hygiene promotion strategy is to promote sustainable use of improved water supply and sanitation infrastructures and to create an enabling environment ensuring comprehensive hygiene promotion and practices to reduce water and sanitation-related diseases	It enforced the hill councils in Chittagong Hill Tracts (CHT) as responsible for planning and implementing WASH promotion activities, creating effective partnerships with communities, and effectively collaborating with NGOs/CBOs and private sector, business enterprises, and individuals
National Strategy for Water Supply and Sanitation 2014 [25]	To achieve the sector goal, uniform strategic guidelines must be provided to sector stakeholders, including government institutions, the private sector, and NGOs	There is no specific use of the word 'indigenous' or 'ethnic minority' in the strategy. They are used as a 'vulnerable' or 'hard-to-reach' group
4TH Health Nutrition and Population Sector Program, 2016 (HNPSP) [26]	To ensure that all citizens of Bangladesh enjoy health and well-being by expanding access to quality and equitable health care in a healthy environment	There are no specific actions or strategies for WASH, rather ethnic minority populations
8th Five-Year Plan (July 2020-June 2025) [28]	Bangladesh adopted a new Perspective Plan 2041 (PP2041) that defines a long-term vision of the Father of the Nation, Bangabandhu Sheikh Mujibur Rahman's dream of a poverty-free and prosperous Bangladesh. The Eighth Five Year Plan (8FYP) is the first in a series of 4 medium-term development plans aimed at implementing the PP2041	The policy mentioned implementing an ethnic minority health plan. However, no specific policy has been suggested for their access to WASH
National Strategy for Water Supply and Sanitation 2021 [24]	To provide uniform strategic guidelines to sector stakeholders, including government institutions, the private sector, and NGOs, to achieve the sector goal	There is no specific use of the word 'indigenous' or 'ethnic minority' in the strategy. They are used as a 'vulnerable' or 'hard-to-reach' group
Making Vision 2041 a Reality Prospective Plan of Bangladesh 2021–2041 [29]	The Perspective Plan 2021–2041 has been prepared to translate the policies and programs enshrined in Vision 2041 into development strategies. This document is the development vision of the government of a prosperous Bangladesh, a strategic description of the goals and objectives, and a roadmap for its implementation	There is no mention of 'ethnic minority' or 'indigenous' people in the policy

access to improved water sources among minorities [34]. Safe water at home decreased the time spent collecting water, allowing time for livelihoods, child care, school attendance, and play, especially for girls [38, 43, 44].

The picture was the same with the wealth quintile. Ethnic minority populations of higher wealth quintile have higher access to WASH than those of lower wealth quintile. Various studies worldwide presented how poverty was interconnected with access to WASH. Individuals with a lower level of wealth had lower access to WASH, and vice versa [45–47]. Moreover, poverty and formal education were also identified as a determinant of poor access to WASH among the ethnic minority population of the Roma community [36]. Additionally, the minority population of Vietnam showed an identical pattern to this study [34]. However, some studies provided a more crucial insight as they found that communities with the least access are not always the most economically disadvantaged [31]. The study suggests that focusing solely on economic indicators is not sufficient to realize the access of ethnic minorities [31].

The policy analysis portrays the high inequality towards the ethnic minority population in Bangladesh. After analyzing eight policies and plans in Bangladesh, this paper found that only two policies of the country have mentioned the 'ethnic minority' or 'Indigenous' group. Among them, only one policy has mentioned specific actions for their access to WASH. It indicates structural inequality towards them as structural or institutional racism or inequality. The ethnic minority of Bangladesh was not identified in its policy; instead, making policies and taking actions based on their health inequalities. Structural disparities were one of the most critical ways ethnic identity affected health [48].

Inequality towards WASH towards ethnic minority populations explicitly and implicitly affects them. Past research has suggested that structural inequality or racism has a demeaning effect on an individual's healthcare access and health outcomes [48, 49]. Again, previous research also shows that welfare state arrangements and social and economic policy may influence the distribution of health between social groups [50–55]. A growing number of studies concerning social epidemiology have focused on how political systems and priorities shape health inequalities and outcomes [51]. One study in Denmark indicated that years of life lost due to various noncommunicable diseases are lower than those lost due to social marginalization and social inequality [50]. Studies have also focused on how structural inequality affects health [54]. Therefore, focusing on the structural racism of WASH and its health outcome offers a concrete, feasible, and promising approach to advancing health equity and improving population health [56].

Strengths and limitations

This paper has some fascinating strengths as it is one of the pioneering studies to focus on the poor situation of WASH among ethnic minority populations and relate it with structural inequality. We analyzed the nationally representative data, which might increase the acceptability and generalization to similar socioeconomic settings. Moreover, this paper has also utilized Policy reviews that have uniquely focused on inequality. This policy analysis will not only help to understand the absence of a right of WASH for the Indigenous population but also will help to highlight their overall poor representation in policies in the country. Additionally, this paper has presented the WASH indicator of SDGs uniquely, both in separate and combined forms, providing a clear and holistic look at the situation. Finally, this paper's investigation of other covariates gives further scope for working on the SDG goals of WASH.

Despite such strengths, the study has some limitations. This study is based on household data from multiple indicator cluster survey [9]. There was a small sample size for the ethnic population, which may have underestimated or overestimated the WASH situation. This study has focused mainly on the structural inequality of the ethnic minority population. However, the reasons for unequal access to WASH may also be associated with other factors. The data of this study was extracted from the household data file. Therefore, we could not analyze male–female differences within the ethnic minority population, which could give a different picture as women suffer disproportionately from access and quality of WASH [38, 57–59].

Conclusions and recommendations

Ensuring the health and well-being of individuals based on equality is crucial to them. Access to quality water, sanitation, and hygiene can reduce illness and death from disease, leading to improved health, poverty reduction, and socioeconomic development [5, 38, 60, 61]. The world is already facing severe water scarcity at least one month a year, and it is projected to increase due to climate change. This current study has delineated the picture of inequalities in water, sanitation, and hygiene among the ethnic minority population in Bangladesh. Investments in infrastructure and sanitation facilities should be made to protect and restore water-related ecosystems and ensure hygiene education to attain universal access to water and sanitation by 2030. In this situation, the government and policymakers must focus on WASH among the ethnic minority population. Addressing their issues in policy and plans and properly implementing them should be the priority. The policies

of Bangladesh need to focus on the following specific issues to ensure equitable access to WASH services:

i. Policymakers should focus on finding out inequalities in access, which specific groups face, and the reason behind them.

ii. Policies should employ a collaborative approach involving multiple stakeholders.

iii. Participatory research programs should be guided to discover the reasons for unequal situations and which initiatives can apply to the community.

iv. The policies should consider the distinct, regionally specific social and cultural patterns that might affect the effectiveness of the policy.

v. Finally, behavior change communication should be taken into consideration during policymaking for capacity building among ethnic minorities population in the country.

Supplementary Information

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> Supplementary Material 1.

Authors' contributions
Md Zakiul Alam originated the idea and completed statistical analysis. Isna Haque Sheoti analyzed the policies and drafted the manuscript. Both read and finalized the manuscript.

Availability of data and materials
The MICS dataset used in this study is publicly available on the UNICEF website at https://mics.unicef.org/surveys.

Declarations

Ethics approval and consent to participate
It is based on secondary analysis data, and a previously published and publicly available multiple indicators cluster survey was approved by the technical committee of the Government of Bangladesh, led by the Bangladesh Bureau of Statistics (BBS) (9). An interview was conducted only if the respondent provided their informed consent.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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