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# Relationships Among Toilet Sharing, Water Source Locations, and Handwashing Places Without Observed Soap: A Cross-Sectional Study of the Richest Households in Bangladesh

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## ABSTRACT

**BACKGROUND:** A high percentage of the richest households in Bangladesh lack soap at their handwashing places, a problem that is typically considered to be one of the poor.

**OBJECTIVE:** We investigated toilet sharing practices, locations of water sources, and relevant sociodemographic factors associated with the observed handwashing places that lack soap in the richest (ninth wealth decile) households in Bangladesh.

**METHODS:** We used data from the 2017-18 Bangladesh Demographic and Health (BDHS) Survey.

Logistic regression technique was used to investigate how toilet sharing practices, water source locations, and different sociodemographic factors were associated with observed handwashing places without soap.

**RESULTS:** We found that 25.8% of the richest households were observed to have no soap at their handwashing places. Of these households, those that shared their toilets with another household were 4.6 times (95% CI 3.15–6.60) more likely to observe handwashing places without soap as compared with those that did not share their toilets. Further, the richest households were 4.2 times (95% CI 2.38–7.33) more likely to observe handwashing places without soap if they collected water from their own yard or plot, and 7.1 times (95% CI 3.61–13.97) more likely to observe handwashing places without soap if they collected water from elsewhere in comparison to the reference group that collected water from their own dwelling.

**CONCLUSION:** Sharing toilet with other households and location of main water source are associated with handwashing places without observed soap in the richest households in Bangladesh. These results can inform discussions of water availability and soap-handwashing-related policy and program development.

**KEYWORDS:** Water supply, sanitation, toilet facility, hygiene, soap, cross-sectional study

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## Background

Globally, 4.5 billion people lack safe sanitation facilities, while every year, 0.34 million children under 5 years of age die from diarrheal diseases resulting from poor sanitation and hygiene practices or unsafe drinking water.<sup>1</sup> The use of soap in handwashing is one of the most fundamental and preventative sanitation practices for controlling the spread of common communicable diseases (such as diarrhea) and other household health-related illnesses in resource-poor countries like Bangladesh.<sup>2,3</sup> Therefore, the presence of soap in handwashing places is a basic indicator of adequate adherence to handwashing behaviors.<sup>4</sup>

Poor households generally have more limited economic means of obtaining soap, which accounts for the low percentage of households that have observed soap at their handwashing places.<sup>5</sup> Similarly, the lack of physical access to soap is not uncommon in rural areas.<sup>6</sup> Nevertheless, high percentages of the richest households in some sub-Saharan African and South

Asian countries—such as Afghanistan, Malawi, and Nepal—were also observed to have handwashing places that lacked soap.<sup>7</sup> In the 2017-18 Bangladesh Demographic and Health Survey (BDHS), 25.8% of the ninth wealth decile (hereafter referred to as the richest households) were observed to be without soap at their handwashing places.<sup>8</sup> As this lack of soap is commonly recognized as a problem of poor households, it is important to know why a large percentage of the richest households do not have soap at their handwashing places in Bangladesh? In terms of financial ability, these households could easily purchase soap, suggesting there may be other factors that influence the prevalent lack of soap in handwashing places.

Previous studies have explored different demographic and socioeconomic factors (eg, gender, age, education, and regional characteristics), which are commonly used to explain a household's handwashing behaviors and soap use.<sup>9,10</sup> Several studies have additionally identified other possible factors, such as toilet-sharing and water-source selection.<sup>11-13</sup> Most of



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this literature has focused on the poorest or poor groups and households; however, analysis of the richest households' handwashing places and soap use is lacking and generally unknown. This has both household- and public health-related implications. This study addresses this knowledge gap by investigating toilet sharing practices, water source locations, and sociodemographic factors of handwashing places without observed soap in the richest households in Bangladesh.

## Methods

### *Study area and sample design*

We used a nationally representative cross-sectional survey dataset obtained from the 2017-18 BDHS of Bangladesh. Bangladesh is located in South Asia, and additional information can be found at <https://en.wikipedia.org/wiki/Bangladesh>. Using a 2-stage stratified random sampling technique, a total of 19 457 households were interviewed from 675 enumeration areas (250 in urban and 425 in rural areas) across Bangladesh. Initially, 30 household were selected from each cluster, and finally 7103 household interviews from urban areas and 12 345 household interviews from rural areas were recorded.<sup>8</sup>

### *Data collection*

We extracted household-level<sup>14</sup> data from a sample of 19 457 households with observed handwashing places. As our analysis focused on the richest households, we initially selected from the top or fifth wealth quintile (Q5) for both descriptive and statistical analyses. The Q5 consists of the top 2 (ninth and 10th) wealth deciles. According to the 2017-18 BDHS report, the fifth wealth quintile (ninth and 10th wealth deciles) generally refers to the richest household group, while the bottom quintile (first and second wealth deciles) refers to the poorest household group.<sup>8</sup> We found that 25.8% households in the ninth wealth decile (D9) and 5.4% households in the 10th wealth decile (D10) did not have observed soap at their handwashing places. An estimation of wealth index is presented on page 12 of the 2017-18 BDHS survey report.<sup>8</sup> As wealth deciles are more accurate than wealth quintiles for the analysis of socioeconomic inequality and behavior-related issues,<sup>15</sup> and D9 contains a higher percentage (25.8%) of households without observed soap than D10, we considered the households belonging to the D9 as richest households in the study instead of the top wealth quintile (Q5). D10 was excluded in our analysis due to it having a low percentage (5.4%) of households without observed soap.

### *Variable selection and descriptions*

The outcome variable of our study was a dummy variable indicating whether soap was observed in the handwashing places of the richest (ninth wealth decile: D9) households (=0) or not observed (=1). Similar studies conducted previously have suggested that toilet-sharing<sup>11,13,16,17</sup> and water source location<sup>12</sup> are

important considerations in understanding a household's sanitation and hygiene-related preventative health behaviors, along with sociodemographic characteristics. Therefore, the core variables of interest in our analysis were the location of the main water source (0 if from one's own dwelling, 1 if from one's own yard or plot, and 2 if from elsewhere) and the status of a household's toilet-sharing with other households (0 if no and 1 if yes).

We also included sociodemographic control variables such as gender of the head of household (0 if male and 1 if female), age of the head of household (0 if 15-34 years, 1 if 35-54 years, 2 if 55-74 years, and 3 if 75-94 years), the highest educational attainment in the household (0 if no education, 1 if primary, 2 if secondary, and 3 if higher than secondary), residential area (0 if urban and 1 if rural), and divisional area (0 if Barisal, 1 if Chittagong, 2 if Dhaka, 3 if Khulna, 4 if Rajshahi, 5 if Mymensingh, 6 Rangpur, and 7 if Sylhet).

### *Statistical analysis*

We analyzed the data of the richest decile (D9) of the wealth index, which is a proxy for household livelihood status.<sup>15</sup> Recommended BDHS sample weights were used in descriptive and regression analyses in order to account for the sampling design.<sup>8,18</sup> Descriptive statistics, including unweighted frequency and weighted percentages, were calculated to understand the distribution of outcome variables and related sociodemographic characteristics. We then employed a logistic regression model to estimate crude odds ratios (cORs) and adjusted odds ratios (aORs) with 95% confidence interval (CI) for households with handwashing places with unobserved soap in relation to toilet-sharing and water source location related variables, together with the gender and age of household heads, educational attainment, and place and region of residence. The level of statistical significance was specified as  $p \leq .01$ . We used Stata version 16 for both descriptive and statistical analyses.<sup>19</sup>

## Results

### *Results from descriptive statistics*

Of 19 457 households, 2016 households were classified as being in the ninth wealth decile and thus selected for analysis of the richest households. Of the 2016 richest households, 479 (25.8%, 95% CI 22.28-29.62) were observed as having handwashing places without soap (Table 1). However, this percentage was much higher among poorer groups. For example, an average of 89.7% among D1 (first or lowest wealth decile) households had no soap at their handwashing places. The majority (73.9%) of the richest households collected water from their own yards or plots, whereas only 16.7% collected water from their own dwellings (Table 2).

The demographic characteristics of the richest households also varied (Table 2). The mean age of the heads of household was  $45.2 \pm 13.7$  years, which was slightly lower than the national average ( $45.7 \pm 14.3$  years) in Bangladesh. About 83%

**Table 1.** Percentage of households' observed handwashing places with and without soap by wealth group (N = 19 457), 2017-18 BDHS.

HANDWASHING PLACES	Q1		Q2		Q3		Q4		Q5		Q1-5
	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D1-10
Total household	2102	1976	1930	1908	1833	1808	1827	1971	2016	2086	19457
Without soap (%)	89.7	88.8	82.5	79.4	72.2	61.4	57.3	48.4	25.8	5.4	61.2
With soap (%)	10.3	11.2	17.5	20.6	27.8	38.6	42.7	51.6	74.2	94.6	38.8

Abbreviations: D, wealth decile; Q, wealth quintile.

Higher quintile or decile represents the richest household. Estimated percentages were adjusted for household sample weight. Corresponding data description of wealth indices are available at [www.dhs.com](http://www.dhs.com).

of the surveyed households were led by a male. The majority (91.6%) had a head of household with secondary and higher educational attainment than primary education (7.5%). The majority resided in urban areas (57.4%) as compared to rural areas (42.6%). Of all 8 administrative divisions, the highest (39.2%) percentage of the richest households were in Dhaka.

### Results from regression analysis

The cORs calculated from our analysis indicated that water source location and toilet-sharing were significantly positively associated with having handwashing places without soap (column 3 of Table 2). Similarly, the adjusted odds ratios (aORs) indicated that toilet-sharing and water source location were positively associated with observed handwashing places without soap (column 4 of Table 2). The richest households that shared their toilets with other households were 4.6 times (95% CI 3.15-6.60) higher likelihood of having handwashing places without soap compared to those that did not share their toilets. If the richest households collected water from outside of their own dwellings (ie, elsewhere), they were 7.1 times (95% CI 3.61-13.97) higher likelihood of observing handwashing places without soap as compared with the reference group of households that collected water from their own dwellings. Similarly, the likelihood was also high for the "in own yard or plot" households (aOR: 4.2, 95% CI 2.39-7.31).

### Discussion

This study represents the first large-scale population-based study to investigate the richest households' non-preventative hygiene practice related to the absence of soap at their handwashing places in Bangladesh. Our study found that a high percentage of the richest (ninth wealth decile) households had no soap observed at their handwashing places. Other DHS data also suggests that the percentage of handwashing places without observed soap is high in other South Asian countries as well.<sup>7</sup> Among the richest households in Bangladesh, the prevalence of handwashing places without observed soap was associated with the sources of water collection from locations other than their own dwellings and the sharing of toilet facilities with other households.

The high prevalence of handwashing places lacking soap amongst the richest households may be explained by a few factors regarding data collection, access, and availability of soap, and the use of other unhealthy sanitary and hygiene practices. In this study, we can eliminate any considerable observation bias during data collection, as interviewers found designated handwashing places in 96% of households.<sup>8</sup> A possible explanation for the relatively high prevalence of unobserved soap is the single-visit data collection method, as households may have kept the soap in places other than their handwashing places.<sup>20</sup> It is possible that household members, including children and adults, carry soap to the handwashing places whenever it is needed; however, the existing data has not reported such behavioral information. Lack of access and availability of soap are not uncommon in rural and remote regions. It was unlikely that the richest households, even in rural areas, were not financially able to purchase soap for handwashing<sup>21</sup>; however, the limited availability<sup>22</sup> of soap may potentially explain the results (eg, soap was not available at neighboring shops, shops were not available near the household, or both).

The richest households that collected water from places other than their dwellings were more likely to observe handwashing places without soap. The reasons for this association have not been deeply explored; however, there are a few possibilities. Previous studies have suggested that the means used to access a water supply are correlated to the presence or absence of soap use during handwashing.<sup>23,24</sup> When households need to collect water from other dwellings, as in the previous case of toilet-sharing, they might keep soap at home instead and bring it with them when necessary. As stated in an earlier study, water access from the household's dwelling is important, not only to improve handwashing practices but also to enhance toilet use behaviors.<sup>13</sup>

Among the richest households, toilet-sharing with other households had a strong positive association with handwashing places being without soap. One possible explanation for this relationship might be households' unwillingness to share soap with other households and toilet users, given that the majority had open handwashing places. In rural areas, it is not uncommon for households to share a single toilet facility, and so members might keep soap inside their houses rather than at

**Table 2.** Distribution and odds ratios for richest households' observed handwashing places without soap in Bangladesh, 2017-18 BDHS.

VARIABLE	OBS. (%)	HANDWASHING PLACES WITHOUT SOAP	
		COR (95% CI)	AOR (95% CI)
Location of water source (n=1708)			
Own dwelling	300 (16.7)	Ref.	Ref.
Own yard/plot	1194 (73.9)	4.39*** (2.50-7.72)	4.18*** (2.38-7.33)
Elsewhere	214 (9.4)	8.64*** (4.54-16.46)	7.10*** (3.61-13.97)
Toilet sharing (n=2016)			
No	1497 (69.6)	Ref.	Ref.
Yes	519 (30.4)	5.58*** (4.06-7.67)	4.56*** (3.15-6.60)
Gender of HH head (n=2016)			
Male	1685 (83.0)	Ref.	Ref.
Female	331 (17.0)	0.99 (0.74-1.33)	1.20 (0.83-1.74)
Age group of HH head (n=2011)			
15-34y	449 (23.7)	Ref.	Ref.
35-54y	1013 (49.1)	0.78 (0.59-1.04)	0.91 (0.63-1.31)
55-74y	492 (24.1)	0.69 (0.47-1.00)	1.08 (0.67-1.74)
75-94y	57 (3.1)	0.90 (0.43-1.90)	1.49 (0.69-3.23)
Education (n=2016)			
No education	15 (0.9)	Ref.	Ref.
Primary	132 (7.5)	1.18 (0.43-3.28)	0.72 (0.14-3.59)
Secondary	781 (42.8)	0.72 (0.28-1.89)	0.40 (0.08-1.96)
Higher	1088 (48.8)	0.43 (0.17-1.23)	0.38 (0.08-1.82)
Place of residence (n=2016)			
Urban	1308 (57.4)	Ref.	Ref.
Rural	708 (42.6)	0.60** (0.43-0.84)	1.34 (0.94-1.93)
Region of residence (n=2016)			
Barisal	120 (2.5)	Ref.	Ref.
Chittagong	377 (21.5)	0.55 (0.30-1.01)	0.46 (0.24-0.90)
Dhaka	481 (39.2)	1.15 (0.61-2.14)	0.53 (0.26-1.09)
Khulna	271 (10.7)	0.87 (0.46-1.65)	0.73 (0.37-1.45)
Mymensingh	163 (5.3)	0.31** (0.15-0.66)	0.30 (0.12-0.75)
Rajshahi	208 (9.6)	0.30** (0.14-0.65)	0.26** (0.11-0.63)
Rangpur	167 (5.9)	0.19*** (0.08-0.43)	0.19*** (0.08-0.47)
Sylhet	229 (5.6)	0.62 (0.32-1.20)	0.78 (0.38-1.58)

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; cOR, crude odds ratio; HH, household; Obs, observation; Ref, reference category.

The dependent variable of both models was a binary variable taking the value of 1 if a richest household was observed their handwashing places without soap, otherwise 0. Observations were absolute numbers and estimated percentages were adjusted for household sample weight.

\*\* $p < .01$ . \*\*\* $p < .001$ .

their open handwashing places to prevent their soap from being used or stolen by others.<sup>13,21,25,26</sup> They may be responding to a “free riding” problem, which occurs when individuals enjoy the benefits of a good without contributing to its provision.<sup>27</sup> Rural households may also try to keep their soap safe from wild animals or jungle crows.<sup>28</sup> Constructing a private toilet could be one possible option to increase soap-keeping at households’ handwashing places.<sup>29</sup> Similarly, households in urban slums might also keep soap at home, as they used a common sanitary facility between several households.<sup>30</sup> In both cases, it could be possible that household members bring soap with them whenever they use the toilet and then return it home after washing their hands.

A few limitations of this study should be considered when interpreting these results. As survey data were collected through in-person interviews, it is possible that courtesy reporting, observational errors, or recall bias occurred. Additionally, the wealth index is a subjective proxy measure of households’ livelihood status, which is different than their economic or financial status. Therefore, it is possible that some households classified as the richest households in rural areas nonetheless still have financial constraints restricting them from using soap. Finally, in an analysis of a cross-sectional survey, the direction of causal relationships is unidentifiable. Despite the limitations, the findings of our study provide an important public health perspective the handwashing and hygiene behavior of Bangladesh’s richest households.

## Conclusion

Among South Asian countries, Bangladesh has the largest number of richest households with handwashing places with unobserved soap. We found that 25.8% of the ninth wealth decile—or richest households—were observed to have no soap at their handwashing places. Of these households, those that shared their toilets with another household were more likely to observe handwashing places without soap as compared to those that did not share their toilets. Additionally, these households were more likely to observe handwashing places without soap if they collected water from their own yard and elsewhere in comparison to the reference group that only collected water from their own dwelling. Our results can inform discussions of water availability and associated handwashing with soap-related policy and program development. These implications are distinct from previously published literature, which focus on health policies for poor demographics in Bangladesh.<sup>5</sup> Cross-examined and self-reported data along with observed data on handwashing and sanitation practice-related questions are essential to understand a household’s actual soap-keeping and usage. Enumerators, in this case, can ask soap keeping-related questions if soap is unobserved in designated handwashing places. Further longitudinal cohort studies are essential to identify the underlying reasons for why soap may be missing from the handwashing places of the richest households in Bangladesh.

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## Author Contributions

MGA conceived the idea, and MGA and FT planned the study and extracted data from 2017–18 BDHS. MGA performed statistical analysis, data interpretation, and wrote the first draft of the manuscript; MGA, FT, and MB contributed to writing and editing of the manuscript. All authors have approved the final draft of the manuscript.

## Ethical Approval/Patient Consent

Institutional Review Board (IRB) approval was not sought for this research because we used secondary, deidentified, country-level and publicly available 2017–18 BDHS data for both descriptive and statistical analyses. Written approval of data authorization was obtained from the DHS Program of ICF International (Fairfax, VA, USA). Informed consent was obtained from each respondent by the interviewers during the initial surveys. Details on ethical standards and data collection procedures can be found at <https://dhsprogram.com/pubs/pdf/FR311/FR311.pdf> and ethical review documentation can be found at <https://dhsprogram.com>.

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## Availability of Data

2017–18 BDHS data are publicly available at <https://dhsprogram.com/data/available-datasets.cfm>.

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