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Evaluation of a WASH intervention demonstrates the potential for improved hygiene practices in Hiri District, Central Province

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SUMMARY

Water, sanitation and hygiene (WASH) interventions aim to improve health outcomes through provision of safe water supplies and improved sanitation facilities, while also promoting better hygiene practices in communities. Population Services International introduced a WASH intervention project in the Hiri District, Central Province in May 2012. Shortly after its introduction we conducted a survey to determine the uptake of the intervention and gauge its impact. We invited 400 households to participate in the study, which consisted of a questionnaire for the head of the household. A total of 395 questionnaires were completed: 314 from households that had participated in the WASH intervention and 81 that had not (controls). Results demonstrated that improved water sources were not routinely used, with a high dependence on well and surface water. While self-reported handwashing was common, use of soap was not common. Treatment of water inside the house was common in the intervention group (95%), compared to 49% in the non-WASH group. The study indicates that people in the Hiri District are supportive of a WASH intervention, with good uptake of some aspects of the intervention. The sustainability of the intervention remains unknown. Targetted interventions focusing on community priorities might be beneficial in the future.

Background

In low-income countries, diseases associated with unsafe water and inadequate sanitation are of considerable public health importance; indeed, it is estimated that improved water, sanitation and hygiene (WASH) could prevent at least 9.1% of the global disease burden (1). Given their importance in health and development, there has been renewed interest in WASH interventions in recent years. This has been largely driven by the United Nations through the United Nations Children's Fund (UNICEF) and the Millennium Development Goals (MDG), with uptake by many government and non-government organizations. MDG 7 aims to halve the number of people living without access to sanitation and safe water by 2015. Recent data indicate satisfactory progress globally in terms of access to safe water: 89% of the world's population has access to safe water, exceeding the 2015 target for MDG 7. Nonetheless, over 700 million people still lack access to safe water. Of greater concern is the lack of progress in delivering improved sanitation, which is behind schedule to meet the 2015 target (2). In 2011, 2.5 billion people lacked access to an improved sanitation facility. Of these, 761 million use public or

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shared sanitation facilities and another 693 million use facilities that do not meet minimum standards of hygiene (2).

The situation in Papua New Guinea (PNG) reflects that of other low-income settings globally; there has been little or no improvement in WASH in PNG in recent years. According to recent World Health Organization (WHO) data 40% of the population has access to improved water (3), considerably lower than the global rate (~89% access) and one of the lowest in the Western Pacific region. Similarly, approximately 80% of the population is without access to improved sanitation (3), although one other credible source suggests better access, estimating that 55% of the population lack access to sanitation (4). This discrepancy does not mask the fact that access to WASH remains poor, and there has been little improvement in the past 25 years (3).

The poor WASH indices no doubt impact on the burden of diarhoeal disease in PNG, as they do globally. In PNG diarrhoeal disease is one of the leading causes of morbidity and mortality, accounting for 8% of deaths among children aged less than 5 years (3). However, the burden of enteric illness in PNG is not restricted to children. Outbreaks of cholera and shigellosis in the recent past highlight the risk to the broader population of enteric disease outbreaks (5,6), and endemic illnesses such as typhoid fever continue to cause morbidity (7). The cholera outbreak is of particular interest, given that cholera had not been reported in PNG before 2009. New incursions of cholera often follow natural or human-induced disasters (eg, Haiti, Zimbabwe) (8,9); however, the cholera epidemic in PNG was not preceded by any such disaster. The outbreak spread throughout coastal PNG and resulted in over 15,500 cases and approximately 500 deaths, with a case fatality rate of 3.2% (6). It has been postulated that lack of sanitation and hygiene in PNG was key to its spread throughout the country (10).

Given the above considerations, a WASH project was introduced to the Hiri integrated Health and Demography Surveillance Site (iHDSS) in mid-2012 by Population Services International (PSI). Here we evaluate the hygiene and handwashing practices in the Hiri HDSS, and the impact of the WASH intervention.

Methods

Study location and population

The Hiri HDSS covers four coastal villages in Hiri West, Kairuku-Hiri District, Central Province, PNG. It is situated at latitude 9° south and longitude 147° east and approximately 30 km west of Port Moresby. Three villages are Motuan (Lealea, Boera and Porebada) and one is Koita (Papa) (the Koita are referred to as Koitabu by the Motuan people). In the 2011 Hiri HDSS census survey 1347 households were recorded, with a total population of 11,531. The average density was approximately 10 persons/km^2. The area has a mean annual rainfall of 995 mm with a long dry season. All villages lie within a 5 km radius of the PNG Liquefied Natural Gas (PNGLNG) plant, and are classified as resource development impact areas.

The village centres in Boera and Porebada are on the beach, and in all four villages the majority of houses are built on the beach or the reef. The Motu are an essentially maritime people; the villagers engage in fishing, hunting and gardening activities to sustain their daily livelihoods. Other activities that the villagers engage in to earn income include small-scale commerce (trade stores, street markets) and working for the PNGLNG project.

The intervention

PSI, who managed the intervention, distributed WASH kits consisting of: a bucket with a tap to store drinking water; 30 water purification tablets (Aquatabs® with the active ingredient sodium dichloroisocyanurate – see www.aquatabs.com); 2 bars of soap; 2 sachets of oral rehydration salts (ORS) and 10 tablets of zinc for treating diarrhoea; and an information, education and communication (IEC) brochure. Distribution of kits was conducted primarily though PSI-trained community-based volunteers called healthy men/women (‘helti man’/‘helti meri’). These trained volunteers then educated local communities in the use of the kits as well as resupplying ORS, zinc and water treatment tablets. The WASH kit included enough contents to last for 1 month, with resupply given monthly.

Data collection

A cross-sectional survey was conducted

from September 2012 to May 2013; before the survey a questionnaire had been developed and piloted in July-August 2012. The questionnaires sought information about: water sources; water collection and storage; treatment of drinking water; water contamination; hygiene practices; and people's perception and knowledge on causes and risks factors associated with diarrhoea. People's perception was ranked on a Likert scale, ranging from strongly disagree – 1 – to strongly agree – 4. The WASH project was being rolled out by PSI as we conducted the survey; thus at the time of the survey the intervention had not reached all households in the study villages. This enabled a comparison of responses between households that had access to the WASH intervention and those that did not yet have access (controls).

A sample size of 400 (of the total 1347) households was randomly selected from the Hiri Demography Surveillance database: 170 households in Porebada, 103 in Lealea, 73 in Boera and 54 in Papa. After obtaining consent from the heads of households, research scientists and village reporters conducted the survey.

Data analysis

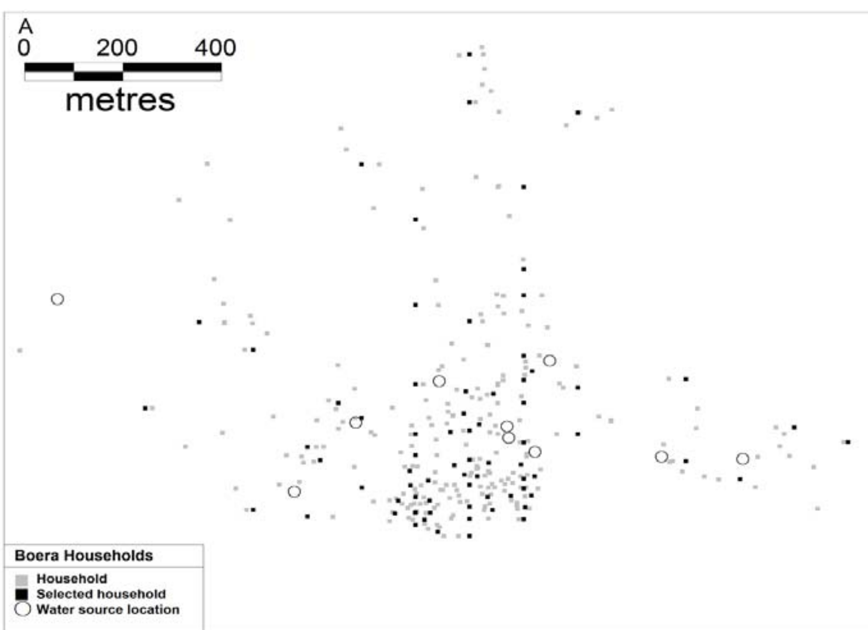
Research staff checked all questionnaires to ensure there were no data missing and numeric codes were assigned to responses before data processing. Data entry was done using EpiInfo 7 (Centers for Disease Control and Prevention, USA). Statistical analysis was performed with STATA software version 12 (STATACorp., College Station, TX). Chi-squared (χ^2) and Fisher's Exact tests were used to determine association between hygiene practices and exposure to the WASH intervention. Probability values were considered to be significant when the p value was ≤0.05. For the perception and knowledge of diarrrhoea (Likert scale 1 to 4) the mean was calculated and compared between intervention (access to WASH) and control groups.

Ethical considerations

The study was granted ethical approval from the PNG Institute of Medical Research Institutional Review Board (IRB 1113) and the PNG Medical Research Advisory Committee (MRAC 11.20). Informed consent was sought from every participating household through the self-identified head of the household. Participants were informed about their right to withdraw from the study at any stage.

Results

Of the 400 randomly selected households, 395 consented and completed the survey: 170 from Porebada, 103 from Lealea, 72 from Boera and 50 from Papa. The distribution of study households is presented in Figure 1. Of the 395 participating households, 314 participated in the WASH intervention and 81 did not (as the WASH intervention had



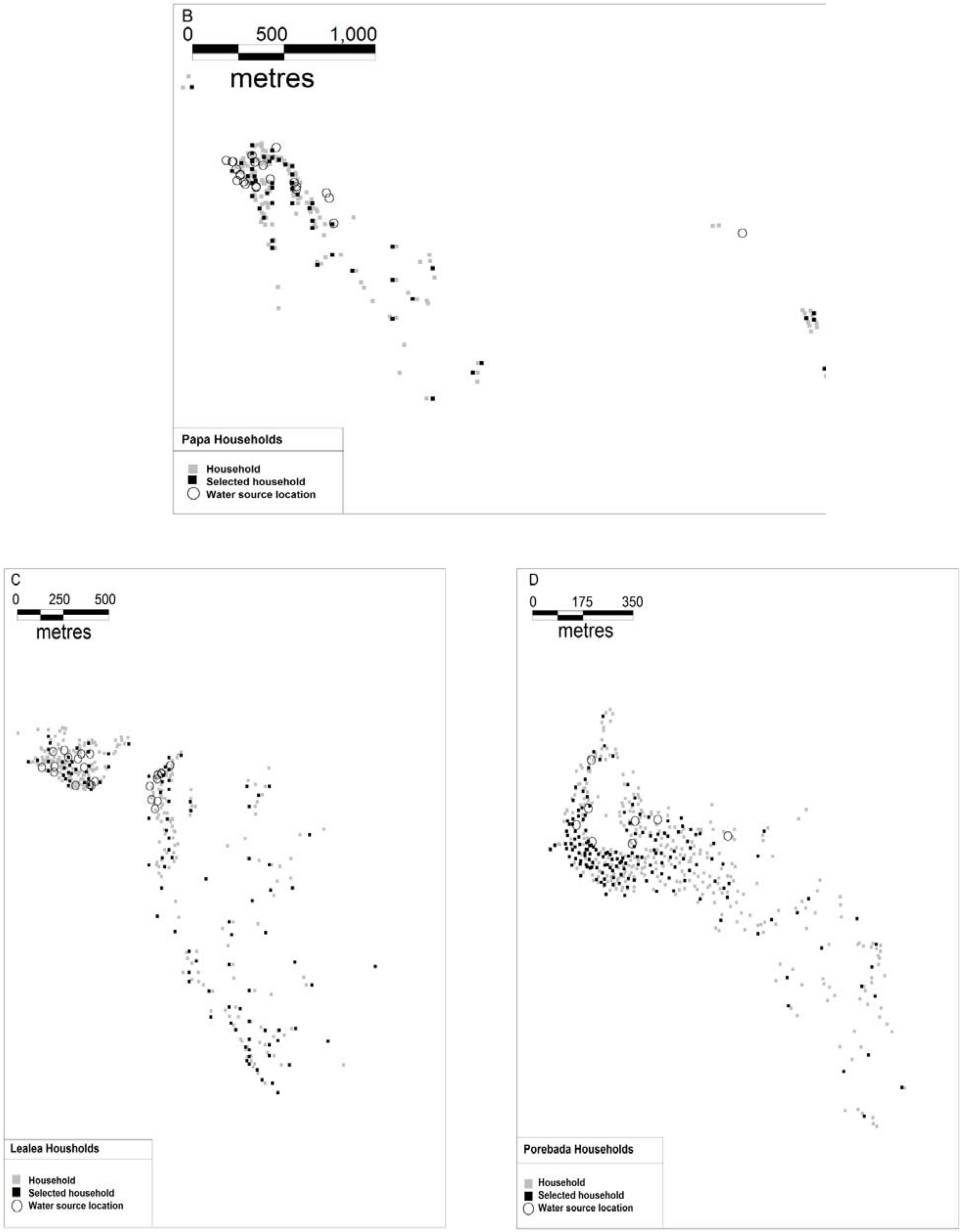


Figure 1. Maps showing households randomly selected for the study survey and water sources in the Hiri health and demography surveillance site (HDSS), Central Province.

not reached those households). Of the 81 households without the WASH intervention (controls) 68 were from Porebada, 1 from Lealea, 10 from Boera and 2 from Papa.

The primary source of water varied between villages. In Porebada and Boera there is at least some access to village piped water (75% and 41% of respondents, respectively, used piped water). However, even when piped water was available, it was not always widely used. In Boera more households used deep well water (52%) than piped water. In Papa only 4% of households used piped water compared to 46% using river/creek water and 31% using deep well water. In Lealea almost two-thirds (63%) of households used surface well water (Figure 2). In the study area the term 'surface well water' is used to describe a shallow well excavated below the groundwater table until incoming water exceeds the digger's bailing rate. The well can be lined with stones or brick to prevent collapse. Where reticulated water (piped water or rain water tanks) was absent, there was no protection of the water sources; this applied in particular to the surface well in Lealea and deep wells in Boera and Papa. It was commonly reported that water sources had potential causes of contamination nearby, such as rubbish, animal defecation/ urination or human defecation/urination (65% of participants in Boera, 52% in Lealea and 13% in Papa). Nonetheless, participants considered water from these sources to be sufficiently clean (Boera 70%, Lealea 63%, Papa 77%).

Most households travel by foot to fetch water. Adult females (65%) and adult males (26%) were primarily responsible for fetching water. As water sources were typically located in or nearby their villages, the majority of the population (71%) took less than 10 minutes to travel to fetch water. All participants washed at least once a day, with children washing more frequently than once a day.

Handwashing was a common practice after using a toilet (96%), before eating food (94%) and before breastfeeding babies (88%). The WASH intervention group more commonly washed their hands than the control group after using a toilet (96.8% vs 91.4%; p = 0.031) and before eating food (96.5% vs 86.4%; p <0.001) (Table 1).

The frequency of hand soap use varied: 59% (234 of 395) reported using soap whenever soap was available and 41% (161 of 395) reported using soap to wash their hands all the time. Alternatives to soap were using leaves, sand and ashes. Despite soap being distributed with WASH kits, self-reported rates of using soap to wash hands among the intervention households was lower than in control households, although the difference was not significant. The buckets distributed in the WASH project for storing drinking water were well accepted by communities. Those who received the WASH intervention were more likely to separate drinking water containers from washing water containers (WASH 73.2% vs non-WASH 56.8%, p =

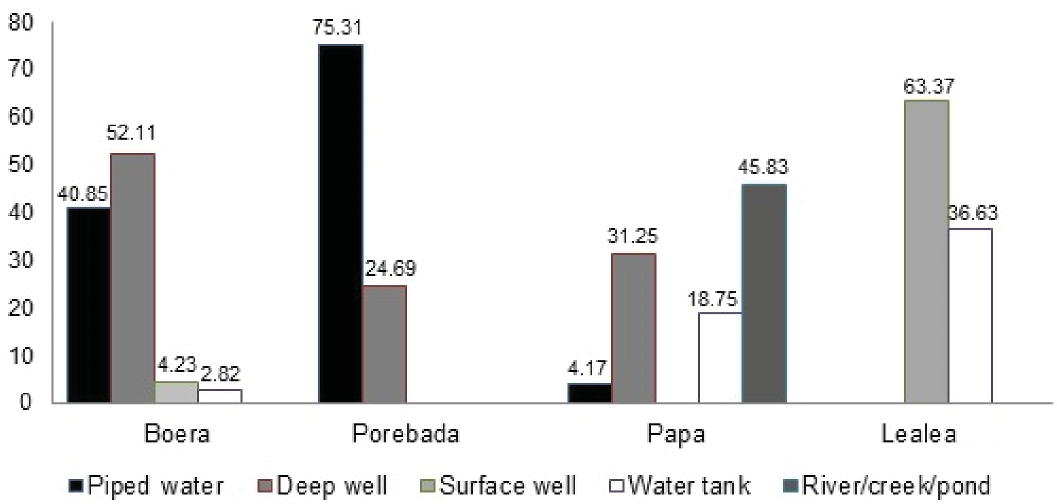


Figure 2. The water sources used in four study villages in Hiri health and demography surveillance site (HDSS), Central Province.

TABLE 1

Hygiene practices of the WASH intervention group and non-WASH group in the Hiri HDSS area

Hygiene practices	Total population		WASH		Non-WASH		p value
	N = 395	%	N = 314	%	N = 81	%	
Handwashing after toilet	378	95.7	304	96.8	74	91.4	**0.031**
Handwashing before eating	373	94.4	303	96.5	70	86.4	**<0.001**
Handwashing before breastfeeding	346	87.6	277	88.2	69	85.2	0.453
Handwashing + soap after toilet	161	40.8	122	38.9	39	48.1	0.129
Handwashing + soap before eating	156	39.5	119	37.9	37	45.7	0.202
Handwashing + soap before breastfeeding	151	38.2	115	36.6	36	44.4	0.197
Separated drinking water from washing water	276	69.9	230	73.2	46	56.8	**0.004**
Kept water containers in safe and clean places	377	95.4	299	95.2	78	96.3	0.680
Sick children and elderly had separate drinking water	45	11.4	39	12.4	6	7.4	0.205

WASH = water, sanitation and hygiene
HDSS = health and demography surveillance site

0.004) (Table 1).

Households participating in the WASH intervention were more likely to treat their drinking water than control households, based on self-reported data (WASH intervention 95.2% vs control 49.4%, p <0.001). In the WASH group 51% used water purification tablets alone to treat their drinking water, while 42% used combination methods including water purification tablets, boiling and/or filtering (Table 2). In the absence of water purification tablets, 49% of the control group treated their drinking water, by boiling or filtering it.

Overall there was a trend towards better comprehension of the potential severity of diarrhoea in the WASH intervention group than the control group, as demonstrated by higher mean knowledge scores (Table 3). The WASH intervention group had higher mean knowledge scores than the control group for all but one statement – that the presence of animal or human faeces around the house is a risk for diarrhoea – although scores were very similar. The mean knowledge score was above 3 for all statements, in both the WASH intervention and the control households.

Discussion

The findings of this study demonstrate a willingness to take up WASH interventions and an improved understanding of aspects of sanitation and hygiene in the households that received the WASH intervention.

Participants demonstrated a willingness to treat water when provided with water purification tablets, with the proportion of households treating water in WASH intervention households almost double that in control households. In WASH intervention households 90% used water purification tablets, either as the sole source of treatment

TABLE 2

Treatment of drinking water in the WASH intervention group and non-WASH group in the Hiri HDSS area

Treat drinking water	Total population		WASH		Non-WASH		p value
	N = 395	%	N = 314	%	N = 81	%	
Treat water	**339**	**85.8**	**299**	**95.2**	**40**	**49.4**	**<0.001**
Boiled alone	20	5.1	7	2.2	13	16.0	0.487
Filtered alone	12	3.0	0	0	12	14.8	0.055
WPT alone	161	40.8	161	51.3	0	0	<0.001
Boiled + filtered	24	6.1	9	2.9	15	18.5	<0.001
Boiled + WPT	28	7.1	28	8.9	0	0	0.002
Filtered + WPT	18	4.6	18	5.7	0	0	0.031
Boiled + filtered + WPT	76	19.2	76	24.2	0	0	<0.001
Total boiled	148	37.5	120	38.2	28	34.6	0.545
Total filtered	130	32.9	103	32.8	27	33.3	0.928
Total WPT	283	71.6	283	90.1	0	0	<0.001

WASH = water, sanitation and hygiene
HDSS = health and demography surveillance site
WPT = water purification tablets

or in combination with other methods. This suggests that if simple, user-friendly methods of water treatment are provided to this community they will be used. It is noteworthy that half of all control respondents treated their water. Recent data on point-of-use treatment of drinking water in PNG are not available, but personal observations suggest that this rate is higher than in many other parts of PNG (SP and ARG, personal communication). It may be that the higher than expected rate of water treatment is an outcome of the cholera epidemic that affected the area in 2010, at which time public health awareness was conducted.

When piped water was available it was not always used, despite piped water being one of only two improved water sources available to study participants (Figure 2). The other improved water source, tank water, was not the main source of water at any of the villages included in the study. We can only speculate as to why improved water is not routinely used when available, but it is likely that people will use the nearest water source that they deem to be sufficiently safe. Understanding the motivational factors (or absence thereof) associated with the use of improved water should be the focus of future studies. Large volumes of water are heavy, and carrying is most commonly done by women. Unfortunately, the dependence on, or preference for, non-improved water sources presents a health risk. Adding to the health risk, study participants commonly acknowledged that their water was potentially contaminated, but also considered the water to be sufficiently clean. This incongruence is indicative of a lack of understanding of sanitation, hygiene, safe water and agents of infectious disease. It highlights the need for ongoing IEC in PNG.

The proportion of study respondents self-reporting handwashing was high, with

TABLE 3

KNOWLEDGE SCORE OF HOUSEHOLDS IN FOUR VILLAGES ON DIARRHOEAL DISEASES (TOTAL SCORE OF 4*)

Knowledge	WASH	Non-WASH	p value
Diarrhoea can cause weight loss among children	3.66	3.47	<0.05
Diarrhoea causes the body to dehydrate very quickly	3.56	3.43	0.052
A child could die from diarrhoea	3.43	3.37	0.08
Having animal or human faeces in or around the house can increase risk of diarrhoea	3.15	3.17	0.37
Diarrhoea can be prevented	3.42	3.32	0.16
It is important to use ORS and zinc at the first sign of diarrhoea in a child	3.37	3.08	<0.05
Unseen germs in clear water can cause diarrhoea	3.21	3.20	0.24
Unseen germs in food, flies and fingers can cause diarrhoea	3.42	3.28	0.06

*Score: 1 Strongly disagree; 2 Disagree; 3 Agree; 4 Strongly agree
WASH = water, sanitation and hygiene
ORS = oral rehydration salts

approximately 95% of participants reportedly washing their hands after using the toilet and before eating. Soap use, however, was considerably less common. Approximately 40% of participants reported use of soap all the time, despite soap being part of the WASH intervention kit. Indeed, self-reported use of soap was lower in WASH intervention households than non-WASH households, though the difference was not significant (p >0.1) (Table 1). It appears that washing hands with soap is not a high priority, which is unfortunate given the demonstrated benefits of handwashing with soap in low-income settings (11).

The results of the knowledge-based questions demonstrated a general understanding of issues relating to diarrhoeal diseases, with a general trend (though not always significant) towards better understanding in the WASH intervention group than in the non-WASH group. The average scores were higher for responses to questions about the symptoms of diarrhoea than for responses about risk factors (faecal contamination and germs). Knowledge of the symptoms of diarrhoea can come through experience, whereas an understanding of the germ theory of disease comes through education and understanding. Our study indicates that knowledge pertaining to WASH is incomplete, but nonetheless people are willing to adopt many of the interventions.

It has been long recognized that the provision of infrastructure does not guarantee improved WASH outcomes, as highlighted by Jenkins almost 20 years ago. At that time very few, if any, hygiene education campaigns had been conducted in PNG (12). Ongoing education and community engagement may lead to better uptake of interventions. However, we know from international research and local experiences that health outcomes may not be the main motivational factor for people adopting improved hygiene practices. Fewtrell and colleagues highlighted "the desire to feel and smell clean, and the desire to follow social norms" as an important motivation (13). In the PNG context Jenkins noted that "norms of personal hygiene …. are subject to change under social pressure" (12). In addition to improving knowledge of infectious diseases, the promotion of improved personal hygiene as a socially desirable trait may also lead to improved health outcomes.

This study provides insight into community engagement of a WASH intervention. The importance of the study stems, in part, from the paucity of available data on the topic in PNG. The practice of water treatment at the household level, use of improved water by some participants (particularly at Porebada) and handwashing (though commonly without soap) all indicate that carefully considered WASH interventions may be successful. However, it is acknowledged that the study and the intervention are not without limitations. Hygiene practices were evaluated based on self-reporting, which can lead to bias: handwashing practices may be over-reported (14). We have not been able to determine long-term behaviour change, nor sustainability: would a similar uptake be possible with the availability of the intervention, as opposed to the provision of the intervention? While some studies have demonstrated ongoing improved handwashing behaviour when evaluated 18-24 months after the completion of the intervention (15,16), the effectiveness of that handwashing remains unclear (16). Other studies have evaluated infrastructure sustainability and reported acceptable outcomes within 2-5 years of the intervention (17,18). However, these findings may not translate to the PNG context, where there have been infrastructure interventions in the past that lacked sustainability (12). Singular interventions as opposed to multiple interventions might be considered, given that a meta-analysis of WASH studies demonstrated no cumulative benefit of multiple interventions (13). Carefully planned studies that investigate motivational factors for adopting WASH interventions, and lead to a better understanding of the transmission of pathogens, may be an appropriate next step in WASH research.

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