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ABSTRACT

BACKGROUND: Water, Sanitation, and Hygiene (WASH) promotion is a viable solution to prevent enteric infections. It focuses on hygiene education, where a number of theoretical models have emerged which attempt to guide behavior change interventions. This study was, therefore, conducted to evaluate the effectiveness WASH education program on households' WASH performance in rural Dembiya, northwest Ethiopia.

METHOD: An uncontrolled before-and-after intervention study was conducted. Baseline and endline surveys were done among 225 and 302 randomly selected households with under-5 children, respectively, using a structured questionnaire and observational checklists. Percent point change was used to see the effect of the intervention. Pearson χ^2 and Fisher exact tests were used to test for statistically significant percentage point changes on the basis of $P < .05$.

RESULT: Access to adequate sanitation was significantly improved from 43.1% at the baseline to 50.7% at the endline ($P < .05$). Access to protected water sources was high at the baseline (73.8%) and remained high (81.1%) at the endline ($P < .05$). Significant proportion of households (58.3%) practiced good drinking water handling at the endline compared with the baseline (6.7%) ($P < .001$). Practice of home-based water treatment was improved at the endline (47%) compared with the baseline (7.6%) ($P < .001$). The general hygienic condition of children was significantly improved at the end of the intervention compared with the conditions before the intervention ($P < .05$). At the end of the intervention, mothers' hand washing practice was improved to 68.2% from 24.4% at the baseline ($P < .001$). Moreover, 52.4% and 69.5% of the households at the baseline and endline, respectively, had good food safety practice ($P < .05$).

CONCLUSION: The proportion of households who practiced water safety, basic sanitation, good personal hygiene, and basic food safety measures significantly increased at the endline. This significant increment clearly showed that our WASH interventions were effective to improve households' WASH performance in rural Dembiya. The local health office need, therefore, strengthens the WASH education program.

KEYWORDS: WASH promotion, WASH education, uncontrolled before-and-after intervention study, households' WASH performance, rural Dembiya

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Background

Behavioral change is an essential component of Water, Sanitation, and Hygiene (WASH) programs to improve household's hygiene and sanitation practices. WASH education or promotion can act as the means to create demand for sanitation and thereby increase coverage.[1,2] WASH promotion is aimed at changing specific WASH behaviors.[3-5]

WASH education or promotion is an effective solution for reducing poor sanitation-related diseases due to enteric pathogens, especially diarrheal diseases.[5,6] Diarrhea accounts an estimated 3.6% of the global burden of disease and is responsible for 1.5 million deaths every year. It is estimated that 58% of this burden is attributed to unsafe WASH.[7] WASH has the potential to prevent at least 9.1% of the global disease burden and 6.3% of all deaths.[8]

WASH promotion can also greatly contribute to economic development. Improved WASH plays a role to increased economic productivity. According to the World Health Organization (WHO) report, the total annual economic benefits of achieving universal access to water supply and sanitation are estimated at over US $220 billion annually.[9]

Even though the contribution of WASH to prevent infectious diseases is globally advocated, there is usually less interest in making WASH promotion in developing countries. Some of

the challenges include poverty, lack of political commitment, lack of full community participation, inadequate gender inclusion, lack of coordination among actors, and behavioral issues.[10] In circumstances of severe poverty, survival may naturally take precedence over WASH promotion. WASH promotion may not be immediate enough for attention beyond pressing needs, for example, the need for food and the means to produce it.[11] Unless strategies are found to bring WASH behavioral change at community level, we cannot reduce morbidity and mortality due to infectious diseases. Cognizant of this, the current project was implemented in rural Dembiya, northwest Ethiopia, to improve WASH behaviors of the communities through school, community, and church-based integrated WASH education program. This research was, therefore, conducted to evaluate the effectiveness of the WASH education program on households' WASH performance.

Method

WASH education was implemented in rural Dembiya to reduce the prevalence of intestinal parasitic infections. The project was so-called Dembiya NTD-WASH project. This study is the third study in the Dembiya NTD-WASH project. This study uses methodology from 2 previously published works. The first study was a baseline survey conducted to know the prevalence of childhood intestinal parasitic infections prior to the intervention.[12] The second study was an uncontrolled before-and-after intervention study conducted to assess the impacts of WASH promotion on intestinal worms.[13] The current study is also an uncontrolled before-and-after intervention study conducted to assess the impacts of WASH promotion on household's hygiene and sanitation performance. In this study, 225 and 302 households in the 5 rural kebeles (the lowest administrative unit) were included at the baseline and endline survey, respectively, using systematic random sampling technique. Data were collected using structured interview questionnaires and observational checklists. The detail of the method is presented elsewhere.[12,13]

Health education was delivered to school children and rural communities in 5 selected rural kebeles on WASH and health consequences associated with poor WASH condition. We used interactive approaches like role-play, demonstration, group discussion, song, games, question and answer, and lecturing. In addition to health education, hand washing facilities were built in all schools using locally available materials. We placed 2 to 4 jars with a capacity of 25 Land 1 to 2 barrels of plastic with a capacity of 400 L in each school to facilitate hand washing after visiting the toilet. The detail of the interventions is presented elsewhere.[13] To increase the uptake of interventions, we dispatched leaflets in the community to disseminate health message. We also established WASH committee in every kebele to facilitate the training and to handover the activities at the end of the project.

In this study, authors did their maximum effort to minimize bias. Data collectors at the endline survey were different from the collectors at the baseline to ensure unbiased measurement of outcomes. Moreover, research team members were excluded from data analysis.

Indicators tracked

Table 1 shows indicators we used to assess changes after the intervention. The measurement and definition of each indicator are explained elsewhere.[12]

Statistical analysis

We used SPSS version 20 to analyze data. Descriptive statistics such as frequency and percentages were used to present data. We used percent point change to see the effect of the intervention on household's WASH performance. We also used Pearson χ^2 and Fisher exact tests to test for statistically significant changes at the baseline and endline. A P value less than .05 was used to identify statistically significant percentage point change.

Results

Sociodemographic characteristics of study participants

A total of 225 and 302 children aged 6 to 59 months and their mothers/caregivers were included at the baseline and endline surveys, respectively. One hundred nineteen (52.9%) and 144 (47.7%) children were female at the baseline and endline, respectively. Most study participants were aged above 24 months both at the baseline, 166 (73.8%), and endline, 206 (68.2%). Twenty-one (9.3%) and 76 (25.2%) households had at least 1 family member whose education status is secondary and above at the baseline and endline, respectively. One hundred thirty-eight (61.3%) and 234 (77.5%) households at the baseline and endline, respectively, reported that they discussed about health and WASH issues with their families (Table 2).

Access to drinking water and handling at point of use

Access to protected water sources was high at the baseline (73.8%) and remained high (81.1%) at the endline ($P<.05$). The proportion of households who stored drinking water in clean containers and clean area was increased from 11.6% at the baseline to 62.3% at the endline ($P<.001$). Similarly, 34.7% and 69.5% households properly covered drinking water storage containers at the time of baseline and endline surveys, respectively, which showed significant improvement ($P<.001$). The proportion of households who did not withdraw water from the storage containers by dipping was significantly increased from 68.9% at the baseline to 92.7% at the endline ($P<.01$). Overall, households' drinking water handling practice was significantly increased from 6.7% at the baseline to 58.3% at the endline ($P<.001$). At the baseline, 7.6% of households practiced home-based water treatment. Conversely, 47% of the households practiced home-based water treatment

Table 1. Household-level indicators by domain used to track changes due to WASH education program in rural Dembiya, northwest Ethiopia.

DOMAINS	INDICATORS
Drinking water safety	Percentage of households with children under 5 who had access to protected water sources
	Percentage of households with children under 5 who had stored drinking water in clean storage containers and in clean areas
	Percentage of households with children under 5 who had not withdrawn water from the storage containers by dipping
	Percentage of households with children under 5 who had properly covered drinking water storage containers
	Percentage of households with children under 5 who practiced 1 or more home-based water treatment methods
Sanitation	Percentage of households with children under 5 using hygienic latrine facilities
	Percentage of households with children under 5 whose living compound is free from human excreta
	Percentage of households with children under 5 who practice safe disposal of solid wastes
	Percentage of households with children under 5 who cleaned their living compound regularly
	Percentage of households with children under 5 who had access to adequate sanitation
Personal hygiene	Percentage of children whose personal hygiene condition is generally considered as clean or good
	Percentage of children who washed their body with clean water and soap at least once in 3 days
	Percentage of children who kept finger nails short
	Percentage of children who wore shoes
	Percentage of children who frequently washed hands after playing, defecation, and before eating
	Percentage of mothers or caregivers who washed hands after visiting the toilet or changing baby's diaper or touching wastes, before eating and food preparation
Food safety	Percentage of mothers who did not prepare food while having diarrhea/vomiting or other communicable diseases
	Percentage of households with children under 5 whose food utensils were clean
	Percentage of households with children under 5 who stored food stuffs and food utensils using shelves
	Percentage of households with children under 5 where vectors or rodents were not seen in food storage areas
	Percentage of households with children under 5 who had clean kitchen

Abbreviation: WASH, Water, Sanitation, and Hygiene.

at the endline which showed significant change compared with the baseline ($P < .001$) (Table 3).

Households' sanitation practice

The proportion of rural households who used latrine was significantly increased ($P < .05$) at the end of the intervention, which was 32% at the baseline and 49% at the endline. Similarly, 44.9% and 66.2% of households at the baseline and endline, respectively, kept their living compound free from human excreta ($P < .01$), and 10.7% and 37.7% of rural households at the baseline and endline, respectively, properly disposed solid wastes which we found the percentage point change was statistically significant ($P < .01$). The proportion of households who cleaned their living compound regularly was significantly increased ($P < .001$) from 5.8% at the baseline to 49.7% at the endline. Overall, 43.1% households at the baseline and 50.7% at the endline had access to adequate sanitation. The percentage point change of access to adequate sanitation was 7.6% ($P < .05$) (Table 4).

Children's personal hygiene condition

The general hygienic condition of children was significantly improved ($P < .05$) at the endline (34.4% of children had good hygienic condition) compared with the baseline (1.3% of children had good hygienic condition). The proportion of children who washed their body once in 3 days was increased from 70.2% at the baseline to 99.3% at the endline ($P < .05$). At the endline, 61.6% of the children kept their finger nail short which is greater than the proportion of children who kept their finger nail short at the baseline (26.2%) ($P < .001$). This study revealed that the interventions had significant effect to improve mothers' hand washing practice ($P < .001$). (Table 5). The hand washing practice of mothers at different critical times is presented in Table 6.

Food safety practices

The current study found that 52.4% and 69.5% of the households at the baseline and endline, respectively, had good food safety practice ($P < .05$). The proportion of households who

kept their food utensils clean was significantly increased ($P < .001$) from 9.8% at the baseline to 49% at the endline. This study depicted that significant ($P < .01$) proportion of households at the endline (92.7%) stored food stuffs and food utensils in shelves compared with the proportion of households at the baseline (63.6%). We did not observe vectors in food storage areas among 49.8% households at the baseline and among 59.6% households at the endline which showed significant improvement ($P < .05$). We also found that the proportion of households who had clean kitchen was increased from 1.8% at the baseline to 13.2% at the endline ($P < .05$) (Table 7).

Table 2. Sociodemographic information of households with children aged 6 to 59 months in rural Dembiya at the baseline (May 2017) and endline (May 2018), northwest Ethiopia.

SOCIODEMOGRAPHIC VARIABLES	BASELINE	ENDLINE
	N (%)	N (%)
Sex of children		
Male	106 (47.1)	158 (52.3)
Female	119 (52.9)	144 (47.7)
Age of children		
6-24	59 (26.2)	96 (31.8)
>24	166 (73.8)	206 (68.2)
Maternal education		
No formal education	180 (80.0)	248 (82.1)
Have formal education	45 (20.0)	54 (17.9)
Was there at least 1 member whose education status is secondary and above in the family		
Yes	21 (9.3)	76 (25.2)
No	204 (90.7)	226 (74.8)
Did the households discus about health and WASH issues		
Yes	138 (61.3)	234 (77.5)
No	87 (38.7)	68 (22.5)

Abbreviation: WASH, Water, Sanitation and Hygiene.

Discussion

This uncontrolled before-and-after intervention study was conducted to evaluate the effectiveness of school, community, and church-based integrated WASH promotion/education program on households' WASH performance in rural Dembiya, northwest Ethiopia. The study found that the WASH education program had positive impact to improve households' WASH conditions. The proportion of households who practiced water safety, basic sanitation, good personal hygiene, and basic food safety measures significantly increased at the endline compared with the baseline. Other studies in different parts of the globe also reported the positive impact of WASH promotion on improved WASH practices.[14-18] The effect of WASH education on households' WASH performance might be due to the fact that health education increases awareness on good WASH practices and encourages behavioral change.[19-22]

This school, community, and church-based integrated WASH education program was significantly associated with improved home-based drinking water handling practices of the rural households. The finding of the current study is in line with the findings of other studies. Studies reported that hygiene education is of paramount importance in the promotion of safe water-handling and storage practices with little investment from households.[23-26]

Latrine construction and utilization was one of the focuses of the WASH education program. The result of this study

Table 3. Access to drinking water and handling practice at point of use in rural Dembiya at the baseline (May 2017) and endline (May 2018), northwest Ethiopia.

VARIABLES	BASELINE	ENDLINE	PERCENT POINT CHANGE	*P* VALUE
	N (%)	N (%)		
Percentage of households with children under 5 who had access to protected water sources	166 (73.8)	245 (81.1)	7.3	<.05
Percentage of households with children under 5 who had stored drinking water in clean storage containers in clean area	26 (11.6)	188 (62.3)	50.7	<.001
Percentage of households with children under 5 who had properly covered drinking water storage containers	78 (34.7)	210 (69.5)	34.8	<.001
Percentage of households with children under 5 who had not withdrawn water from the storage containers by dipping	208 (68.9)	280 (92.7)	23.8	<.01
Percentage of households with under 5 children who had treated water at household level	17 (7.6)	142 (47.0)	39.4	<.001
Percentage of households with under 5 children who practiced good drinking water handling	15 (6.7)	176 (58.3)	51.6	<.001

Table 4. Sanitation condition of households in rural Dembiya, northwest Ethiopia at the baseline (May 2017) and endline (May 2018).

VARIABLES	BASELINE	ENDLINE	PERCENT POINT CHANGE	*P* VALUE
	N (%)	N (%)		
Percentage of households with children under 5 using hygienic latrine facilities	72 (32.0)	148 (49.0)	17.0	<.05
Percentage of households with children under 5 whose living compound is free from human excreta	101 (44.9)	200 (66.2)	21.3	<.01
Percentage of households of children under 5 who practice safe disposal of solid wastes	24 (10.7)	114 (37.7)	27	<.01
Percentage of households with children under 5 who cleaned their living compound regularly	13 (5.8)	150 (49.7)	43.9	<.001
Percentage of households with children under 5 who had access to adequate sanitation	97 (43.1)	153 (50.7)	7.6	<.05

Table 5. Personal hygiene of under 5 children and mothers at the baseline (May 2017) and endline (May 2018) in rural Dembiya, northwest Ethiopia.

HYGIENE VARIABLES	BASELINE	ENDLINE	PERCENT POINT CHANGE	*P* VALUE
	N (%)	N (%)		
Percentage of children whose personal hygiene condition is generally considered as clean	3 (1.3)	104 (34.4)	33.1	<.05*
Percentage of children who washed their body once in 3 days with soap	158 (70.2)	300 (99.3)	29.1	<.05
Percentage of children who kept their finger nails short	59 (26.2)	186 (61.6)	35.4	<.001
Percentage of children who wore shoes	65 (28.9)	98 (32.5)	3.6	<.2
Percentage of children frequently wash their hands after playing, defecation, and before eating	102 (45.3)	224 (77.2)	31.9	<.01
Percentage of mothers or caregivers who washed their hands effectively at all critical times	55 (24.4)	206 (68.2)	43.8	<.001

Note: "*" indicates that Fisher's exact test is used for this variable to see percentage point change hence the expected values are less than 5.

Table 6. Hand washing habits of mothers at the baseline (May 2017) and endline (May 2018) in rural Dembiya, northwest Ethiopia.

MOTHERS' OR CAREGIVERS' HAND WASHING HABITS	BASELINE (N = 225)	ENDLINE (N = 302)
	N (%)	N (%)
Before meal	223 (99.1)	302 (100)
After latrine use	154 (68.4)	300 (99.3)
After handling baby's diaper/feces	138 (61.3)	300 (99.3)
After meal	209 (92.9)	300 (99.3)
Before feeding a child	154 (68.4)	298 (98.7)
Before food preparation	201 (89.3)	302 (100)
After handling rubbish/ animals	112 (49.8)	212 (70.2)

revealed that the education program was effective to increase latrine coverage in the area. An intervention-based study in Zimbabwe[27] and a systematic review and meta-analysis conducted to see the impact of sanitation interventions on latrine coverage and latrine use[28] also showed that sanitation education interventions can increase households' latrine coverage and use.

In our intervention, we promoted hand washing practice through training and demonstration. This intervention effectiveness evaluation study found that the interventions played roles to improve hand washing practice. The proportion of mothers/caregivers who washed their hands effectively at different critical times was increased from at the endline compared with the baseline. Other similar studies also reported the impact of hygiene education/training on hand washing practice. An intervention-based study in India depicted that hand washing with soap at key events was more common in the intervention group than in the control group.[29] Similarly, other studies reported that health education was significantly associated with good hand washing practice.[22,30,31]

Our food safety education focusing on hand hygiene and general food safety played a significant role to improve the food safety practices of the rural communities. This study found that the proportion of households who practiced good food safety measures was higher at the endline compared

Table 7. Food safety practices of rural households in Dembiya, northwest Ethiopia at the baseline (May 2017) and endline (May 2018).

VARIABLES	BASELINE	ENDLINE	PERCENT POINT CHANGE	*P* VALUE
	N (%)	N (%)		
Percentage of households with under 5 children whose food safety practice is considered as good	118 (52.4)	210 (69.5)	17.1	<.05
Percentage of mothers who did not prepare food while having diarrhea or vomiting or other communicable diseases	85 (37.8)	118 (39.1)	1.3	<.20
Percentage of households with children under 5 whose food utensils were clean	22 (9.8)	148 (49.0)	39.2	<.001
Percentage of households with children under 5 who stored food stuffs and food utensils using shelves	143 (63.6)	280 (92.7)	29.1	<.01
Percentage of households with children under 5 where vectors or rodents were not seen in food storage areas	112 (49.8)	180 (59.6)	9.8	<.05
Percentage of households with children under 5 who had clean kitchen	4 (1.8)	40 (13.2)	11.4	<.05

with at the baseline. Other studies also reported the significant contribution of food safety education to improve food safety practices.[32-34]

As a limitation of the study, this research was uncontrolled before and after intervention study with no control group. The evidence generated may not be strong because of the weak nature of the research design. It is also difficult to attribute observed changes to the intervention because the intervention is confounded by external factors. We, therefore, recommend randomized controlled trial studies in the area to generate strong evidence.

Conclusions

In this study, the proportion of households who practiced water safety, basic sanitation, good personal hygiene, and basic food safety measures significantly increased at the endline compared with the baseline. This significant increment clearly showed that our WASH interventions were effective to improve households' WASH performance in rural Dembiya. The local health office need, therefore, strengthens the WASH education program.

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Authors' contribution

Both the authors actively participated during conception of the research issue, development of a research proposal, data collection, analysis and interpretation, and writing various parts of the research report. ZG had designed the protocol, analyzed the data, supervised the overall research process, and prepared the manuscript. AA had developed data collection tools and supervised the data collection process. Both the authors read and approved the final manuscript.

Availability of data and material

Data will be made available upon requesting the primary author.

Consent for publication

This manuscript does not contain any individual person's data.

Ethical approval and consent to participate

Ethical clearance was obtained from the Institutional Review Board of the University of Gondar and an official letter was submitted to the district administrators. There were no risks due to participation in this research project and the collected data were used only for this research purpose. Verbal informed consent was obtained from the mothers/caregivers. Information was kept with complete confidentiality.

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