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RESEARCH ARTICLE

Improving WASH Status and Knowledge in the Coastal Areas of Bangladesh

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Abstract. This action research aimed to improve the status of water, sanitation, and hygiene (WASH) and related knowledge in the coastal Kalia and Lohagara upazilas of Narail district in Bangladesh. The project offered a total of 606 safe water options, 950 household latrines, 50 latrines for disabled individuals, five community latrines, and 20 sanitation blocks. Further, created WASH awareness through organizing courtyard meetings and folk song events, distributing awareness posters, WASH pouts, school routines, school WASH posters, installing billboards, and painting community walls. Female adults from 534 randomly selected households' were interviewed during the base-line survey and end-line survey. This study revealed that the rate of use of deep tube wells and hygienic latrine—that is, septic tanks and leak-free ring slab latrines—has increased substantially in both areas. Besides, perceptions about health problems associated with drinking arsenic-contaminated water improved considerably. Furthermore, knowledge about hygienic latrine improved by about 25 percentage points. Perception about hygienic hand washing and post-defecation hand washing (both hands with soap) practice improved but still needs to work on improving before eating both hand washing with soap practice. Therefore, suggesting further education and reinforcement on the importance of washing hands with soap before eating. This study also explored that knowledge about the mode of diarrheal transmission improved at the end of the intervention. However, to maintain favourable impressions and overcome difficulties in comprehending diarrhoea transmission mechanisms, particularly with regard to water, further education and focused interventions are needed.

1. Introduction

Water and sanitation are pressing issues in many countries around the world (Ari et al., 2024; Ifrat et al., 2024; Moniruzzaman & Siddik, 2013; Widyastuti & Haryono, 2017; Yunus et al., 2021). The UN General Assembly's recent statement on the rights to clean water to drink and improved sanitation further reinforced and confined the scope for changes that are unavoidable (GED, 2022). Approximately 1.6 billion people do not have access to safe drinking water at their premises, and about 2.8 billion do not have access to safe sanitation. Moreover, still about 1.9 billion people lack basic hand washing facilities (WHO & UNICEF, 2021). Inadequate access to safe drinking water, personal hygiene and improved latrine facilities has considerable effects on people's health, social well-being, and economic development (Chimankar, 2016; Hoque et al., 2015; Hutton & Chase, 2017; Rahman et al., 2015; Siddik & Moniruzzaman, 2013; Siddik et al., 2014). An estimated 0.8 million individuals in low-income and middle-income countries die annually as a direct result of inadequate access to WASH services, with poor sanitation accounting for around half of these deaths (WHO, 2022). In Bangladesh, overall drinking water coverage is adequate, and attaining the clean water provision of SDG is critical due to presence of arsenic exposure in groundwater. Furthermore, access to improved latrines has increased to 84.6% (BBS & UNICEF, 2019). Besides, hand washing facilities after defecation are available in roughly 58% of families (WHO & UNICEF, 2021). The coastal regions have greater challenges in maintaining water, sanitation, and sanitary standards since these areas are particularly susceptible to natural disasters including storm surges, cyclones, water logging, floods, and other related phenomena (Akhtar et al., 2018; Alam & Mukarrom, 2022; Hoque et al., 2022; Moniruzzaman & Siddik, 2012; Moniruzzaman et al., 2013; Moniruzzaman et al., 2014; Siddik et al., 2022; Siddik & Islam, 2024a, 2024b).

A number of scholars have been studied focusing water, sanitation and hygiene issues in Bangladesh. Amongst them, Islam et al. (2015) focused on water, sanitation, and hygiene in Lohagara Upazila, Chittagong. They found that the least proportion of lower-class households (12.5%) have been using sanitary latrines. Later, Hoque et al. (2018; 2023) emphasized on women member of union parishad led water, sanitation, and hygiene in Bangladesh. They identified that women members of union Parishad have successfully led the WASH activities in their respective areas. Furthermore, Hsan et al. (2019) studied the determinants of water, sanitation, and hygiene behaviour. They explored that more than half of the studied households' water, sanitation, and hygiene practices were unsafe. In addition, Yunus et al. (2021) focused on spatial distribution of water, sanitation, and hygiene components in Bangladesh. They found that about half of the households do not have access to all of these three facilities. However, Islam

et al (2021) studied WASH behaviour as a strategy in response to COVID-19 in Bangladesh. In recent, Ifrat et al. (2024) discovered that poor sanitation was linked to illnesses like diarrhoea that affected people's ability to work, learn, and take care of their homes. They recommended that both government and non-governmental organisations step up and take quick action to improve hygienic practices and sanitation facilities.

Drinking water supply in Narail district has been experiencing one of the worst arsenic contaminations since it's finding in 2002. Most of the tube-well water in Kalia and Lohagara upazilas (out of 3 upazilas in the district) and some in Narail Sadar was found with high arsenic contamination during 2002-2003 blanket arsenic screening under DPHE-UNICEF commissioned community based arsenic mitigation water supply project. Following that project, SHEWA-B, DART and coastal deep tube-well programme by GoB on safe drinking water supply and/or WASH were implemented in Narail district. But in 2009, the UNICEF water quality survey reported arsenic contaminated drinking water among half a million people in Narail. During 2012-2014, BWDB implemented safe drinking water supply sub-component under the south-west project in parts of Kalia and Narail Sadar upazilas found disproportionately spread risks for exposure to drinking low to high arsenic contaminated water (EPRC, 2014). This action-based study aimed to improve the status of water, sanitation and hygiene and related knowledge in the coastal two upazilas, namely Kalia and Lohagara upazila of Narail district in Bangladesh.

2. Methods

Study Area

The project was conducted in reported worst arsenic contaminated 10 unions in Narail district. Narail district includes an area of approximately 967.99 square kilometres. The district is located from 89°22'58" to 89°47'24" east longitude and 22°55'07" to 23°19'28" north latitude (Figure 1). It is located in the extended coastal areas of Bangladesh. It is divided into three upazilas: Narail sadar, Kalia, and Lohagara (Hoque et al., 2022, 2015). Out of the 3 upazilas, reported worst arsenic affected 10 unions were selected from Kalia and Lohagara upazilas. The arsenic contaminated unions were selected based on local "Sanitation, Hygiene Education and Water Supply in Bangladesh" (SHEWA-B) documents, census report, EPRC's reports and experience, and in consultation with DPHE (Table 1).

Interventions

Installation of Water Devices

The project staff preliminary selected water device installation sites based on arsenic screening results and local observations. Information about the preliminary sites was shared with the Chairman of the respective union Parishad and finalised with his concern. Then both of the kinds of safe water options: Bangladesh Arsenic Mitigation Water Supply Policy suggested alternative safe water options (such as deep tube-wells, different rainwater harvesters, multiple connection tube-wells, pond sand filters, dug wells, and pond sand filter devices) and GoB provisionally certified arsenic removal devices were discussed/promoted among the identified arsenic-affected cluster populations by the project staff. We installed the most requested device once we determined its technical feasibility. A total of 606 safe water options were installed or repaired in the respective suitable site in the project areas (Table 2). Out of the installed devices, 501 were DTWs due to their highest demand in technically feasible areas. Besides, solar energy-based two-pipe water supply systems were installed in

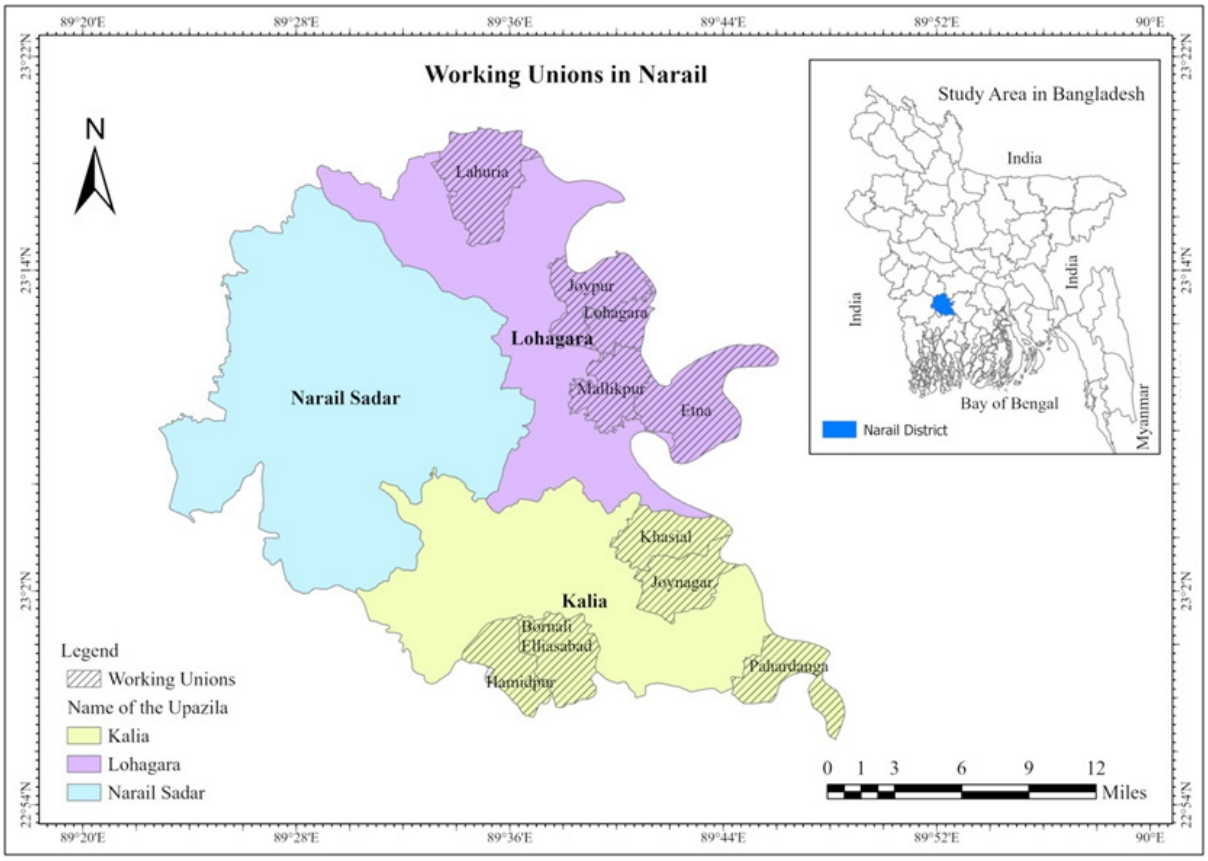

Figure 1. Working unions in Lohagara and Kalia upazila in Narail district.

Table 1. Demographic characteristics of the project areas.

Upazila	Unions	Population	Households
	Bornal Illiasabad	11516	2045
	Hamidpur	15174	3317
Kalia	Joynagar	14092	3151
	Khasial	14006	3206
	Pohardanga	12653	2715
	Mollickpur	15288	3491
	Lohagara	7571	1780
Lohagara	Etna	22276	4983
	Joypur	20119	4513
	Lahuria	25044	5953
2 upazilas	10 unions	157739	35154

Source: BBS (2014)

Table 2. Installed and repaired water devices in the project areas.

Variables	Kalia upazila	Lohagara upazila	Total
Installed water option at community:			
- DTW	208	284	492
- RWH (HHs)	36	25	61
- TW multiple connection	5	0	5
- Repaired TW	29	6	35
- Pipeline	2	0	2
Installed water option at school:			
- RWH (Community/School)	2	0	2
- DTW	9	0	9
Total	291	315	606

two villages in collaboration with Rahimafrooz. The villages were approx. 100% arsenic-contaminated but not suitable for DTW. Other installed water devices included household and community rainwater harvesters (RWHs), tube-well multiple connections, and repaired tube-wells.

Installation of Sanitation Systems

Access to and use of basic latrine facilities by all was promoted by asking the applicants for a water device to install sanitary latrines. In addition, limited community education about sanitation was done during the WASH awareness creation by the project. Table 3 shows the constructed sanitation systems in the project areas. The project constructed and distributed 950 latrines among the identified poorest of the poor households in the study areas. The distributed latrines included 5 rings, one slab, and 2 no. of tin for the roof at no cost. In addition, 50 numbers of commercially available steel chair latrines for disabled members were distributed among the identified poorest families. Five community latrines with two chambers were installed in different public places and markets also. Moreover, the project constructed a total of 20 sanitation blocks with running water supply in the study areas.

Creation of WASH Awareness

The awareness was created mainly about safe drinking water, problems associated to drink arsenic contaminated water, importance of hygienic latrine and washing of hands, and mode of diarrhoea transmission. Two rounds of courtyard meetings were conducted among about 20000 households in 90 Wards. Approximately 20 households in a neighbourhood were made a group. UP members and women UP members were invited to the meeting. The project collected available educational materials from the SHEWA-B project and implemented those during the session discussions. The materials included flash cards and a booklet showing good, bad and mixed situations. Also some awareness materials were developed by identifying and collecting earlier UNICEF produced materials, and reprinting the materials in consultation with C4D section of UNICEF.

About 18,000 posters, 800 WASH pout, 20,000 school routine and 3000 school WASH posters were printed and distributed on WASH massages. Ten bill-boards were installed in public places in 10 unions in consultation with the respective UP chairmen. The messages mainly promoted: use of green colour tube well water for cooking and drinking, use of red colour (>0.05 mg/l As concentration) tube well water for other purposes. The messages were developed by EPRC in consultation with UNICEF-Bangladesh. In addition, ten walls of Kalia and Lohagara upazila were painted with WASH messages. Moreover, thirty events of folk songs were arranged at community level in all unions. The events were arranged in bazaar and public places of the unions.

Data Collection and Analysis

Housewives/female adults from 534 numbers of randomly selected households' including households of 30 female local

Table 3. Constructed sanitation systems in the project areas.

Sanitation options	Kalia upazila	Lohagara upazila	Total
Household latrine	475	475	950
Latrine for disable person	25	25	50
Community latrine	0	5	5
Sanitation Block Construction with Running Water Source	10	10	20

Table 4. selected socio-demographic characteristics of the study populations

Variables	Kalia upazila		Lohagara upazila		Total	
	Base-line	End-line	Base-line	End-line	Base-line	End-line
N	268	267	266	267	534	534
Respondent's education (%)						
– No schooling	17.2	8.2	17.3	13.9	17.2	11.0
– ≤ 5 year	36.9	39.3	35.0	36.7	36.0	38.0
– > 5 year	45.9	52.4	47.7	49.4	46.8	50.9
Household head's profession (%)						
– Agriculture	42.5	46.1	42.5	37.5	42.5	41.8
– Business	27.2	22.1	16.9	13.9	22.1	18.0
– Service	15.3	17.6	23.3	17.2	19.3	17.4
– Day labour	8.2	7.5	14.7	22.8	11.4	15.2
– Others	6.7	6.7	2.6	8.6	4.7	7.7
Having child (up to 5 year) (%)	36.6	43.8	39.5	38.6	38.0	41.2

Table 5. Types of drinking water devices in the study areas.

Sources	Kalia upazila (%)		Lohagara upazila (%)		Total (%)	
	Base-line	End-line	Base-line	End-line	Base-line	End-line
DTW	46.6	71.2	28.2	64.8	37.5	68.0
STW Green	18.7	7.5	13.2	16.9	15.9	12.2
STW Red	32.8	16.5	12.8	17.2	22.8	16.9
STW not tested	0.4	0.4	45.5	0.4	22.7	0.4
Pond	0.7	0.4	0.0	0.0	0.4	0.2
PSF	0.7	0.7	0.4	0.0	0.6	0.4

government members were interviewed during the base-line survey. Same number of randomly selected households was surveyed during the end-line survey. We employed descriptive statistics to analyze the respondents' basic statistics of years of schooling, profession of their family heads, percent of households having children up to 5 years, and information related to water use for drinking purpose, perceptions about associations between drinking of arsenic contaminated water and health problems, sanitation systems, perceptions about washing of hands, and perception about mode of diarrhoea transmission.

3. Results

Socio-economic and Demographic Characteristics

Selected socio-demographic characteristics of the populations as observed during sampled base-line and end-line surveys are presented in the following Table 4. The socio-economic and demographic statistics are more or less similar for both of the surveys, i.e. base-line and end-line. For instance, about half of the women had less than 5 years of schooling and little more than one-third had up to 5 years children during the surveys. The main profession of household heads for approximately half of the households (42.5% in base-line and 41.8% in end-line survey) was agriculture and followed by business, service, day labour and others.

Water use for drinking purpose

The rate of use of deep tube wells (DTWs) increased 31 percentage point, almost 68% at end-line from about 38% at base-line survey. The increasing rate of use of DTWs was higher in Lohagara upazila than Kalia upazila. Lohagara upazila possessed about 37 percentage point improvement while Kalia upazila possessed about 25 percentage points. The rates of use of not screened shallow tube wells (STWs) for drinking purpose reduced from 23% base-line to less than 1 % at the end-line. This is because the project screened almost all the functional tube wells during the project period. But, surprisingly about 17% of the respondents were using red/ contaminated STWs after the screening and this rate was almost similar for both of the surveyed upazilas (Table 5).

Sanitation system

The table presents the reported types and usage rates of sanitation systems by surveyed households in Kalia and

Lohagara upazila at two distinct times—base-line and end-line. The proportion of households using hygienic latrine (here, septic tanks and ring slab latrines without leakage) has considerably increased in both Kalia upazila (from 35.7% at the base-line to 65.9% at the end-line) and Lohagara upazila (from 47.7% at the base-line to 65.6% at the end-line). This implies that initiatives to enhance sanitary systems have been effective. Furthermore, a significant improvement in hygiene behaviours is shown by the sharp decline in open defecation rates, which fell from 19.5% to 0.7% in Kalia and from 11.9% to 1.9% in Lohagara. This can slow the spread of illnesses, improving public health results. Nonetheless, for assuring that the system continues to be efficient and functioning, operation and maintenance are needed.

Perception Analysis

Drinking of arsenic contaminated water and health problems

This research highlights potential for ongoing education and intervention within the project area and offers insightful information about how people perceive and comprehend the health issues related to drinking water polluted with arsenic. Table 7 shows the perception about health problems associated with drinking arsenic-contaminated water. We considered only the first response of the respondent. The respondents reported about cancer, skin issues, stomach disease, kidney disease, problems with intelligence quotient (IQ), and so on. The findings indicate a noteworthy rise in the belief that drinking water contaminated with arsenic might cause cancer, especially in Kalia, where this belief increased from 0.8% to 13.5%. Lohagara has a rise as well, rising from 0.8% to 6.4%. Overall, this suggests increased knowledge or anxiety of the cancer risks linked to arsenic exposure. The belief that skin issues are caused by arsenic-contaminated water has decreased in both areas. This may indicate a change in knowledge or a decline in the number of cases of skin problems linked to arsenic that has been documented. Similarly, in Kalia, the belief that arsenic causes stomach issues either stayed mostly unchanged or slightly declined, whereas in Lohagara, it somewhat grew. Overall, this view hasn't changed substantially much throughout time. The belief that arsenic causes kidney problems has decreased in both areas, suggesting that knowledge about kidney problems may have improved or changed.

Hygienic latrine

Figure 2 shows the perception about hygienic latrine among the community dwellers in the study areas. From the base-line to the end-line evaluation, the results show an improvement in knowledge or mention of the practice of keeping faeces away from the environment in both areas. About 29% of respondents to the end-line survey, compared to just 3% in the base-line survey, indicated the confinement of excrement away from the environment as one of the key characteristics of a sanitary latrine. It seems that programs to raise awareness or educate people about the significance of properly handling waste have been successful, but more work is required to reach a greater number of people.

Hand Washing

Figure 3 illustrates the community's perceptions about hygienic hand washing and practicing washing both hands with soap before eating and after defecation in the project area. In the case of hygienic hand washing, the perspective in the Kalia upazila showed a large positive shift from 43.3% at the base-line to almost 88% at the end-line. Perception increased from 44.4% to 81.3% in the Lohagara upazila as well, exhibiting a similar upward trend but marginally lower compared to Kalia. Overall, perceptions of hygienic hand washing increased significantly in both areas, rising from 43.8% to 84.7%. The findings show that initiatives to increase public awareness of the necessity of washing one's hands hygienically have been successful across both areas, with notable improvements in perceived significance and probably in reality as well.

In Kalia, the percentage of people who wash both hands with soap before eating, dropped somewhat, from 48% to 42%.

Table 6. Reported types and rates of latrine used by the households.

Type of latrine used	Kalia upazila (%)		Lohagara upazila (%)		Total (%)	
	Base-line	End-line	Base-line	End-line	Base-line	End-line
Septic tank	12.7	16.1	10.5	12.4	11.9	14.2
Ring slab without leakage	23.0	49.8	37.2	53.2	28.3	51.5
Ring slab leakage and hole	44.8	33.3	40.4	32.6	43.2	33.0
Open defecation	19.5	0.7	11.9	1.9	16.6	1.3

Table 7. Perception about health problems associated with drinking of arsenic contaminated water (1st Response).

Arsenic associated health problems	Kalia upazila (%)		Lohagara upazila (%)		Total (%)	
	Base-line	End-line	Base-line	End-line	Base-line	End-line
Cancer	0.8	13.5	0.8	6.4	0.8	9.9
Skin Problem	65.9	54.7	77.6	56.6	71.8	55.6
Stomach Problem	10.6	9.7	1.2	3.7	5.9	6.7
Kidney Problem	1.2	0.4	0.8	1.5	1.0	0.9
I.Q	0.0	4.1	0.0	0.7	0.0	2.4
Only diseases	19.6	12.7	18.0	27.0	18.8	19.9
Others (incorrect)	2.0	4.9	1.6	4.1	1.8	4.5

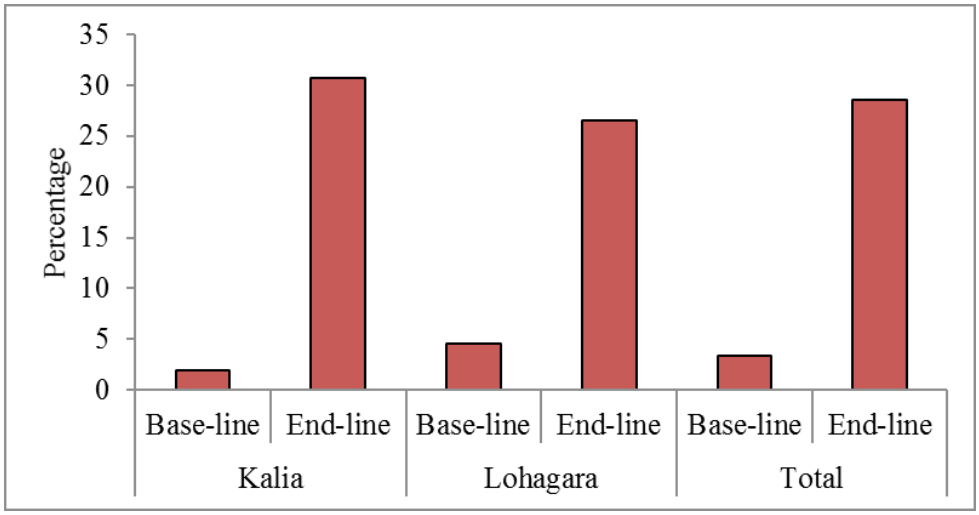

Figure 2. Knowledge about hygienic latrine (confinement of faeces).

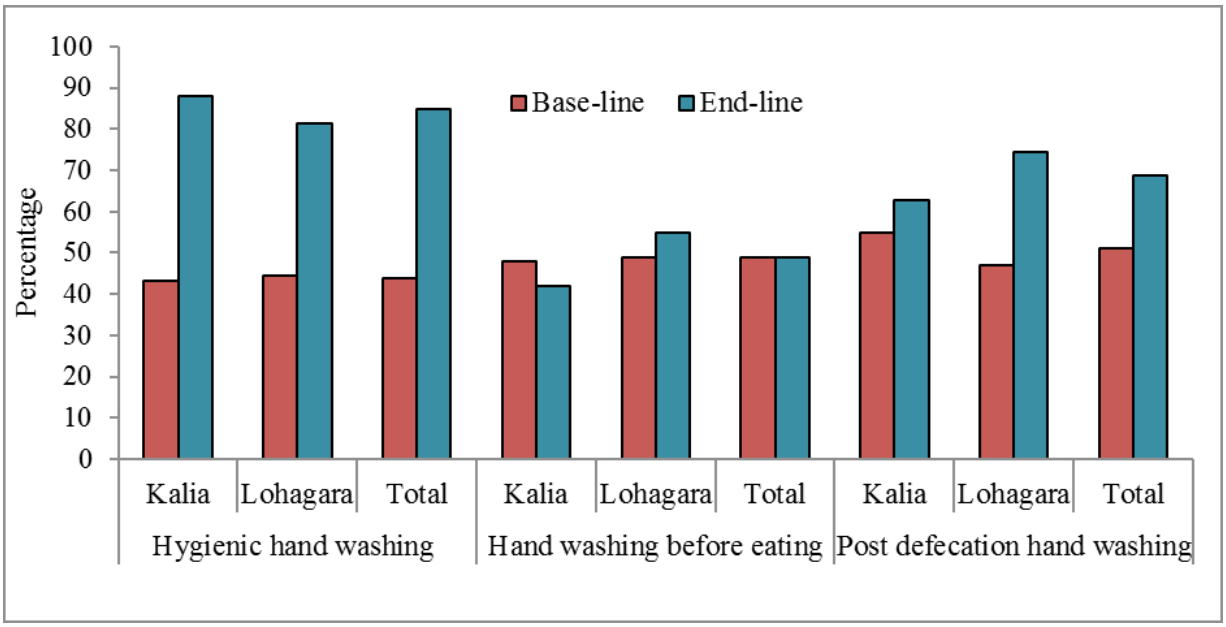

Figure 3. Perceptions about hygienic hand washing and practicing washing both hands with soap before eating and after defecation in the project area.

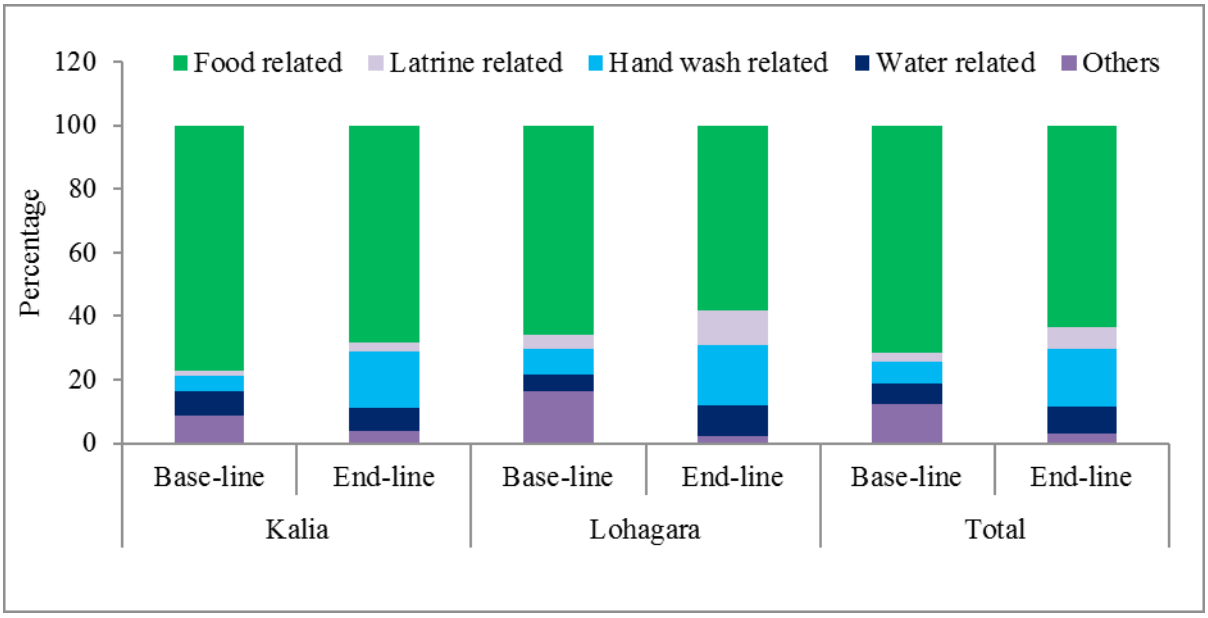

Figure 4. Reported mode of diarrhoea transmission in the study areas.

Conversely, such practice improved in Lohagara, from 49% to 55%. However, interestingly, the overall practice of washing both hands with soap before eating remained unchanged. This suggests that, in the study areas, particularly in Kalia, where there was a decline in perception, there is a need for additional teaching and reinforcement of the need to wash hands with soap before eating.

Post-defecation hand washing practice (both hands with soap) showed a significant improvement in both areas. In Kalia, the percentage of people who felt that washing their hands with soap after defecating was significant rose from 54.9% to 62.9%, suggesting that people are becoming more conscious of this practice. On the other hand, Lohagara had a more notable improvement, rising from 47.1% to 74.5%, which indicates a notable improvement in perception. Overall, perception increased significantly from the baseline (51%) to the end-line (68.7%), indicating that interventions or awareness efforts centred on this particular hygiene behaviour were beneficial.

Mode of diarrhoea transmission

The reported modalities of diarrhoeal disease spread in the research areas are illustrated in Figure 4. It primarily draws attention to diarrhoeal transmission linked to food, latrines, hand washing, and water. There has been noticeable improvement in perceptions of hand washing, latrines, and water-related diarrhoeal transmission in both communities. For example, total impression of diarrhoeal illness due to latrines improved to around 6.9% at the end-line from just 3% at the base-line. This may indicate a growing understanding of the value of good hygiene and the protective effects of latrines against diarrhoeal illnesses. Likewise, there was a belief that water plays a major role in the spread of diarrhoea, with varying degrees of variation across the two areas. Water was seen as a means of transmission more often in Lohagara than in Kalia, where it stayed more or less constant. From the base-line to the end-line evaluation, there was a notable rise in the impression of hand hygiene, or washing one's hands, as a means of transmission in both areas. This probably indicates that attempts to promote hand cleanliness as essential to avoiding diarrhoea were successful.

4. Discussion

This study found that about 68% of the households had been using deep tube wells as their improved water source at the end of the final survey in the study areas. A similar result was also found by other scholars in other parts of Bangladesh. Khanam et al. (2024) studied on another coastal upazila, and they found about 80% of households using improved drinking water sources. Deep tube wells were found to be a more familiar alternative improved water source in the arsenic-affected areas (Hoque et al., 2016). Results show significant improvements in sanitation use in Kalia and Lohagara upazila. In the case of using hygienic latrine, overall approximately 66% reported using septic tank and ring slab with no leakage latrine at the end-line survey in the study areas. But in order for these contributing improvements to last and continue, a thorough comprehension of the underlying causes, ongoing observation, and context-specific treatments are required. However, Khanam et al. (2024) found converse results in the coastal Satkhira district. They observed that about 66% of the households do not have access to improved latrine, like pit latrine having a water seal. Islam et al. (2015) found similar result with Khanam et al. (2024). They found about 87.5% of lower-class households do not have sanitary latrine. However, Hsan et al. (2019) found that about 50% of the households do not have such facility. Yunus et al. (2021) found that about 50% of the households do not have access to safe water, sanitation, and hygiene facilities. Current study also focused on people's perception on hygienic latrine. Approximately 29% in the end-line survey and 3% in the base-line survey mentioned confinement of faeces away from the environment in the characteristics of a hygienic latrine. Result indicates improved knowledge at the end-line survey—about 25 percentage points.

Chronic arsenic exposure is associated with skin lesions, skin cancer, liver cancer, cancer in other organs, and with neurological, respiratory, cardiovascular, multiple endocrines, IQ, developmental, and other effects (Naujokas et al., 2013). The reported knowledge about the health problems associated with drinking arsenic-contaminated water improved at the end-line survey. About 10% of the households reported carcinogenic effects as the main problem of having arsenic-contaminated water. Hoque et al. (2023) found similar results in Matlab Uttar upazila of Chandpur. At the end-line survey, about 22% of the respondents reported about the risk of cancer of consuming arsenic-contaminated water.

Hand cleanliness is one of the oldest and most effective behaviour for avoiding illness and transferring germs to others. Water alone can eliminate bacteria, but it is not as efficient as soap (Phillips et al., 2015). Overall, perceptions of hygienic hand washing increased significantly in both areas, rising from 43.8% at the baseline to 84.7% at the end-line survey. Besides, overall practice of washing both hands with soap after defecation improved from 51% to 68.7%. Similarly, Hoque et al. (2023) conducted an intervention-based study in coastal Matlab Uttar upazila, Bangladesh. But only 1% improved regarding practicing such hygienic hand washing behaviour at the end of the study. Diarrhoeal illnesses continue to be a serious danger to human health, accounting for a significant portion of global morbidity and death. It kills thousands of babies and kids in Bangladesh each year, causes malnutrition, and has major economic consequences. This study explored that knowledge about the mode of diarrheal transmission improved at the end of the intervention. It was found that about 18.2% of the respondents reported about hand wash related causes of diarrheal disease at the end-line survey, compared to only 6.4% at the base-line survey. Similarly, latrine-related causes were reported by about 6.9% at the end-line from only 3% at the base-line. And, water-related causes were reported by about 8.6% at the end-line from about 6.4% at the base-line. According to WHO (2022), typhoid, cholera, and dysentery may all spread across neighbourhoods with inadequate sanitation circumstances. Similarly, Nakagiri et al. (2016) found the usage of pit latrine as the main cause of diarrheal illness in Sub-Saharan Africa. Ifrat et al. (2024) found inadequate sanitation-induced diarrheal disease may further impact the community's education as well as professional and household work. Azupogo et al. (2019) found diarrheal disease is highly linked with poor water, sanitation, and hygiene facilities. Altered immune responses are consistent with the observation of increased risk for lower respiratory infections and diarrhoea in infants with increasing arsenic exposure (Rahman et al., 2011). There is no questioning that a lack of access to sanitary facilities and clean water causes diarrhoea. Over the past few decades, diarrhoea has also been linked to much lower than average rates of cognitive growth in children and babies (Mahmud & Mbuya, 2016).

5. Conclusions

This was an intervention-based study carried out in two upazilas of Narail district, coastal arsenic-prone areas in Bangladesh. We mainly provided interventions with suitable safe water and sanitation devices as well as different sorts of awareness programs in the study areas. In both areas, the rate of use of DTWs increased substantially. But, surprisingly, some households in both areas are yet using contaminated water from STWs. This indicates further intervention and awareness in the study area. However, the percentage of households using hygienic latrines—that is, septic tanks and leak-free ring slab latrines—has significantly improved. This suggests that efforts to improve hygienic systems have been successful. Perception about health problems associated with drinking arsenic-contaminated water improved in the study areas. The respondents reported about cancer, skin issues, stomach disease, kidney disease, problems with intelligence quotient (IQ), and so on. After the intervention, knowledge about hygienic latrine improved by about 25 percentage points, indicating an effective awareness programs in the study areas. But still, a large portion of dwellers' knowledge is yet to improve—about 71%—which needs further educational programs. Both areas have seen improvements in attitudes as a result of successful campaigns to encourage hand washing after defecation, with Lohagara seeing especially notable improvements. However, further education and reinforcement on the importance of washing hands with soap before eating are required. Perceptions about the overall modes of diarrheal transmission have improved, suggesting that education initiatives or interventions were successful. However, to maintain favourable impressions and overcome difficulties in comprehending diarrhoea transmission mechanisms, particularly with regard to water, ongoing education and focused interventions are needed.

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