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Effectiveness of Mass Media Campaigns to Improve Handwashing-Related Behavior, Knowledge, and Practices in Rural Bangladesh

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Abstract. Water, sanitation, and handwashing interventions that use intensive interpersonal communication improve targeted behaviors, but are expensive at scale. Mass media is an alternative that could reach more people at lower cost but has rarely been rigorously evaluated. We assessed the effectiveness of a mass media campaign in improving handwashing knowledge and practices in rural Bangladesh. We conducted a cross-sectional assessment before the campaign among 8,947 households and again after 4 months of the campaign among 8,400 different households in the same areas. Trained enumerators conducted spot checks of water, sanitation, and hygiene facilities, and recorded reported knowledge and practices. We compared these outcomes after versus before the campaign using generalized linear models with robust standard errors. After the media campaign, caregivers were more likely to recall ≥ 3 messages regarding handwashing (prevalence ratio [PR] = 1.44, 1.34–1.55), sanitation (PR = 1.45, 1.35–1.55), and safe water (PR = 1.17, 1.08–1.26). After the campaign, the prevalence of using soap and water during handwashing demonstrations was higher among caregivers (PR = 1.15, 1.12–1.19) and children (PR = 1.31, 1.22–1.41). Hands were more commonly observed to be visibly clean among caregivers (PR = 1.14, 1.07–1.20) and children (PR = 1.13, 1.05–1.21). Soap and water was more commonly observed in handwashing stations near latrines (PR = 1.12, 1.06–1.19) and in cooking/eating places (PR = 1.09, 1.01–1.18). Our findings indicate improved handwashing knowledge and behaviors following a mass media campaign. This promising approach can be deployed to improve water, sanitation, and hygiene practices at scale and should be evaluated in other contexts.

INTRODUCTION

Infectious diseases remain an important health problem for most low- and middle-income countries, including Bangladesh. Pathogens that can cause diarrhea and respiratory infections can be transmitted through contaminated hands, objects, foods, or water supplies.[1–3] Simple measures like washing both hands with soap at key times can reduce 50% of diarrheal episodes by interrupting pathogen transmission.[4] Handwashing with soap prevents about 30–47% of child diarrhea[4,5] and 23% of respiratory infections.[6,7] Hand hygiene is a critical strategy against the transmission of COVID-19 infection.[8] Similarly, during the outbreak of SARS, observational evidence suggests that handwashing reduced viral spread.[9] Frequent handwashing would reduce the risk of viral transmission by 55%.[6,9] To prevent virus transmission, the U.S. CDC recommends frequent handwashing with soap and water for 20 seconds.[10]

Despite its protective effect, the practice of handwashing with soap remains suboptimal. In low- and middle-income countries, only 3–34% of people routinely wash their hands with soap at critical times,[11] and hands were washed with soap on only about 5–15% of key occasions such as after the toilet or after cleaning up a child.[12] Not having a specific location with soap and water available, especially after leaving the toilet, is a common major environmental constraint to optimal handwashing.[13] In addition, local culture, beliefs, traditions, and norms are some social factors that also influence caregiver handwashing behavior that are promulgated through social structures such as the family, neighbors, local social organizations, government health workers, schools, and mass media.[13] Although the benefits of handwashing with soap are clear, encouraging people to adopt a habit of regular handwashing has proved difficult.

Studies that have achieved high adherence to handwashing have typically implemented sustained daily to fortnightly contact between promoters and participants[14–17] that is costly and not necessarily scalable.[18] In an assessment of the Sanitation, Hygiene Education, and Water Supply in Bangladesh Program (SHEWA-B), a large-scale program to improve water, sanitation, and hygiene in Bangladesh through in-person promotion, approximately half of respondents did not recall ever meeting a SHEWA-B hygiene promoter.[18] Mass media is an alternative that could reach more people at lower cost, but it has not been rigorously evaluated. Media campaigns have been used to alter various health behaviors, including tobacco, alcohol, and illicit drug use; cancer screening and prevention; sexual behaviors; child care; and many other health-related issues. The outcomes of these efforts have been mixed, although there have been some notable successes.[19] Evaluations of mass media campaigns to discourage dangerous alcohol consumption,[20] to reduce exposure to arsenic contaminated water in Bangladesh,[21] to promote vaccination in Zambia,[22] and to prevent obesity[23] concluded that these campaigns enhanced knowledge about the promoted topic, but did not affect behavior.

UNICEF along with the government of Bangladesh implemented the SHEWA-B program in 2007, which was among the largest intensive water, sanitation, and hygiene quality improvement programs ever attempted in a low-income country. Intervention methods included dissemination of key hygiene

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messages among targeted population through household visits, courtyard sessions, tea stall sessions, fairs, and interactive popular theaters. The program was designed to make improvements in hygiene practices, particularly handwashing with soap. At a smaller scale, the program also targeted provision of arsenic-safe water and improved sanitation facilities.

The International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b) conducted a health impact evaluation of the SHEWA-B intervention. This assessment included a baseline evaluation of SHEWA-B in 2007 and a midline evaluation in 2009 that compared the extent of behavior change with prespecified targets. Changes were apparent in only a handful of the outcome indicators; modest changes in observed handwashing after fecal contact became evident as early as 1 year after implementation, but there was little additional change in the second year.[24] After 2 years, participants washed their hands with soap < 3% of the time around food-related events in both intervention and control households, washing both hands with soap or ash after cleaning a child's anus increased from 22% to 36%, and no access to a latrine decreased from 10% to 6.8%; there was no difference in diarrhea or respiratory disease in children younger than 5 years living in households that had received the intervention compared with control households.[24]

Although the failure to achieve midline targets was disappointing, these findings provided an unambiguous signal that the program would need to change to achieve its goals. In response, UNICEF and the Department of Public Health Engineering of the government of Bangladesh implemented substantial changes in an effort to improve the effectiveness of the SHEWA-B interventions. These improvements included a more targeted and specific behavior change strategy to improve the frequency of handwashing with soap, as well as some messaging encouraging use of arsenic-free safe water for both cooking and drinking, and use of sanitary latrines for defecation and to discard child feces. Therefore, they reduced the number of key messages that were delivered. Another major change was that mass media was used to deliver the messages rather than in-person promotion. In this study, we assess the effectiveness of the mass media campaign in improving handwashing-related behavior, knowledge, and practices in rural Bangladesh.

METHODS

Mass media campaign. Sanitation, Hygiene Education, and Water Supply in Bangladesh Program was a 5-year project implemented by the government of Bangladesh and UNICEF. The program aimed to provide handwashing messaging to approximately 19 million people living in urban and rural areas of Bangladesh, as well as delivered information on safe water and sanitation at a smaller scale. The program focused on 58 subdistricts (upazilas) of 16 districts and 300 para centers from eight subdistricts in the three Chittagong Hill Tract districts. UNICEF implemented a mass media campaign in two phases: November 2011 to February 2012 and again from October to December 2012. As part of this campaign, television and radio spots were used to convey SHEWA-B messages (Figure 1). From November 2011 to February 2012, 1,814 radio spots and 458 television spots were aired for handwashing and sanitation. These messages were again aired with the addition of safe water messages from October to December 2012 (Figure 1). There were a total of 3,381 radio broadcasts and 776 television broadcasts during the campaign.

Hand washing (with soap) messages		Sanitation Messages	Safe water messages (arsenic only)
AUDIO/Radio coverage ---- • After defecation • After cleaning a child who defecated • Before feeding a child • Before food preparation	VIDEO/Television coverage ---- • After defecation • After cleaning a child who defecated • Before feeding a child • Before food preparation • Before touching and caring of babies	• Use sanitary latrine for defecation • Discard child feces into latrine • Clean feces from latrine slab, pan and floor with water, which helps reduce flies and bad smell	• Encouraged arsenic testing of tube well water • Use arsenic free safe water for both cooking and drinking • Arsenic contaminated water is harmful for the baby and pregnant mother, and other family members

FIGURE 1. Summary of audio and video promotion messages, derived from watching/listening to television and radio spots.

Study setting and design. We conducted a cross-sectional study from July 2011 through May 2012 to assess the subdistrict level frequency of health behavior outcomes across SHEWA-B intervention subdistricts to measure the quality of intervention implementation.[18] We leveraged this large cross-sectional study to evaluate the SHEWA-B mass media campaign. We classified the data from the first 15 evaluated subdistricts (Figure 2) collected between July and September 2011 just before the mass media campaign as the first round (before mass media campaign). Field-workers conducted a second round of cross-sectional data collection between July and October 2012 after the mass media campaign from the same 15 subdistricts (Figure 3). Because the mass media campaign was broadcast throughout the country, there was no opportunity to enroll a contemporaneous unexposed control group.

Sampling approach. For the first round of data collection, field research assistants implemented a cross-sectional survey with a sample large enough to detect differences in implementation between upazilas. The survey was completed among intervention communities in 60 upazilas, including 30 clusters per upazila and 28 households per cluster, yielding a sample of approximately 277,200 people. Data collection was carried out on a rolling basis, and the number of clusters included in each union was determined using probability proportionate to size sampling. UNICEF subdistricts and union officers kept lists of the villages in each union where SHEWA-B was operating. These lists were reviewed for each union, and the number of villages assigned to each union by probability proportionate sampling was randomly selected from the list. Villages that were previously sampled for SHEWA-B evaluations were excluded from this list. For the second round of data collection, the field team interviewed residents from the same 15 SHEWA-B intervention subdistricts that were evaluated pre-intervention. From each subdistrict sampled, approximately 20 clusters were identified, and then field staff interviewed 28 households per cluster.

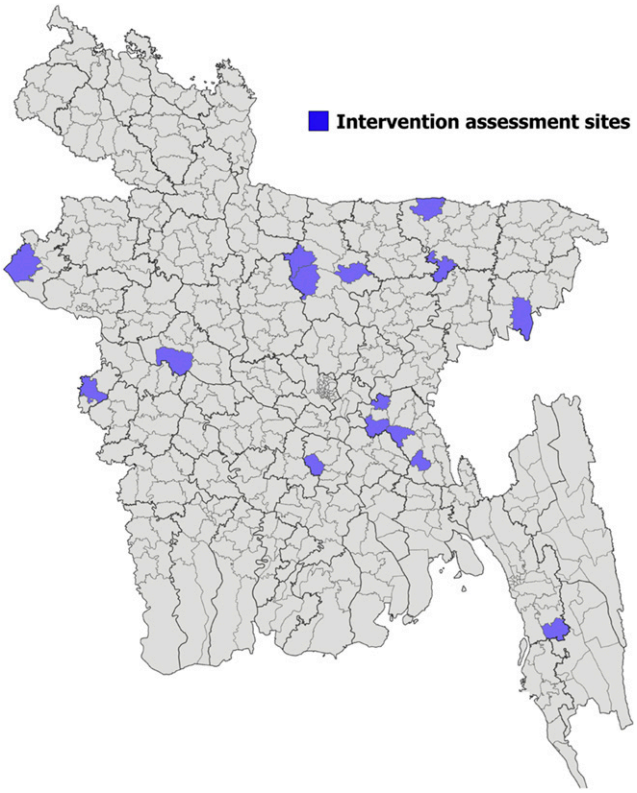

FIGURE 2. Pre- and post-intervention subdistricts of Sanitation, Hygiene Education, and Water Supply in Bangladesh Program mass media campaign study. This figure appears in color at www.ajtmh.org.

In sampled villages, field-workers worked with village residents to identify the central point of the village. Households were considered eligible if at least one child younger than 5 years lived in the household. The study team identified the first eligible household closest to the selected starting point and invited them to participate in the evaluation. Once a household was enrolled, field-workers skipped the next two closest households, and then looked for the next closest eligible household. The process of skipping the two closest households and then seeking to enroll additional households was repeated until the sample from the selected starting point was enrolled. If the next closest household had the same intervention assignment (i.e., intervention or control) but was outside of the union, then the union line was crossed, and the household was enrolled. If the next closest household had a different intervention assignment, then it was ineligible, and the team located the next closest eligible household within the union.

Data collection. Trained field staff from the icddr,b used a pretested structured questionnaire to record reported SHEWA-B messages recalled by the caregiver regarding hygiene practices, water treatment, and latrine use. Field staff assessed handwashing practices by observing handwashing demonstrations and examining the availability of handwashing facilities and cleansing agents such as water and soap in the handwashing station. For the handwashing demonstration, caregivers and children aged 3–5 years were asked to show how they usually wash their hands after defecation. We defined a handwashing station as the location where the respondent reports that she usually washes her hands after defecation and before cooking or eating or feeding child. Field-workers also examined hands of caregiver and children aged < 5 years (fingernails, finger pads, and palms of each hand) for visible dirt using a three-point scale (visible dirt particles, unclean appearance, and clean). Visible dirt particles were defined as specks of dirt, mud, soil, ash, or any other visible material; unclean appearance was defined as no visible dirt particles but general uncleanliness; and clean was defined as would appear after someone washes hands or takes a bath. In addition, the field staff conducted spot checks to observe household hygiene conditions, drinking water storage containers, sanitation facilities, and latrine cleanliness. We defined stored water in a covered container if all the containers found in a house are fully covered. We classified improved and unimproved latrines using WHO/UNICEF Joint Monitoring Programme definition.[25] Field-workers classified a latrine that on observation had no visible feces on the latrine slab or floor as clean.

Data analysis. We compared the prevalence of knowledge and practice outcomes among respondents from households visited before the mass media intervention with those visited after the mass media intervention. We compared the following outcomes before and after the mass media campaign: 1) household and caregiver characteristics and WASH facilities; 2) beneficiary health behavior knowledge about water, sanitation, and hygiene; and 3) beneficiary health behavior practices about water, sanitation, and hygiene. We estimated unadjusted and adjusted prevalence ratios (PRs) comparing prevalence after versus before the intervention using generalized linear models with a binomial family and log link function, with robust standard errors to account for the clustering at the village level. In multivariable models, we included all covariates that were associated with the dependent variable at the $P < 0.2$ level in bivariate analyses. We used principal component analysis to calculate a household wealth index using assets and housing materials.[26,27] This index was used as a covariate representing household wealth.

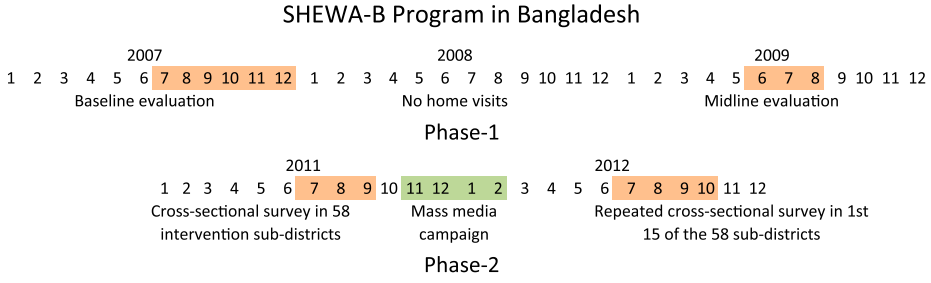

FIGURE 3. Study time line. This figure appears in color at www.ajtmh.org.

Ethical considerations. All households provided written informed consent. The protocol was reviewed and approved by human subjects review committees at icddr,b (PR-11021) and by an institutional review board at the U.S. CDC.

RESULTS

Household characteristics. Households enrolled before the mass media campaign were similar to households enrolled after the mass media campaign (Table 1). In both populations, 25% (before campaign, *n* = 2,250, and after campaign, *n* = 2,081) of mothers had no formal education, whereas 37% (*n* = 3,318) of fathers interviewed before the campaign had no formal education compared with 39% (*n* = 3,317) of fathers interviewed after the campaign. Participants enrolled before and after the campaign had similar occupations, were equally likely to own their own homes, and had similar rankings by wealth index (Table 1). About 73% (*n* = 6,546) and 70% (*n* = 5,854) of households had shallow tube wells as a source of drinking water before and after the mass media campaign (Table 1). The most frequently observed drinking water storage containers were *kalash* (a lidless aluminum vessel with a narrow mouth but a wide brim that is typically covered using a plate), 83% (*n* = 5,040) and 88% (*n* = 2,826) before and after the campaign, respectively. About 4% (*n* = 398) of households reported open defecation before the mass media campaign compared with 6% (*n* = 532) of households after the campaign (Table 1).

Association between mass media campaign and health behaviors. Most of the households recalled at least one massage regarding handwashing both before and after the

TABLE 1
Sociodemographic characteristics of respondents and households before and after mass media campaign in rural Bangladesh

	Before mass media campaign (*N* = 8,947)		After mass media campaign (*N* = 8,400)	
	% (*n*)	*N*	*N*	% (*n*)
Male household head	95 (8,497)	8,400	8,947	98 (8,240)
Mean age of the respondent (SD)	27 (7)	8,400	8,947	28 (7)
Education of mother of the youngest child				
No education	25 (2,250)	8,400	8,947	25 (2,081)
Primary education	36 (3,204)	8,400	8,947	35 (2,902)
Secondary and above education	39 (3,493)	8,400	8,947	41 (3,417)
Education of father of the youngest child				
No education	37 (3,318)	8,400	8,947	39 (3,317)
Primary education	31 (2,754)	8,400	8,947	29 (2,440)
Secondary and above education	32 (2,875)	8,400	8,947	31 (2,643)
Occupation of father of the youngest child				
Agri and non-agri labor	20 (1,779)	8,400	8,947	19 (1,600)
Farmer/cultivator/landlord/poultry/ livestock/rearer/homemaker	20 (1,802)	8,400	8,947	22 (1,875)
Service	9 (764)	8,400	8,947	9 (737)
Skilled worker/profession	7 (631)	8,400	8,947	7 (595)
Rickshaw/van puller	10 (933)	8,400	8,947	11 (891)
Traders/business occupation	18 (1,638)	8,400	8,947	18 (1,520)
Staying abroad	9 (785)	8,400	8,947	9 (724)
Ownership of house				
Self-owned	95 (8,496)	8,400	8,947	94 (7,906)
Rental	1 (90)	8,400	8,947	1 (109)
Government land	1 (81)	8,400	8,947	1 (90)
Owned by a landlord	1 (132)	8,400	8,947	1 (117)
Mean number of household rooms (SD)	2.12 (1.27)	8,400	8,930	2.10 (1.27)
Wealth index*				
Low	34 (3,005)	8,400	8,947	33 (2,778)
Medium	33 (2,927)	8,400	8,947	34 (2,860)
High	33 (3,015)	8,400	8,947	33 (2,762)
Main fuel used for cooking				
Crop residue/grass/dung cakes	64 (5,737)	8,400	8,928	70 (5,864)
Wood	34 (3,106)	8,400	8,928	28 (2,371)
Liquid gas/biogas	0.50 (45)	8,400	8,928	1.4 (119)
Coal/coke/lignite/charcoal	0.45 (40)	8,400	8,928	0.54 (45)
Source of drinking water				
Shallow tube well	73 (6,546)	8,400	8,939	70 (5,854)
Deep tube well	22 (1,964)	8,400	8,939	24 (1,998)
Household alone own drinking water point	30 (2,650)	8,400	8,938	32 (2,680)
Primary drinking water storage container†				
Kalash (narrow-mouthed container)‡	83 (5,040)	3,221	6,049	88 (2,826)
Pitcher (wide-mouthed container)	47 (2,825)	3,221	6,049	32 (1,037)
Type of toilet facility the household members usually used				
Open defecation	4 (398)	8,400	8,933	6 (532)
Unimproved latrine§	59 (5,292)	8,400	8,933	53 (4,454)
Improved latrine§	36 (3,243)	8,400	8,933	41 (3,413)

* Wealth index calculated as tertiles from principal component analysis of household assets.
† Multiple drinking water storage containers were reported by some households this is why these proportions sum to greater than 100%.
‡ *Kalash* is a lidless aluminum vessel with a narrow mouth but a wide brim that is typically covered using a plate.
§ Defined using WHO/UNICEF Joint Monitoring Programme definition for improved and unimproved latrine.[25]

campaign (Table 2). Before the mass media campaign, 40% (n = 3,542) of participants recalled at least three messages on handwashing, 15% (n = 1,306) on safe water, and 32% (2,891) on sanitation, whereas after the campaign, 57% (n = 4,797) of participants recalled at least three messages on handwashing, 19% (n = 1,592) on safe water, and 50% (n = 4,198) on sanitation (Table 2). In bivariate analysis, the prevalence of households recalling at least one message was significantly higher after the campaign for handwashing (PR = 1.64, 1.45–1.84), safe water (1.29, 1.17–1.42), and latrine use and feces disposal (PR = 1.68, 1.49–1.89). The prevalence of households recalling at least three messages was significantly higher as well, suggesting improvement of caregiver's knowledge regarding target behaviors messages (Table 2).

Observed health behaviors also improved after the mass media campaign in bivariate analyses. During handwashing demonstration, we found that before the mass media campaign, 67% (n = 5,807) of caregiver and 53% (n = 845) of children aged 3–5 years used soap and water, whereas after mass media campaign, 79% (n = 6,207) of caregiver and 69% (n = 613) of children aged 3–5 years used soap and water (Table 3). In bivariate analysis, we found that using soap and water by caregiver was 1.17 (CI: 1.13, 1.21) times higher and by children aged 3–5 years was 1.30 (CI: 1.19, 1.40) times higher among household after mass media campaign than before mass media campaign (Table 3). Before mass media campaign, the prevalence of no visible dirt on hands of caregivers and children aged 3–5 years was 41% (n = 3,616) and 27% (n = 2,264), whereas after mass media campaign, the prevalence was 47% (n = 3,889) for caregiver and 30% (2,380) for children aged 3–5 years (Table 3). In bivariate analysis, the prevalence of no visible dirt on hands of caregivers (PR = 1.14, 1.07–1.20) and children aged 3–5 years (PR = 1.13, 1.05–1.21) was more common after mass media campaign than before mass media campaign (Table 3).

There were also significant improvements in the prevalence of a convenient handwashing station available with water and soap usually used after defecation (PR = 1.19, 1.06–1.33) and before cooking or eating or feeding child (PR = 1.12, 1.03–1.22) (Table 4). After the mass media campaign, a higher percentage of households had covered stored drinking water container (PR = 1.34, 1.21–1.48) and access to improved latrine (PR = 1.10, 1.03–1.19) (Table 4). The PRs estimated in the bivariate and multivariable analysis were similar.

DISCUSSION

Following the mass media campaign, about half of the households recalled at least three messages regarding handwashing, latrine use, and feces disposal, and one-fifth of the households recalled safe water messages; most of the households recalled at least one message. The recall of messages was significantly improved compared with before the campaign, suggesting that mass media can successfully change knowledge of targeted behavioral messages. We also found improvements in observed behavior indicators, including visibly cleaner child and caregiver hands, availability of water and soap for handwashing, covered drinking water storage containers, and presence of improved latrines. Although increased knowledge does not necessarily translate into target practices,[28] these results demonstrate improvements in both knowledge and practices following the mass media campaign.

Although measuring handwashing behavior is difficult, the simplest and cheapest method for measuring handwashing with soap is to ask respondents to self-report their behavior. However, respondents tend to overreport handwashing because of courtesy bias,[29] especially if they know that handwashing with soap is recommended. In our study, we measured the handwashing practice by observing handwashing demonstration, visible hand cleanliness, and availability of handwashing facilities and cleansing agents. We chose not to use structured observation, because of expense and our prior work in rural Bangladesh demonstrating that the presence of an observer substantially alters handwashing behavior.[30]

Behavior change is complex, and the evidence for a beneficial effect of traditional hygiene education in low- and middle-income countries is limited.[31,32] Our findings of improved recall and behaviors following the mass media campaign contrast with our previous findings from the large-scale in-person SHEWA-B campaign to promote water, sanitation, and hygiene-related behaviors in these areas during the first 18 months of the intervention. Approximately half of the respondents did not recall ever meeting a SHEWA-B hygiene promoter.[18] Moreover, recall of key messages by hygiene promoters was low,[18] suggesting a poorly implemented program. Indeed, 18 months of SHEWA-B intervention did not substantially improve targeted behaviors.[24] Moreover, health behaviors and access to hygiene and sanitation infrastructure

TABLE 2

Sanitation, Hygiene Education, and Water Supply in Bangladesh Program handwashing, sanitary latrine use, and feces disposal and safe water message recall by beneficiaries before and after the mass media campaign in rural Bangladesh

	Before mass media campaign (N = 8,947)	After mass media campaign (N = 8,400)	Bivariate model*	Multivariable model†
Recalled messages	% (n)	% (n)	PR (95% CI)	PR (95% CI)
Able to state at least one message included in the SHEWA-B mass media campaign on				
Handwashing	71 (6,324)	85 (7,141)	**1.64 (1.45, 1.84)**	**1.65 (1.46, 1.85)**
Handwashing	71 (6,324)	85 (7,141)	**1.64 (1.45, 1.84)**	**1.65 (1.46, 1.85)**
Safe water	62 (5,506)	72 (6,055)	**1.29 (1.17, 1.42)**	**1.30 (1.18, 1.43)**
Sanitary latrine use and feces disposal	68 (6,125)	84 (7,075)	**1.68 (1.49, 1.89)**	**1.69 (1.50, 1.90)**
Able to state at least three messages included in the SHEWA-B mass media campaign on				
Handwashing	40 (3,542)	57 (4,797)	**1.44 (1.34, 1.55)**	**1.45 (1.35, 1.56)**
Safe water	15 (1,306)	19 (1,592)	**1.17 (1.08, 1.26)**	**1.17 (1.08, 1.26)**
Sanitary latrine use and feces disposal	32 (2,891)	50 (4,198)	**1.45 (1.35, 1.55)**	**1.46 (1.36, 1.56)**

PR = prevalence ratio; SHEWA-B = Sanitation, Hygiene Education, and Water Supply in Bangladesh Program. Values in bold indicate prevalence ratios that are statistically significant at the $P < 0.05$ level.

* We estimated the prevalence ratio by using generalized linear model to adjust for clustering.

† Multivariable model includes all covariates associated with the outcome variables in bivariate analyses at the $P < 0.2$ level.

TABLE 3

Demonstrated handwashing behavior and hand cleanliness of the beneficiaries (caregivers and children aged 3–5 years) before and after the mass media campaign in rural Bangladesh

	Before mass media campaign		After mass media campaign		Bivariate model*	Multivariable model†
	N	% (*n*)	*N*	% (*n*)	PR (95% CI)	PR (95% CI)
Caregiver demonstrated handwashing behavior after defecation						
Used only water	8,611	18 (1,517)	7,871	11 (894)	**0.62 (0.52, 0.73)**	**0.65 (0.57, 0.74)**
Used soap and water	8,611	67 (5,807)	7,871	79 (6,207)	**1.17 (1.13, 1.21)**	**1.15 (1.12, 1.19)**
Washed both hands	8,611	72 (6,201)	7,871	80 (6,332)	**1.12 (1.10, 1.15)**	**1.11 (1.08, 1.15)**
Caregiver dried hands	8,611	85 (7,280)	7,871	92 (7,268)	**1.09 (1.07, 1.11)**	**1.09 (1.07, 1.11)**
Hands dried with clean clothes or air	7,280	5 (340)	7,268	1.7 (125)	**0.37 (0.27, 0.49)**	**0.36 (0.27, 0.48)**
Children aged 3–5 years demonstrated handwashing behavior after defecation						
Used only water	1,580	35 (559)	885	24 (209)	**0.67 (0.56, 0.79)**	**0.66 (0.56, 0.78)**
Used soap and water	1,580	53 (845)	885	69 (613)	**1.30 (1.19, 1.40)**	**1.31 (1.22, 1.41)**
Washed both hands	1,580	79 (1,240)	885	85 (756)	**1.09 (1.03, 1.14)**	**1.09 (1.04, 1.15)**
Children dried hands	1,580	58 (926)	885	77 (682)	**1.32 (1.23, 1.41)**	**1.31 (1.22, 1.41)**
Hands dried with clean clothed or air	926	13 (122)	682	8.2 (56)	**0.62 (0.42, 0.93)**	**0.63 (0.42, 0.95)**
Hand cleanliness						
No visible dirt on caregiver nails, palms, and finger pads	8,882	41 (3,616)	8,361	47 (3,889)	**1.15 (1.09, 1.21)**	**1.14 (1.07, 1.20)**
No visible dirt on child nails, palms, and finger pads	8,486	27 (2,264)	7,883	30 (2,380)	**1.13 (1.04, 1.22)**	**1.13 (1.05, 1.21)**

PR = prevalence ratio. Values in bold indicate prevalence ratios that are statistically significant at the $P < 0.05$ level.
* We estimated the PR by using generalized linear model to adjust for clustering.
† Multivariable model includes all covariates associated with the outcome variables in bivariate analyses at the $P < 0.2$ level.

were similar whether or not participants had met a SHEWA-B promoter,[18] further demonstrating the ineffectiveness of the interpersonal communication intervention deployed within SHEWA-B study area. By contrast, the data presented in this article suggest that the subsequent SHEWA-B mass media campaign was more effective in improving both knowledge and practice than the earlier interpersonal communication approach.

The evidence of the effect of mass media in improving water, sanitation, and hygiene-related health behavior knowledge and practices is mixed. A study in Tanzania found a positive association of media access with increased water, sanitation, and hygiene knowledge,[33] and another study in Ghana found that a handwashing campaign strongly increased awareness of the importance of washing hands with soap,[34] consistent with the findings of our study. Our findings were also similar to those of a study in Kenya that showed a positive association between media access and an increase in handwashing with soap (24%).[35] A cross-sectional study conducted in Bangladesh similarly identified a strong association between television access and handwashing practices.[25]

By contrast, a study conducted in Peru found that an intervention based solely on radio messages had no significant effect on exposure to the handwashing promotion campaign messages and no effect on the availability of soap for handwashing, and concluded there was no effect on handwashing knowledge or handwashing behavior.[36]

The Bangladesh radio and television campaign was aired in the entire country; therefore, it was not possible to enroll a contemporaneous control group to compare the difference in health behavior knowledge and health behavior. It is possible that our findings reflect secular trends in knowledge and

TABLE 4

Household water, sanitation, and hygiene practices before and after the mass media campaign in rural Bangladesh

	Before mass media campaign		After mass media campaign		Bivariate model*	Multivariable model†
	N	% (*n*)	*N*	% (*n*)	PR (95% CI)	PR (95% CI)
Convenient hand washing location available with water and soap‡						
Usually washed hands after defecation	7,123	18 (1,291)	7,272	22 (1,566)	**1.19 (1.06, 1.33)**	**1.12 (1.06, 1.19)**
Usually washed hands before cooking or eating or feeding child	5,243	34 (1,797)	7,095	38 (1,988)	**1.12 (1.03, 1.22)**	**1.09 (1.01, 1.18)**
Stored drinking water in a covered container§						
*Kalas*h (narrow-mouthed container)	5,040	47 (2,369)	2,826	63 (1,779)	**1.34 (1.21, 1.48)**	**1.37 (1.24, 1.51)**
Pitcher (wide-mouthed container)	2,825	29 (825)	1,037	32 (330)	1.09 (0.93, 1.29)	1.15 (0.98, 1.35)
Households sanitation						
No access to latrine‖	8,933	4 (392)	8,399	4 (354)	1.00 (0.83, 1.16)	0.98 (0.84, 1.15)
Have access to an improved latrine¶	8,541	33 (2,780)	8,045	37 (2,974)	**1.10 (1.03, 1.19)**	**1.12 (1.04, 1.20)**
Cleanliness of latrine#	7,990	46 (3,713)	7,248	46 (3,356)	1.00 (0.94, 1.05)	1.01 (0.95, 1.06)

PR = prevalence ratio. Values in bold indicate prevalence ratios that are statistically significant at the $P < 0.05$ level.
* We estimated the PR by using generalized linear model to adjust for clustering.
† Multivariable model includes all covariates associated with the outcome variables in bivariate analyses at the $P < 0.2$ level.
‡ Convenient is defined as the location where the respondent reports that she usually washes her hands after defecation and before cooking or eating or feeding child.
§ If all the containers found in a house is fully covered, then the households is considered to store water in a covered container. The denominator is the number of households that store water in a container.
‖ No access to latrine is defined as no latrine facility/defecated in bush/open field.
¶ Defined using WHO/UNICEF Joint Monitoring Programme definition for improved latrine.
# Cleanliness of latrines is defined as feces were not observed on the latrine slab or floor.

behaviors that coincided with the timing of the mass media campaign. However, we are unaware of any interventions in these communities that would have generated such an effect. It is also possible that population characteristics associated with improved behaviors increased over time or that the before and after cross-sectional samples captured participants with different characteristics. However, we found similar PRs estimated in the bivariate and multivariable analysis, suggesting no evidence of substantial confounding by measured household characteristics between the two cross-sectional sets of households enrolled for data collection before and after the mass media campaign. The data collectors were not blinded; therefore, enumerators could have been subject to bias in their data collection related to this unblinded intervention.

In our study setting, over the 1-year period when the mass media campaign was aired, we found increased hygiene message recall by caregivers and increased observed health behaviors. Considering the low cost per household reached by mass media compared to in-person communication, this approach can be deployed to improve water, sanitation, and hygiene practices and should be evaluated in other contexts.

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