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# Handwashing Behavior Change at Scale

## Evidence from a Randomized Evaluation in Vietnam

*Claire Chase*
*Quy-Toan Do*

The World Bank
Sustainable Development Network
Water and Sanitation Program
&
Development Research Group
Poverty and Inequality Team
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## Abstract

Handwashing with soap, which has been shown to reduce diarrhea in young children by as much as 48 percent, is frequently mentioned as one of the most effective and inexpensive ways to save children's lives. Yet rates of handwashing remain very low throughout the world. Handwashing with soap campaigns are de rigueur in developing countries, but little is known about their effectiveness. Few have been rigorously evaluated, and none on a large-scale. This paper evaluates a large-scale handwashing campaign in three provinces of Vietnam in 2010. Exposure to the campaign resulted in a slight increase in the availability of handwashing materials in the household, and caregivers in the treatment group were more likely to report washing hands at some of the times emphasized by the campaign. However, observed handwashing with soap at these times is low, and there isn't any difference between the treatment and control groups. As a result, no impact on health or productivity is found. These results suggest that even under seemingly optimal conditions, where knowledge and access to soap and water are not main constraints, behavior change campaigns that take place on a large scale face tradeoffs in terms of intensity and effectiveness.


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# Handwashing behavior change at scale: Evidence from a randomized evaluation in Vietnam

Claire Chase[1]
with
Quy-Toan Do[2]

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[1] World Bank, WSP, corresponding author.
[2] World Bank Development Economics Research Group.

Claire Chase is Evaluation Specialist at the World Bank Water and Sanitation Program. Quy-Toan Do is Senior Economist in the Development Research Group at the World Bank. The Global Scaling Up Handwashing project impact evaluation task team is led by Bertha Briceño (in its early stages was led by Jack Molyneaux), together with Alexandra Orsola-Vidal and Claire Chase. Professor Paul Gertler has provided guidance and advice throughout the impact evaluation. Advisors also include Sebastian Galiani, Jack Colford, Ben Arnold, Pavani Ram, Lia Fernald, and Patricia Kariger. The authors are grateful to Nga Nguyen and Minh Hien Thi Nguyen, the country task team for project implementation in Vietnam, Almud Weitz, Regional Team Leader for WSP-East Asia and Pacific region, and to Eduardo Perez, overall task team leader for the Scaling Up project. Generous financial support was provided by the Bill and Melinda Gates Foundation.

## 1. INTRODUCTION

Preventable diseases resulting from poor hygiene behavior are responsible for a tremendous disease burden among the world's poor, especially infants and children under five years old. Globally, diarrheal disease is said to contribute to more child deaths than HIV/AIDS, Tuberculosis and Malaria combined. A large body of evidence suggests that improvements in hygiene behavior and handwashing with soap in particular, can reduce diarrheal disease substantially. For example, a recent systematic review of observational and experimental studies cites reductions in diarrhea of 48 percent for handwashing with soap (Cairncross, et al., 2010), and a synthetic review carried out by the International Initiative for Impact Evaluation (3ie) of impact evaluations in water, sanitation and hygiene found that handwashing at critical times including before eating or preparing food and after using the toilet can reduce diarrhea rates by almost 40 percent (Waddington, et al., 2009). Handwashing works by interrupting the transmission of harmful pathogens obtained through contact with human feces in the environment. When ingested these pathogens cause diarrhea and other gastro-enteric infections and lead to longer term adverse outcomes for young children who are infected, including growth faltering, malnutrition, and cognitive and learning impairments (see (The World Bank, 2008) for a complete review).

It has been called the 'do-it-yourself' vaccine, yet despite its low cost and proven benefits, rates of handwashing with soap are very low throughout the developing world (The World Bank, 2005). Campaigns employing a range of methods are de rigueur in developing countries, however little is known about the effectiveness of these campaigns in getting people to wash their hands with soap. Few have been rigorously evaluated, and none on a large-scale. Where evaluations have been done, they are often under trial conditions, with provision of soap and close follow-up of trial participants (see for example Haggerty, et al., 1994; Luby, et al., 2005; Ejemot, et al., 2009). While the interventions studied have proven effective in reducing diarrhea morbidity, they are not feasible on a large scale due to the vast amount of resources they require. Thus, rigorous evidence on the effectiveness of handwashing behavior change promotion in real-world settings is lacking.

In December 2006, the Water and Sanitation Program (WSP) began implementation of a large-scale hygiene project, called Global Scaling Up Handwashing (HWWS), with funding from the Bill & Melinda Gates Foundation. The HWWS project set out to learn how to apply a combination of commercial marketing and public health promotional approaches to behavior change to generate large scale and sustainable improvements in handwashing with soap. The project also spearheaded efforts to strengthen the enabling environment of local and national governments, NGOs and local implementing agencies to carry out handwashing promotion

beyond the lifetime of the project. The overarching goal of the project was to stimulate and sustain handwashing with soap behavior at critical times in 5.4 million people in Peru, Senegal, Tanzania, and Vietnam over the four years of the project. This in turn was hypothesized to lead to improvements in child health and development outcomes and increases in household productivity. As part of the HWWS monitoring and evaluation plan, the project incorporated a randomized controlled trial impact evaluation (IE) in each of the four countries to rigorously test the effectiveness of these approaches to handwashing promotion in caregivers of children under five.

The results of the impact evaluation in Vietnam suggest that handwashing with soap behavior in the target population has not changed substantially as a result of the intervention, and thus no health or productivity impacts are found. Knowledge about the correct way to wash hands was found to be high at baseline, and while the intervention led to an increase in knowledge about some of the key times for handwashing, it had little differential effect on already high access to soap and water in households and only modest effects on the self-reported handwashing behavior of mothers of children under five. Structured observations of handwashing show that rates of handwashing with soap at key junctures, especially after defecation and contact with child's feces, are very low among the target group, and no differences are found between treatment and control groups. More often, caregivers are foregoing soap to rinse their hands with water only. These results suggest that even under seemingly optimal conditions where knowledge and access to soap and water for handwashing are not main constraints, behavior change campaigns that intend to reach a mass audience face tradeoffs in terms of effectiveness.

The remainder of this paper proceeds as follows. In the next section, we describe the setting for the study, the design of the campaign and the intervention components that were evaluated. Section 3 describes the theory of change, the evaluation design, and discusses threats to identification of the counterfactual such as baseline balance and sample attrition. In section 4 we describe the estimation strategy and Section 5 presents the main results of the impact evaluation along the causal chain. Section 6 discusses potential reasons for the limited behavior change impacts found and Section 7 concludes.

## 2. BACKGROUND AND DESCRIPTION OF THE PROGRAM

Vietnam is a lower middle income country in Southeast Asia bordered by China to the north, Lao PDR to the northwest and Cambodia to the southwest, and with a GNI per capita in 2010 of $3,070 (PPP, current international $). Seventy-two percent of the population of 86 million live in rural areas. Access to water and sanitation infrastructure in Vietnam is high, even in rural areas, with 92% of the rural population having access

to an improved water source and 75% of the total population having access to an improved sanitation facility (World Development Indicators, 2008).

Alongside rapid economic growth, Vietnam has witnessed remarkable improvements in child health over the past several decades and successfully halved infant and child mortality rates well ahead of the 2015 Millennium Development Goals (MDG) deadline.[3] In spite of this, diarrheal diseases and acute respiratory infections remain two of the most common causes of child illness and deaths. The most recent national level surveys report 2 week prevalence of these diseases at 6.8 and 6.3% respectively (GSO, 2006) but these figures appear to mask the burden of child malnutrition that still exists in Vietnam. In particular, child stunting, or low height for age, still affects more than one-third of children in Vietnam. (NIN, 2010).

The setting for this research differs in important ways when compared with national level indicators. To begin with, poverty in Vietnam is largely concentrated in ethnic minority and mountainous communities. Two of the three provinces selected for the handwashing campaign, Hung Yen in the North and Tien Giang in the South have poverty rates that are well below the national poverty rate in 2006 of 20% at 11.9% and 6.2% respectively. Thanh Hoa province on the North Central Coast, however, has a higher poverty rate of 36.1% (Nguyen, et al., 2010). Secondly, 95% of the study sample identifies with the Kinh majority ethnic group, the largest of 54 officially recognized ethnic groups in Vietnam, and represented by 85.7% of the population nationally.[4] Finally, on key water, sanitation, and health indicators the study sample meets or exceeds the national level statistics. Ninety-six percent of households have access to an improved water source, 68% improved sanitation, 81% a place for handwashing with soap and water available, and just 14% of children under two are stunted at baseline.

Vietnam was selected for the HWWS project due to its engagement in handwashing promotion under the Public Private Partnership for Handwashing (PPPHW), a global handwashing initiative established in 2001. Handwashing promotion activities began in 2006 under the name of the Handwashing Initiative (HWI) with various partners including the Vietnam Ministry of Health, Women's Union and WSP. The HWWS project sought to improve and scale-up these efforts through capacity building of local organizations, such as the Vietnam Women's Union, training them in behavior change approaches, and providing technical support for development of behavior change communication campaign materials. WSP-supported HWWS activities targeted at caregivers and schoolchildren have been underway since 2007 in 7 provinces. These activities had a target of reaching over 2 million mothers and children with the goal of improving the handwashing

[3] MDG 4 seeks to reduce infant and child mortality by two-thirds
[4] Vietnam Population and Housing Census, 2009

behavior of 750,000, or approximately 37.5% of those reached (Water and Sanitation Program, 2011). The impact evaluation study covers a period of the caregiver communications campaign that was implemented between January and October 2010 in 3 of the 7 provinces, selected to be geographically representative of the north, central and southern regions of Vietnam. We refer to the intervention evaluated under this impact evaluation as the handwashing interpersonal communication campaign (HWIPC) in order to differentiate it from the larger and more comprehensive Vietnam Handwashing Initiative.

Hygiene behavior change, and handwashing campaigns in particular, have been regular components of disease prevention, water, and sanitation projects in Vietnam. Since the 1940s handwashing has been an integral part of national social development efforts by the government of Vietnam, including one major campaign effort known as the Three Cleans Movement which sought to educate the population on clean food, water and living conditions. Past campaigns have emphasized threat of disease as the main driver to get people to change their behavior, and have primarily focused on increasing knowledge about handwashing and transmission of disease in the target population. However, recent evidence from handwashing behavior change research suggests this may not be the most effective way to change behavior, but rather promotional messages should appeal to the emotion, habits and motivations of the target audience (Curtis, et al., 2009).

The HWIPC campaign was designed using a conceptual behavior change framework developed by WSP known as FOAM (Focus on Opportunity, Ability and Motivation)[5] (Coombes & Devine, 2010) . The framework draws on a range of well-known behavior change theories and models in health, psychology and the social sciences which hypothesize that a particular set of internal and external factors determine individual behavior, and that interventions which target these determinants will lead to behavior change.

The HWIPC campaign identified mothers of children under five as the primary target audience, but included other caregivers of young children, such as grandparents, in the target group given their involvement in childrearing in rural Vietnam. The available evidence suggests that effective handwashing among caregivers of young children; that is, handwashing with the right materials (soap and water) and at the right times (after contact with feces and before touching food) will reduce diarrheal disease burden in infants and children under five. As such, the caregiver campaign emphasized handwashing at critical times, after defecation and cleaning a child's bottom, before food preparation and before feeding children, rather than frequent or regular handwashing or handwashing by other family members.

[5] The FOAM framework is based on the PERForM model developed by Population Services International (PSI)

In order to identify the handwashing behavior change determinants specific to this target audience and behavior, the HWIPC carried out audience research in 2007 with mothers of children under 5 in rural and peri-urban areas from 8 provinces geographically representative of Vietnam. The research used a range of methods to elicit determinants of caregiver handwashing with soap, including product (soap) trials, in-depth interviews, focus group discussions, structured observations of handwashing and face-to-face structured surveys. The research found that the majority of mothers who report washing their hands do not find soap necessary and the tendency is to wash hands only when they smell or are visibly soiled. In addition, researchers found that soap was widely available in households but that cleansing agents were generally found in toilet and bathing areas, and far from cooking facilities (Indochina Research (Vietnam) Ltd., 2007).

The findings from the formative research led to the design of a communication campaign that focused on changing beliefs and addressing other motivational barriers to handwashing with soap. More specifically, messages highlighted the importance of using soap to wash hands and that even clean-looking and clean-smelling hands can harbor germs (belief determinants). The campaign sought to promote handwashing as something practiced by 'good mothers' to ensure the health and development of their children (locus of control determinant). In addition, communications activities emphasized the need to make soap and water available for handwashing (access and availability determinant).

A series of materials were developed for the campaign including a television ad with the messages "Hands are not clean if you wash only with water, soap is needed" and "Wash your hands with soap for the health and development of children"; posters showing the four key junctures for HWWS with the tagline: "Remember to wash your hands with soap for children's health and development"; a paper handout of the four key junctures poster for people to stick on their walls to remind them to wash hands with soap; and various promotional items such as stickers, hand clappers, and washcloths printed with the campaign logo and tagline.

The study evaluates the joint effect of mass media and interpersonal communication (IPC) activities at the community level compared with mass media alone[6]. Given the lack of control group for the mass media arm we are unable to evaluate the effect of this component separately. The components are described in detail below:

[6] The HWWS Project initially included a third component of direct consumer contact (DCC) activities. These were intended to be 1-day events in each treatment community. Due to difficulty of finding qualified firms and the limited scale of the DCC interventions the DCC activities were never carried out. This component was thus dropped from the study.

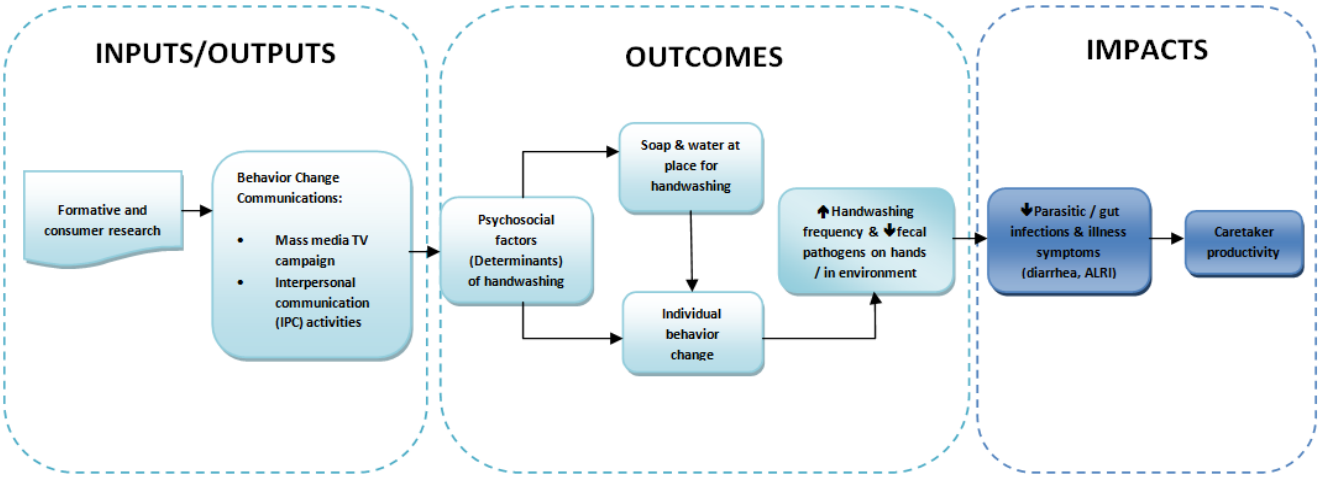
**Component 1—Mass Media Campaign:** The mass media campaign features 30 second and 15 second television spots carried out across ten popular national and regional channels. The frequency and timing of the spots varied over time in an effort to reach the target audience as often as possible. The television ad makes use of the popular Vietnamese tradition of proverbs and songs to teach children and incorporated the song 'Five Clean Fingers', the lyrics of which are: "One plus one is two. Two plus two is four. Four plus one is five. All five fingers clean." The campaign comprised a total of 363 national and 165 local television spots that ran from March 2010 to January 2011.

**Component 2—Interpersonal Communication (IPC) Activities:** The Vietnam Women's Union (VWU), a mass organization with over 13 million members, carried out an extensive training program for over 14,000 (20-26 per commune) village health workers, teachers, and Women's Union members on how to promote group and household level IPC activities that reinforce handwashing with soap behavior in the target population. These trained handwashing motivators were responsible for carrying out IPC activities in their communities, including group meetings with mothers of children under five, grandparents, and women between the ages of 18-49, household visits, market meetings, loudspeaker announcements, Women's Union club meetings, handwashing with soap festivals, cooking contests, and distribution of HWWS informational and promotional materials at key locations in the village. These activities took place over a period of approximately 9 months.

## 3. EVALUATION DESIGN

The study uses a cluster-randomized controlled trial impact evaluation to establish the causal linkages between the HWIPC campaign and the outcomes of interest. The study's theory of change is illustrated in Figure 1. As discussed in the previous section, the project carried out formative research, leading to the design of a behavior change communication campaign comprising mass media and interpersonal communication activities with the target audience. These activities were hypothesized to change behavioral determinants of handwashing, resulting in increased access and availability of handwashing materials in the household, individual behavior change, and reduced household and environmental contamination. Finally, improved handwashing behavior among caretakers was hypothesized to result in reductions in diarrhea and acute-respiratory infections in young children, relieving caregivers of the burden of caring for their sick children and resulting in increased time for more productive activities.

**Figure 1: HWIPC campaign theory of change**




### 3.1. Treatment assignment and sample selection

Since the intervention was carried out at the commune administrative level, and was designed to be confined to the geographic borders of the commune, treatment assignment was made at the commune level.[7] Starting with a list of 401 communes across 18 districts in the three intervention provinces, a total of 15 rural districts (*huyện*) were selected by the VWU to participate in the experimental phase of the HWIPC. These districts were selected because of dense population and willingness, commitment, and capacity of VWU staff to carry out the planned activities. Five districts were chosen in Hung Yen, 4 in Thanh Hoa, and 6 in Tien Giang. Within the 15 selected districts a total of 315 rural and urban communes (*xã* and *Thị trấn*) were used as the sampling frame. The sample was first stratified by province to account for regional variation between the provinces. Then, within each province communes were matched into groups of three using the *Mahalanobis* matching metric, to minimize the statistical distance between the units based on population size, number of households, and geographic location (coastal, flat, or mountainous area). A total of 70 groups of three were then randomly selected into the study (24 in Hung Yen, 20 in Thanh Hoa and 26 in Tien Giang).[8] As a final step, the communes in each group of three were randomly assigned to one of three arms to account for the original design of the evaluation that comprised

[7] A Vietnamese commune is an administrative sub-division of the district. The average population of the communes in this study is 7,577 people (1,807 households) with a population range of 409 to 27,898 (172 to 5,531 households)

[8] The VWU imposed a restriction that no more than 40 communes could be selected for implementation of the HWIPC project in Thanh Hoa province, thus only 20 matched triplets were selected.

of two separate treatment arms.[9] A total of 140 communes were assigned to treatment and 70 to control. [10] [11][12]

The study was designed to detect a 20% relative reduction in the primary outcome indicator of diarrhea in children under five. This called for a sample size of 3,150 households; 15 households in each commune with at least one child under the age of two at baseline. The study focused on households with children under two in order to capture changes in outcomes for the age range during which children are most sensitive to changes in hygiene in their environment. To assess impact, outcomes in the treatment group (D) are compared against outcomes in the control group (C). Both the treatment and control group comprise a representative sample of the population of households in intervention communes with at least one child under the age of two at baseline, however the sample is not representative of the Vietnam, nor should it be taken to represent the communes and districts where the HWIPC campaign took place. [13]

Approximately one month prior to the baseline survey a list of all children under the age of two was obtained from the health post in each commune. From this listing a random selection of 15 households was made with an additional 10 replacement households selected to accommodate households that refused to participate in the survey, or to replace households that did not meet eligibility criteria at the time of the survey. Households in which specially trained community motivators lived were excluded from the sample, since these volunteers would later play a role in delivering handwashing messages to the community. For structured observations carried out at the endline survey a sample of 600 households (2 – 3 per commune) were randomly selected from among the 3,150 households.

### 3.2. Data collection

Data were collected for this study in three rounds. For the first round, a baseline survey was carried out from September to December 2009 before the intervention began in 3,149 households. A midline monitoring survey was carried out in the same households in July 2010. Finally, 1 – 4 months after

[9] A direct consumer contact (DCC) component of the intervention was dropped during the implementation stage but these communes were maintained in the study

[10] The remaining 191 communes were not part of the evaluation sample and did not receive the IPC project interventions, but were exposed to the national and regional level TV ad campaign.

[11] For map of intervention communes see (Chase & Do, 2010)

[12] Random assignment of treatment, whereby a statistically random selection of communities receives the treatment and the remainder serve as controls, gives us a robust counterfactual to measure the causal effect of the HWIPC intervention. The randomization process ensures that on average the treatment and comparison groups are equal in both observed and unobserved characteristics, (Hernan, et al., 2004) and that an appropriate counterfactual can be measured.

[13] See (Chase & Do, 2010) for discussion of representativeness of the sample

intervention activities had ended in October 2010,[14] an endline household survey was carried out in 3,147 households (December 2010 – March 2011). Approximately 5.7% of households could not be reinterviewed at the endline survey mostly due to temporary relocation. These households were replaced by the next household on the list of replacement households that had been pre-selected during the baseline. A community survey was also carried out in the 210 communes with village and commune officials during the baseline and endline rounds of data collection. See Table 1 below for an overview of data collected throughout the study.

**Table 1: Data collection tools**

| Instrument | Baseline (Sep-Dec '09) | Midline (July '10) | Endline (Dec '10 – Mar '11) | Description |
|---|---|---|---|---|
| Household questionnaire | ✔ | | ✔ | Conducted in all households. Includes: roster, demographics, labor, income, assets, spot-check observation of handwashing facilities, handwashing behavior, handwashing determinants, dwelling characteristics, water sources, drinking water, and sanitation |
| Child health questionnaire | ✔ | ✔ | ✔ | Conducted in all households. Includes: caregiver reported health symptoms for 7 day recall |
| Exposure module | | ✔ | ✔ | Conducted in all households. Includes: caregiver exposure to HWIPC campaign |
| Community questionnaire | ✔ | | ✔ | Conducted with group of key informants in all communes. Includes: socio-demographics of community, accessibility, connectivity, education and health facilities, water and sanitation facilities, and government or other development projects |
| Anemia & Anthropometrics | ✔ | | | Conducted on all children < 2 years. Includes: height, weight, head and arm circumference, hemoglobin measurement |
| Structured observations of handwashing | | | ✔ | Conducted in 600 households. Includes: 3 hour observation of household activities to record handwashing behavior of primary caregiver of oldest child under two years |

[14] IPC activities were most intensive from January to July 2010

The survey instrument was developed by a group of experts in economics, epidemiology, child development, nutrition, and behavior change. All instruments were translated into Vietnamese, back-translated into English, and pre-tested prior to use in the field. Data collection instruments were administered to respondents in Vietnamese by native speakers.

The National Institute of Hygiene and Epidemiology (NIHE) was contracted to conduct the field work for the baseline and midline survey and Mekong Economics (MKE) was contracted for the endline survey. With support from the principal investigator and the global IE team, the survey firm trained field supervisors and enumerators on all data collection protocols and instruments during a 3-day training in each province, separately for baseline and endline rounds of data collection.

Field teams for the baseline survey consisted of one supervisor who oversaw quality control of the interviews, one health technician responsible for interviewing the household, and one laboratory technician responsible for child anthropometrics and hemoglobin measurement, in addition to two members of commune level health cadres responsible for backstopping child growth measures and administering the child health calendar for the baseline and midline survey. Activities in each province were supervised by a field manager from NIHE.

Survey team structure for the endline survey was largely similar. A provincial field manager oversaw two teams, each comprising one supervisor and six enumerators. Since anemia and anthropometrics were not part of the endline survey, specially trained health technicians were not necessary. Therefore, each enumerator was responsible for administering the household questionnaire and structured observations. The community questionnaire was administered by a senior enumerator. The survey teams were supported by a commune liaison officer who was responsible for setting up household interviews and ensuring adequate replacement households in the case of households no longer willing to participate, respondent unavailability and / or vacant households.

### 3.3 Baseline balance and sample attrition

The baseline report for this study presented a series of balance tests comparing each treatment group (D1 and D2) to the control group. Due to changes in implementation during the study that removed differences between the two treatment groups, and the loss of three communes due to changes in administrative borders, here we recalculate baseline balance between the merged treatment groups with

the control group.[15] Tables 2.A through 2.J present mean comparison tests[16] between treatment and control for key variables collected during the baseline survey. The null hypothesis of equality of means was rejected at the 10% level in 8.4% of the tests on key characteristics (12 out of 143 tests). Random chance would predict we reject the null 10% of the time, so we are confident that the randomization was carried out successfully. Along key handwashing behavior, child health and development outcomes there is balance between the treatment and control arm at baseline, except for length/height for age z-score, which is -0.756 standard deviations below the median in the treatment arm as opposed to -0.604 in the control arm (p=0.069). However, the raw length measures are balanced so the difference is more likely due to age variation.

The study was able to successfully follow up over 94% of households across the three rounds of data collection, with no differential attrition found between treatment and control arms (Table 3A). The households that were successfully followed up were compared across key baseline demographic and socioeconomic characteristics to determine if they differed in important ways that could be correlated with the treatment (Table 3B). We find no significant differences between treatment and control *panel* households. Additionally, we conduct mean comparison tests for those households that were included as *replacement* households during the follow-up survey (Table 3C). Several characteristics, such as number of livestock owned, availability of soap and water at or near the toilet and soap available anywhere in the home are higher in the control arm, suggesting that these household are somehow better off, at least along these dimensions. When we compare the entire endline sample (panel plus replacement) on characteristics presumably independent of treatment, we find there are still differences in livestock ownership and that control households are more likely to have access to an improved water source. While access to an improved water source is an important characteristic, it is over 95% for both groups and thus is not likely to help explain much of the variation in outcomes across households. Therefore, we maintain the full sample of panel plus replacement households in all models for estimation of impact.

In addition to household attrition we analyze attrition of caregivers as they are the primary target of the HWIPC campaign and the main respondent for the household survey (Table 3A). Importantly, the study defines the primary caregiver as the person who has spent the most time with the child over the past 6 months, usually the mother. Between baseline and endline approximately 26% of primary caregivers

[15] Balance tests using original treatment assignment are available in the Scaling Up Handwashing Behavior: Findings from the Impact Evaluation Baseline Survey report

[16] The standard errors used in the comparison of means tests were clustered at the commune level, allowing for the possibility of intra-commune correlation.

changed. New caregivers are on average older, less educated and more likely to be male.[17] In rural Vietnam when a child reaches the age at which he or she is no longer breastfeeding it is common for mothers to leave him with the grandparents or other family members during the daytime while she works in the fields.[18] This could explain the shift in demographics of the primary caregiver, since both grandmothers and grandfathers tend to take on the role of caregiver in these cases. Since the HWIPC intervention was targeted at caregivers, including grandparents, we leave these new caregivers in the sample for estimation of program impact on outcomes at the caregiver level but include a dummy in the adjusted models to indicate there has been a change in caregiver.

## 4. EVALUATION METHODOLOGY

Since the evaluation of the HWIPC campaign was prospectively designed as a randomized experiment the evaluation is relatively straightforward. Given a robust counterfactual generated through random assignment we are able to assess the causal impact of the HWIPC campaign by simply comparing average outcomes between those communes assigned to treatment to those communes assigned to control. This is what is known as the intention-to-treat parameter (ITT). Randomized assignment of $Treat_i$ in the HWIPC campaign ensures that $E(\varepsilon_i \mid Treat_i) = 0$ such that the unadjusted OLS estimates of $\beta$ will be unbiased. Additionally, we may choose to control for baseline characteristics known to be strongly correlated with the outcome. Since observed characteristics were balanced across the treatment arms at baseline, inclusion of these covariates does not change the results, but results in more precision of the estimates.[19] Where possible, we control for the outcome at baseline. Both unadjusted and adjusted estimates are reported.

To examine the overall impact of the HWIPC campaign, for each outcome of interest, we estimate the ITT parameter using the following regression for 207 of the original 210 communes (unadjusted model)[20]:

$$(1) \quad Y_i = a + \beta Treat_i + \varepsilon_i$$

[17] Throughout the paper we sometimes refer to the primary as 'she' even though 5.7 percent of primary caregivers are male in the study sample

[18] Based on personal communication with project staff

[19] While inclusion of time-invariant $X_i$ can increase the efficiency of the estimates, it may also lead to bias since randomization does not ensure that $E(\varepsilon_i \mid X_i, Treat_i) = 0$ . See (Freedman, 2006) and (Lin, 2011).

[20] Three of the original 210 communes are dropped from the analysis since administrative borders were reassigned during the study, Thoi Son and Phuoc Thanh communes did not receive the handwashing intervention although at the time of treatment assignment they were assigned to treatment. Four villages of Thanh Phu, originally a control commune, were moved to Phuoc Thanh commune, assigned to treatment.

Where $Y_i$ is the outcome of interest for individual or household i, $Treat_i$ is a dummy equal to 1 if the household has been randomized to treatment and 0 otherwise. Where outcomes are highly correlated between baseline and endline we add the outcome observed at baseline to the right hand side of the equation to increase the precision of our estimates[21], as shown below in Model 2 (lag dependent variable model):

$$(2)\quad Y_i = a + \beta Treat_i + \tau Y_{i1} + \varepsilon_i$$

Where $Y_{i1}$ is the lagged dependent variable for individual or household i at baseline. In Model 3 (full model) we add caregiver age, education and sex for caregiver level outcomes, and caregiver education, child age and sex for child level outcomes. In addition we add an indicator for the province and month of interview to account for seasonality of some health outcomes and the systematic difference between when the endline survey was carried out in treatment group 2 (D2) and treatment group 1 (D1)/control communities, $X_i$:

$$(3)\quad Y_i = a + \beta Treat_i + \tau Y_{i1} + \delta X_i + \varepsilon_i$$

Finally, Model 4 (DID) is the double difference estimate where the parameter of interest is $\delta$:

$$(4)\quad Y_i = a + \beta Treat_i + \lambda t_i + \delta(Treat_i \cdot t_i) + \varepsilon_i$$

All regression estimates include triplet dummies for each treatment and control matched triplet, and cluster-randomized standard errors since the experiment was clustered at the commune level.

## 5. ESTIMATING PROGRAM EFFECTS

In this section we present the main results of the HWIPC campaign. Results are presented along the hypothesized causal chain of handwashing behavior change (Figure 1) leading from exposure to the campaign and its messages, the effect of campaign exposure on knowledge of handwashing, the effect of the intervention on changes in behavioral determinants of handwashing, handwashing behavior, child health and, finally, caregiver productivity.

The results tables are organized by outcome grouping following (Figure 1) with each row representing a different outcome. The main results are shown in Tables 4 – 10 for the entire sample. Reading the tables

[21] This is highly unlikely for acute child illness outcomes (see Schmidt 2011 for example)

from left to right, Column 1 is the mean and standard deviation of the variable at baseline in 2009, if available[22]. Otherwise, the first column is the mean and standard deviation of the outcome variable for the control group at follow-up (midline for exposure and endline for all other outcomes). The next column is the coefficient and standard error on the outcome variable from the intention to treat estimation equation (1) presented in section 4.1 above. Since we estimate a linear probability model the coefficient can be interpreted as the marginal effect of treatment such that the average outcome in the treatment arm is the sum of the control mean and the coefficient. The remaining columns show the conditional mean effect of treatment on the outcome variable from the intention to treat estimation equation for the respective models presented in section 4.1. Impact estimates reported in the text are absolute percentage point differences estimated from the full model except for household exposure to the campaign (Table 4) which reports on the unadjusted model.

### 5.1. Exposure to the HWIPC campaign

As the HWIPC was designed as a behavior change communication campaign, expected impact depends on sufficient exposure to the campaign. Program designers theorized that the most effective way to change behavior would be to reach the target audience with a consistent message through multiple channels. Thus, the campaign used 4 distinct channels: mass media TV ads, print materials, interpersonal communication (IPC) through household visits or face-to-face group meetings, and community events. Exposure to these channels and messages was measured midway through the campaign by asking primary caregivers whether they remember seeing or hearing anything about handwashing in the past month. [23] The respondent was asked to spontaneously recall what messages she heard, from whom or where she heard them, and the frequency of the exposure.

Caregivers in the treatment group were approximately 10% more likely to report high exposure to the campaign, defined as exposure through more than 3 channels. They were likewise more likely to have talked to someone from the Women's Union about handwashing in the past month (56.4% in treatment vs. 34.7% in control). However, on average respondents in the control arm reported exposure to handwashing messages via 2.8 channels and 46% reported exposure to more than 3 channels. At least one of these

[22] Given underreporting of child health symptoms at baseline difference-in-difference estimates are not presented for child health outcomes

[23] The exposure module asked about activities that took place over the previous month. A one month recall period was used in order to balance recall bias with targeting to the intervention. All activities were underway during the month prior to the midterm survey. Exposure was measured at the endline survey as well, however since the question asked about exposure in the past month and the intervention had ended more than three months before endline, these results are not analysed here.

channels, the mass media TV ad, was aired in both treatment and control communities, and thus we might expect control households to report hearing or seeing something about handwashing in the past month from 1 channel on average. However, it is not clear why nearly 50% of control arm respondents reported exposure to handwashing promotion through 3 or more channels. It could be that messages about handwashing are now more common in rural Vietnam due to recent concerns surrounding H1N1 and Avian influenza infection. Likewise, private soap companies rigorously promote their products in rural Vietnam and routinely carry out large marketing campaigns, sometimes in partnership with researchers and government agencies[24], so exposure to handwashing messages could come from sources other than the HWIPC.

### 5.2. Effect of the HWIPC campaign on caregiver knowledge, beliefs and attitudes

Prior phases of the handwashing initiative, carried out by the MOH, had spent their efforts on educating the target audience on how, when and why to wash hands with soap, and formative research had shown that knowledge was already high in the target audience. Baseline figures confirmed this, with 79.4% of caregivers reporting that the best way to wash hands is with soap and water. Thus, educating the target audience was not an explicit objective of the campaign (Nguyen, et al., 2011). Instead, the campaign sought to influence the motivating factors and barriers that were identified as determinants of handwashing to effectively translate that knowledge into action.

Knowledge is measured here as a necessary, but not sufficient, requirement for behavior change. Overall, knowledge about the best way to wash hands increased from a baseline of 79.4% to 97.3% at endline in the control arm, with a similar increase found in the treatment arm. Additionally, knowledge about the importance of handwashing and soap use in prevention of diarrhea was found to be higher in the treatment group (84.9% in control vs. 87.8% in treatment). The HWIPC campaign emphasized four critical junctures for handwashing: After defecation and touching a child's feces, before food preparation and before feeding / breastfeeding a child. While a majority of respondents from both arms know that handwashing after using the toilet is important (77%), nearly11% more respondents in the treatment arm stated 'before preparing food' as an important time for handwashing with soap (29.6% in control vs. 40.5% in treatment).

[24] Soap company Lifebuoy claims that nearly half of the brand's soap consumption occurs in rural areas of Asia where the majority of the population lives on less than $1 per day

As described above, the HWIPC campaign sought to influence motivating factors and address barriers to effective handwashing using the FOAM framework. Behavioral determinants such as locus of control, beliefs and access/availability were measured in the target population using a series of Likert scale[25] statements, and the behavioral constructs tracked over time to see how they respond to the program.[26] These findings are presented in Tables 6A and 6B. In particular, we find that some of the statements measuring beliefs were responsive to the program (e.g. You only need to wash hands with soap, if they look dirty or smell bad; You only need to wash hands with soap if you touch unhygienic objects). In the treatment group 3.7% (41.2% in control vs. 44.9% in treatment) and 6.2% (43.2% in control vs. 49.4% in treatment) more caregivers disagreed with these statements respectively, i.e. they gave the correct answer. In addition, some of the statements measuring automaticity or habit were also found to be responsive to the program (e.g. You start washing your hands before you realize you are doing it; You wash your hands with soap automatically; You have to think about it each time you wash your hands with soap), although the effects are small. As we discuss below, despite some movement along these measures in response to the campaign, we do not observe changes in handwashing behavior as hypothesized.

### 5.3. Effect of the HWIPC campaign on handwashing behavior

Asking respondents to self-report their behavior is a simple, low-cost metric commonly used to obtain population estimates of the prevalence of handwashing behavior and to gauge the effectiveness of handwashing campaigns. However, self-reported measures alone cannot be relied upon to give accurate point estimates of prevalence of handwashing behavior. Due to the perceived social desirability of handwashing these measures are subject to substantial bias (Stanton, et al., 1987; Manun'Ebo, et al., 1997; Biran, et al., 2008). Respondents may over-report handwashing because they believe it is the right thing to do or because they fear being judged by the interviewer and others around them. Several methods have been developed and tested in an effort to get more valid rates of handwashing. These methods have had differing degrees of success, validity, reliability and cost (Ram, 2010).

In this study, several different methods were used to triangulate the results as well as to gather evidence on the reliability and bias of particular measures (Ram, et al., 2012). The results of the campaign in

[25] A Likert scale evaluates a series of statements in which the respondent is asked to provide their level of agreement / disagreement with the statement. In this study the following levels were used: strongly disagree, disagree, agree, strongly agree. The statements administered did not provide an option for 'neither agree nor disagree', however respondents could provide the response 'Don't Know'

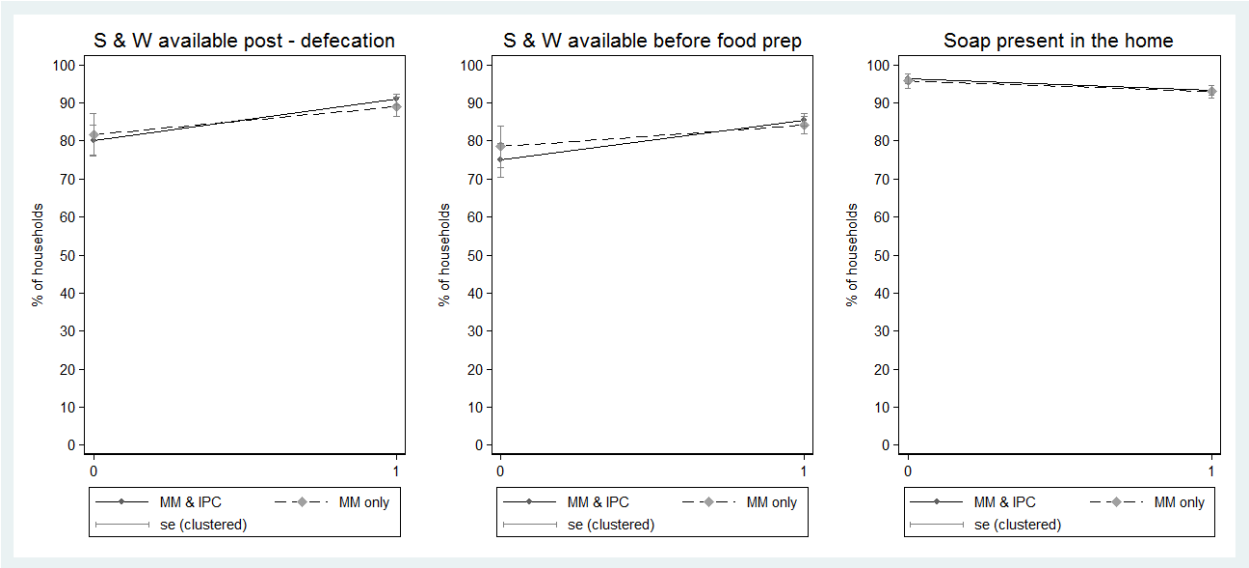
[26] Factor analysis of the Likert scale was unable to reveal a robust underlying construct for any of the behavioral determinants, so only individual statements are analysed here. See (Hernandez, 2012) for discussion of the analysis of behavioral determinants in Vietnam.

regards to handwashing behavior are presented as three separate panels in Tables 7 – 9: availability of handwashing facilities and cleansing agents, self-reported handwashing with soap and observed hand cleanliness, and structured observations of handwashing behavior.

Facilities for handwashing were observed in each household at baseline and endline. Respondents were asked whether or not family members wash hands with soap after using the toilet and before food preparation. If they responded yes, enumerators asked to observe where handwashing took place. At each handwashing place in the household enumerators recorded the distance in meters to either the toilet or food preparation area, the type of handwashing device (basin, bucket, etc.), and whether water and soap were available at the place for handwashing.

At baseline 80.7% of households already had access to a place for handwashing with soap and water at or near the place of defecation and 76.4% had a place at or near the food preparation area of the household. Moreover, some type of cleansing agent (liquid, bar or powder soap) was available in nearly all households surveyed (96.2% at baseline). Even with this high baseline, a general trend is observed over time in both groups whereby soap and water in both places (defecation and food preparation) increased by approximately 10 percentage points (see Figure 2). A statistically higher increase in soap and water availability at the place of defecation is observed in the treatment arm (89.0% vs 91.6%), but the magnitude of the difference between treatment and control at endline is small.

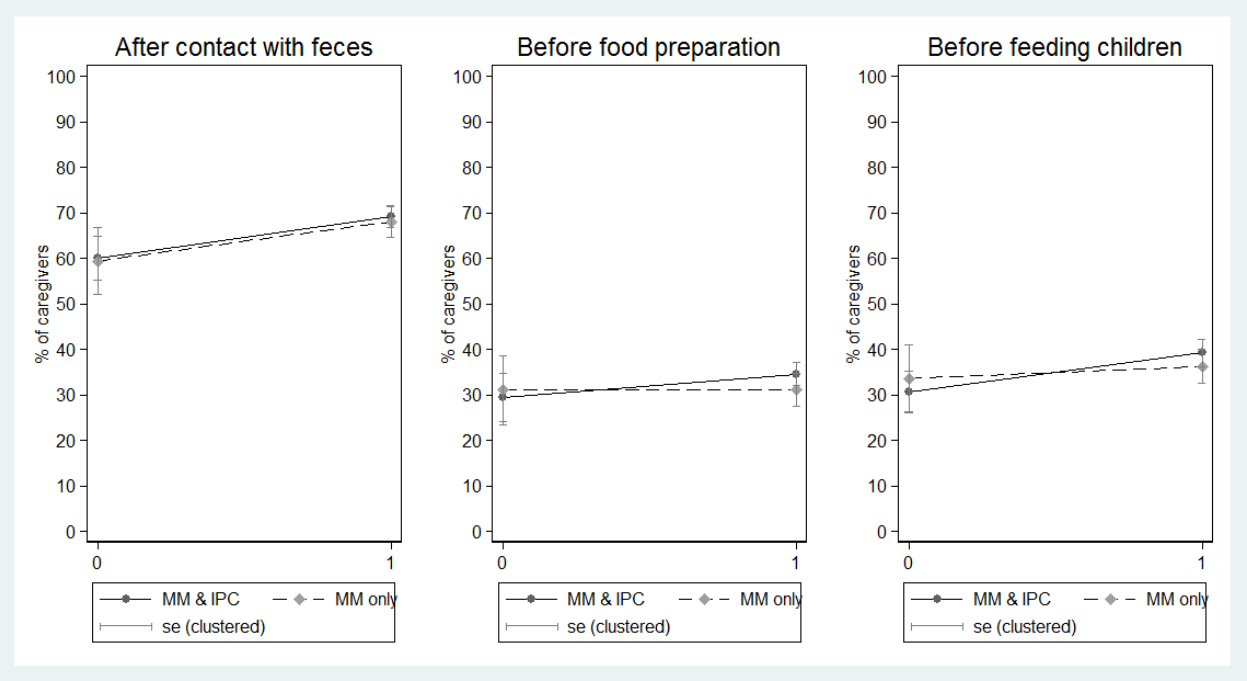
**Figure 2: Trend in availability of handwashing facilities and cleansing agents**




Note: Figures show the trend from baseline (2009) to endline (2011) on availability of soap and water for handwashing in the household for treatment group receiving mass media (MM) and interpersonal communication activities (IPC) versus control group receiving mass media only

To measure self-reported handwashing behavior, caregivers were asked to recall over a period of 24 hours prior to the survey the circumstances under which they last washed their hands with soap. They were then asked to report all other times they washed their hands with soap during this time. At baseline 59.9% of caregivers on average reported to wash their hands with soap after fecal contact (after using toilet and after contact with child's feces), 30% before food preparation, and 31.6% before feeding or breastfeeding a child [27]. At follow-up self-reported handwashing increased at all critical junctures measured (see Figure 3), with statistically significant differences between treatment and control in self-reported handwashing after fecal contact (68.1% vs. 73%) and before feeding/breastfeeding a child (36.3% vs. 41.4%).

**Figure 3: Trend in self-reported handwashing behavior at critical times**




Note: Figures show the trend from baseline (2009) to endline (2011) on self-reported handwashing measures for treatment group, receiving mass media (MM) and interpersonal communication activities (IPC) versus control group receiving mass media only

Given the known biases of self-reported behavior, the study emphasized a series of objective measures of handwashing, including visual inspection of the hands of caregivers to assess cleanliness, and observations of handwashing in a sub-sample of households selected for the endline survey.[28] There were no evident differences in cleanliness of caregivers' hands between treatment and control when controlling

[27] For comparison of self-reported measures see WASH Child Nutrition report (after defecation 36.2%; before eating 22.8%, before preparing food 19%; after helping child stool 14.9%) (MOH 2010)
[28] Structured observations were not carried out during the baseline survey

for covariates. However, overall hand cleanliness appears to have decreased at follow-up, but this could be due to the difficulty of standardizing such observations.

Direct observation of handwashing is considered the gold standard for measuring handwashing, although even these are subject to bias if the person being observed changes his or her behavior in the presence of an observer (Ram, et al., 2010). Furthermore, the reliability and repeatability of this measure has been questioned (Cousens, et al., 1996). Nevertheless, structured observations are the most objective measure of handwashing available in this study. Observations were carried out in a subset of 600 households in treatment and control arms. They took place prior to the main endline survey over a 3 hour period in the morning, typically from 6:00AM to 9:00 AM[29], and focused on the primary caregiver of the oldest child under 2 in the household, and the child under his or her care. Enumerators received extensive training on how to conduct structured observations and were instructed to be discreet and unobtrusive and to focus their observation on exposure events, i.e. food preparation, feeding children, eating, after using the toilet, not on when handwashing took place. Households were informed that the enumerator would be observing daily household activities.

The analysis of structured observations focuses on the primary caregiver since she is the main target audience for the intervention. The results are presented separately for two handwashing behaviors: rinsing with water only and using soap. Unadjusted estimates indicate rinsing of hands before food preparation is more common in treatment households, and that overall the percentage of exposure events that were accompanied by handwashing is higher in the treatment group, however we find no evidence of a difference between treatment and control on observed handwashing rates when controlling for covariates. Furthermore, the rates observed suggest that handwashing with soap is still only practiced by a minority of the target population.

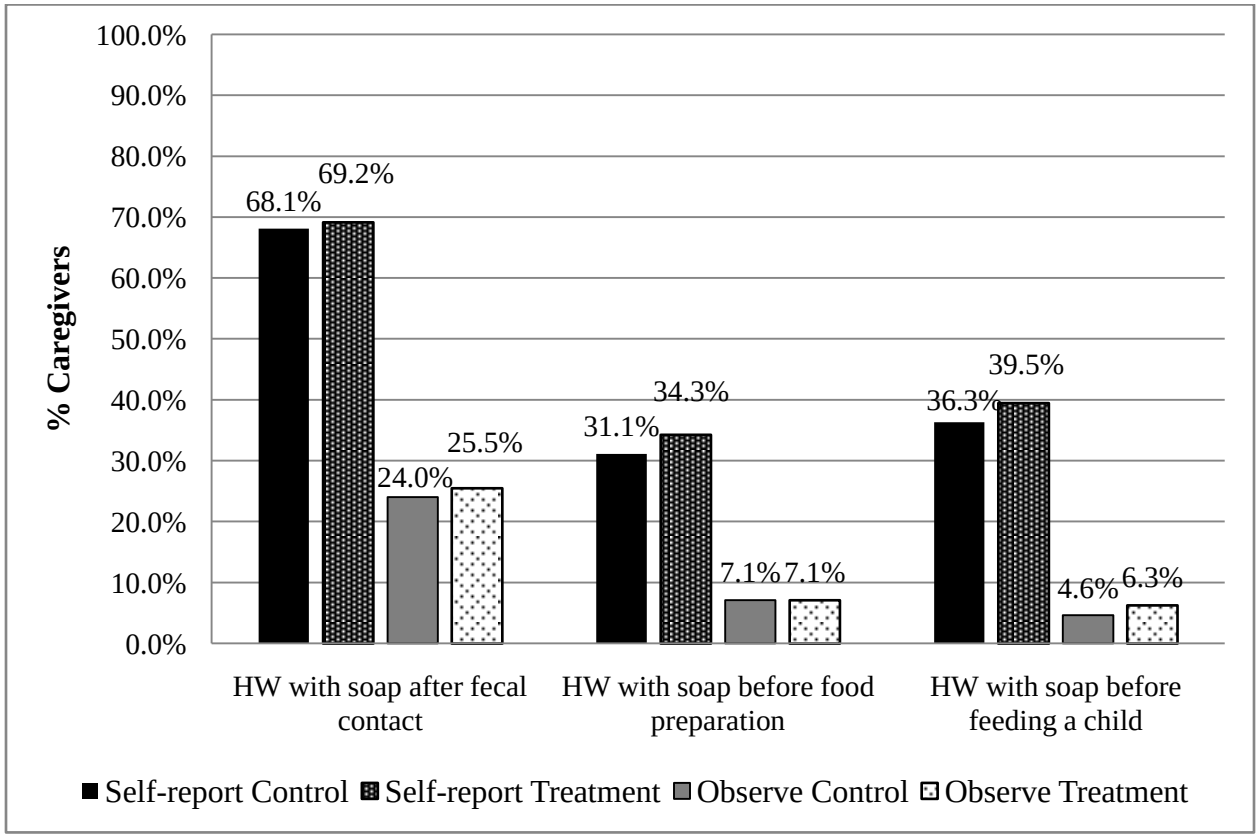
As demonstrated in previous studies, observed handwashing in this study is considerably lower than self-reported behavior. Figure 4 presents self-reported and observed handwashing behavior side by side to illustrate this variation. Whereas 69.2% of caregivers in the treatment group *report* to wash hands with soap after fecal contact, only 25.5% of fecal related exposure events were *observed* to be accompanied by handwashing with soap.[30] The differences hold for all critical junctures measured. Keeping in mind that proxy measures that use availability of a place for handwashing with soap and water present suggest handwashing prevalence after defecation of around 91% in treatment and 89% in control it is clear that

[29] During pretesting of the survey this time period was recommended by households and community members as the most opportune time to observe the caretaker activities in the home

[30] On average caregivers were observed during 1.54 fecal contact events, 1.29 child feeding events and 1.87 food preparation events per household in the structured observation sample

self-report and proxy may serve as indicators of the *direction* of impact, but cannot be relied on to provide anywhere near accurate point estimates.

**Figure 4: % Caregivers reporting handwashing with soap vs. % exposure events accompanied by soap use**




Note: Figures are unadjusted means in treatment and control arms

Given the inherent bias in self-reports and low reliability of proxy indicators, can we trust the observed measures to provide accurate point estimates? To begin with, comparisons between self-report and observed measures demonstrate that the structured observations in this study were likely not subject to the high levels of reactivity that have been found in other studies (Ram, et al., 2010). However, we cannot rule out reactivity and the levels observed (25.5% after fecal contact, 7.1% before food preparation, and

6.3% before feeding a child) should be viewed as upper bounds of actual behavior. Second, the prevalence of handwashing with soap suggested by these findings is in line with other recent studies that have observed handwashing behavior. One recent 11 country review found the prevalence of handwashing after using the toilet to be 17% on average (Curtis, et al., 2009). A baseline study in rural Bangladesh (Halder, et al., 2010) observed 33% of mothers washing their hands with soap after defecation and fewer than 1% before eating and feeding a child. Washing hands with water only was more common: 23% were observed to do so after defecation and 5% before eating. These findings are in line with results for the treatment group in Vietnam (35 and 6% respectively).

### 5.4. Effect of HWIPC on child health and caregiver productivity

Given the lack of substantial changes in handwashing behavior resulting from the HWIPC campaign we do not anticipate impacts on child health outcomes or caregiver productivity. Indeed, we find no impact on caregiver reported diarrhea symptoms or acute respiratory infection[31]. However, symptoms indicative of acute lower respiratory infection, short breath with cough or difficulty breathing, are reportedly lower in the treatment group and the differences are large: approximately 34% relative reductions (prevalence is 4.4% in control vs. 2.9% in treatment). Handwashing with soap has previously been shown to be associated with reductions in lower respiratory infections (Rabie & Curtis, 2006), but the evidence is far from conclusive. Without concurrent compliance data showing handwashing behavior has increased in the treatment arm these results should be viewed with caution.

As we might expect given that no impacts were found on child health, there was no impact on caregiver productivity, measured as instances of time lost to care for a sick child.

## 6. DISCUSSION

In this section we present some hypotheses that have emerged as potential explanations for the limited impacts of the HWIPC campaign on handwashing behavior and describe some limitations of the study. While none of these hypotheses have been properly tested, they should nevertheless help put the findings into context and potentially guide future research.

[31] The analysis excludes health symptoms measured at baseline. Extremely low prevalence of diarrhea (1.2 percent 7-day recall period prevalence) and other health symptoms led the research to conclude that health symptoms were likely underreported.

Given the large scale of the HWIPC campaign and the use of a mass organization in partnership with national government agencies to implement the intervention, there was limited control by the project implementing team over intervention activities at the commune and village level, with the result that actual implementation of the intervention reflects more closely 'real-world' conditions as opposed to trial conditions. Efforts were made to standardize the behavior change messages and delivery of those messages by village motivators, but there is no way to confirm that motivators 'stayed on message'. In fact, field supervision visits by the country implementation team suggested that some motivators tended to overemphasize health messages and germ theory and reverted to delivering the messages in a didactic manner, despite training that emphasized participatory methods. In terms of whether the activities actually took place, the Women's Union reported on the number and type of activities that were carried out in each commune and district, and the number of participants at each event as part of its contractual obligation with WSP. These monitoring data show that all activities (and in some cases more) took place as planned in the time frame expected. While systematic third party monitoring data on these activities do not exist, the program implementation team expressed confidence that the activities were carried out.

The HWIPC campaign relied on a common formula for behavior change in Vietnam: commune meetings, face-to-face communication, loudspeaker announcements and mass media print and television, with grassroots behavior change led by mass organizations like the Women's Union[32]. The methodology, in the case of the HWIPC, necessarily relied on the active participation and engagement of mothers and caregivers during meetings and home visits in order to be fully effective. However, engaging all mothers and caregivers in a commune can be a challenge given the competing demands that rural households face. Qualitative research on gender norms in Vietnam has shown that rural Vietnamese women are often overwhelmed by the demands of private and public commitments and find it difficult to meet the expectations of their family and community to simultaneously care for children, work on the farm and tend to the household chores, in addition to attending obligatory commune and club meetings (Schuler, et al, 2006). Most meetings with mothers were scheduled in the evenings to maximize participation, but it's possible that women did not actively attend or engage in meetings given the constraints on their time. Village handwashing motivators were instructed to visit the homes of caregivers who failed to attend, but even a few absentee mothers at each meeting would mean an additional burden on the motivator. Since it was these meetings and participation in one-on-one conversations that differentiated the treatment arm from the control arm, full participation seems a necessary (although perhaps not sufficient) criterion for behavior change.

[32] The Farmer's Union, Communist Youth Union, and Vietnam Veteran's Association are other mass organizations found in nearly every rural commune that are active in poverty reduction programs in rural Vietnam

Large-scale effectiveness trials are subject to contamination of control areas by contemporaneous projects, or alternatively, ongoing health and development projects that could have an impact on the outcomes studied across both treatment and control arms, leading to no differential impacts in the treatment arm. To investigate this possibility, data were collected in January 2012 from provincial authorities on other hygiene or health related activities and projects that were underway from 2009 – 2010. We found several concurrent provincial wide projects underway during the study period. In particular, the education and communication component of the National Target Program on Rural Water Supply and Sanitation (NTP II) in Tien Giang reportedly emphasized HWWS through training of village health workers and worked with VWU as a partner. All three provinces reported Avian Influenza (AI) projects over the period as well as yearly diarrhea and general disease prevention campaigns. Many of these projects make use of similar channels (mass media, IPC, group meetings) and methodology (cascade training) as the HWIPC. Handwashing specific campaigns over the study period include the Unilever supported 'Share Love Not Germs' campaign alongside the Ministry of Health Department of Preventive Health in 10 provinces (2006 – present), the UNICEF Water, Sanitation and Health Program and various NGO programs (Plan International, Church World Services, East Meets West, etc).

The timing of the endline survey itself in relation to the intervention implementation schedule determines what effects ultimately get measured. Some communes in the study were surveyed up to four months after IPC activities had completed in October 2010,[33] but the most intensive IPC activities happened between January and July 2010, followed by less intensive household visits and an additional group meeting in October 2010. Therefore, a full eight months had passed in some communes between when the 'intensive' implementation ended and follow up measures were taken. If changes in behavior were stimulated by the intervention and over time these behaviors diminished we would expect the pooling of D1 and D2 treatment groups to have a downward bias on the behavior change estimates. However, analysis of impact for only those communities in the D1 treatment group does not reveal any differences when compared with the combined D1 and D2 results (results available upon request). Since no midline measures of behavior change are available we cannot say with certainty whether or not substantial changes in behavior were ever realized, however the lack of impact on child health symptoms provides further confirmation that handwashing behavior was not meaningfully impacted. An alternative explanation might be that the implementation period was too condensed and the time between baseline and endline measures too short to capture changes in behavior.

[33] Mass media television ads ran through January 2011

## 7. CONCLUSION

Washing hands with soap has been shown to reduce diarrhea in young children by as much as 48%, and may also contribute to reductions in acute respiratory infection, the two main killers of infants and young children worldwide. Despite the effectiveness of handwashing and the ubiquity of handwashing messages in hygiene, water, sanitation and health campaigns, very few people practice this behavior the right way and at the right time. This paper presents the results of an impact evaluation of a large-scale handwashing with soap behavior change campaign that used mass media television advertisements, door-to-door visits and group meetings to communicate handwashing messages to caregivers of children under five. To our knowledge it is the first randomized evaluation of a large-scale behavior change campaign that focused specifically on handwashing with soap. In contrast to small scale and highly controlled studies, this study does not find large health impacts, which suggests that previous estimates are likely overstated for handwashing campaigns that take place in real-world contexts. A forthcoming cost-benefit analysis conducted alongside the impact evaluation will demonstrate whether given these limited impacts, large scale handwashing campaigns can provide good value for money.

Knowledge of the importance of handwashing with soap and the correct way to wash hands with soap is nearly universal among caregivers in this study. While the HWIPC campaign resulted in increased knowledge about some of the key times for handwashing, it had little differential effect on already high access to soap and water in households and only modest effects on the self-reported handwashing behavior of mothers of children under five. Structured observations reveal that more handwashing is not taking place in the treatment arm when compared with the control arm and that rates of handwashing with soap at key junctures, especially after contact with feces, are very low among the target group. As a result, we do not observe improvements in child health or caregiver productivity gains.

The results in Vietnam are consistent with other countries that were part of the study. In the three countries that have completed an impact analysis the findings show the intervention to be successful in reaching the target audience and improving knowledge along some dimensions measured. However translating this knowledge into changes in handwashing behavior has been uneven. Moreover, the results in Vietnam suggest that even under seemingly optimal conditions, where knowledge and access to soap and water are not main constraints, changing behavior is difficult.

This study targeted caregivers from a relatively advantaged population. Diarrhea prevalence is low in the households studied and child growth measures taken at baseline indicate just a small proportion of children are clinically malnourished. Furthermore, based on indicators of access to improved sanitation,

safe water sources and safe drinking water treatment practices, fecal contamination of the environment that these children live in might be expected to be small. Caregivers may be more likely to change their behavior when they feel an immediate and personal threat that their children will fall ill, but when children are observed to be relatively healthy caregivers may lack appropriate incentives to change their behavior. Additionally, although we do not observe large impacts on handwashing behavior in this study, we cannot rule out the possibility that had the study been done on a more vulnerable population, that the rates of handwashing observed would have resulted in health impacts. Indeed, handwashing with soap may be a more effective preventative measure when these other environmental health improvements are not in place. This is the subject of ongoing research.[34]

Handwashing with soap remains a key preventive measure, especially in areas with a high burden of diarrheal disease and malnutrition in children, and the results of this study are not likely to change the priority placed on hygiene by the water and health communities. Other research carried out by WSP has shown the handwashing initiative to be successful in strengthening local capacity to implement large-scale hygiene campaigns and encouraging policies that integrate handwashing with soap into national guidelines on water, sanitation and health. The impact evaluation was not designed to measure the effectiveness of these efforts, nor is it able to measure the long-term impact of this improved enabling environment for handwashing with soap in Vietnam.

[34] See for example the WASH Benefits project, also funded by the Bill and Melinda Gates Foundation, that is testing the individual and combined effects of different water, sanitation and hygiene interventions (http://www.gatesfoundation.org/watersanitationhygiene)

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**TABLE 2A: COMPARISON OF MEANS TEST FOR HOUSEHOLD DEMOGRAPHICS**

| | Baseline | | | | | | | Endline | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | p-value | Treatment | | | Control | | | p-value |
| | N | Avg. | SE | N | Avg. | SE | | N | Avg. | SE | N | Avg. | SE | |
| HH size | 2070 | 4.625 | 0.042 | 1034 | 4.596 | 0.058 | 0.683 | 2070 | 4.983 | 0.039 | 1032 | 4.947 | 0.060 | 0.618 |
| Number children under 5 years age (per HH) | 2070 | 1.191 | 0.011 | 1034 | 1.200 | 0.017 | 0.646 | 2070 | 1.200 | 0.010 | 1032 | 1.198 | 0.014 | 0.916 |
| Age of HH head | 2070 | 41.936 | 0.507 | 1034 | 42.462 | 0.744 | 0.559 | 2070 | 43.048 | 0.414 | 1031 | 43.164 | 0.596 | 0.873 |
| Age of other HH members | 7504 | 18.905 | 0.245 | 3718 | 18.616 | 0.312 | 0.466 | 7685 | 20.325 | 0.197 | 3790 | 20.126 | 0.304 | 0.583 |
| HH head is male | 2070 | 0.872 | 0.011 | 1034 | 0.862 | 0.014 | 0.561 | 2070 | 0.835 | 0.011 | 1031 | 0.834 | 0.013 | 0.949 |
| Other HH members are male | 7504 | 0.375 | 0.006 | 3718 | 0.372 | 0.008 | 0.749 | 8244 | 0.353 | 0.005 | 4074 | 0.348 | 0.006 | 0.475 |
| HH head ever attended school | 2045 | 0.981 | 0.004 | 1018 | 0.985 | 0.004 | 0.440 | 2055 | 0.972 | 0.005 | 1028 | 0.967 | 0.006 | 0.529 |
| Other HH members ever attended school | 4880 | 0.989 | 0.002 | 2431 | 0.984 | 0.003 | 0.171 | 5105 | 0.977 | 0.003 | 2514 | 0.974 | 0.004 | 0.543 |
| **Educational attainment of HH head** | | | | | | | | | | | | | | |
| Incomplete primary | 1983 | 0.151 | 0.012 | 979 | 0.151 | 0.016 | 0.984 | 1982 | 0.209 | 0.011 | 982 | 0.238 | 0.016 | 0.141 |
| Complete primary | 1983 | 0.417 | 0.014 | 979 | 0.402 | 0.019 | 0.532 | 1982 | 0.445 | 0.013 | 982 | 0.420 | 0.016 | 0.218 |
| Incomplete secondary | **1983** | **0.241** | **0.012** | **979** | **0.279** | **0.020** | **0.099** | 1982 | 0.225 | 0.011 | 982 | 0.244 | 0.015 | 0.277 |
| Complete secondary | 1983 | 0.130 | 0.011 | 979 | 0.129 | 0.013 | 0.932 | 1982 | 0.121 | 0.008 | 982 | 0.098 | 0.012 | 0.106 |
| Higher | **1983** | **0.062** | **0.008** | **979** | **0.039** | **0.007** | **0.028** | 1982 | 0.001 | 0.001 | 982 | 0.000 | 0.000 | 0.317 |
| **Educational attainment of other HH members** | | | | | | | | | | | | | | |
| Incomplete primary | 4734 | 0.208 | 0.007 | 2331 | 0.194 | 0.010 | 0.267 | 4966 | 0.331 | 0.008 | 2434 | 0.316 | 0.012 | 0.282 |
| Complete primary | 4734 | 0.354 | 0.009 | 2331 | 0.357 | 0.015 | 0.869 | 4966 | 0.354 | 0.008 | 2434 | 0.359 | 0.012 | 0.717 |
| Incomplete secondary | 4734 | 0.243 | 0.008 | 2331 | 0.256 | 0.013 | 0.386 | 4966 | 0.213 | 0.007 | 2434 | 0.220 | 0.011 | 0.588 |
| Complete secondary | 4734 | 0.138 | 0.007 | 2331 | 0.137 | 0.011 | 0.907 | 4966 | 0.101 | 0.005 | 2434 | 0.104 | 0.008 | 0.707 |
| Higher | 4734 | 0.056 | 0.005 | 2331 | 0.055 | 0.007 | 0.906 | 4966 | 0.001 | 0.000 | 2434 | 0.000 | 0.000 | 0.489 |

**TABLE 2B: COMPARISON OF MEANS TEST FOR HOUSEHOLD PRIMARY WORK, LABOR INCOME, AND NON-LABOR INCOME**

| | Baseline | | | | | | | Endline | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | p-value | Treatment | | | Control | | | p-value |
| | N | Avg. | SE | N | Avg. | SE | | N | Avg. | SE | N | Avg. | SE | |
| HH head is employed | 2056 | 0.857 | 0.010 | 1031 | 0.855 | 0.013 | 0.905 | 2058 | 0.830 | 0.010 | 1029 | 0.815 | 0.014 | 0.400 |
| Others in HH are employed | 3926 | 0.750 | 0.012 | 1946 | 0.750 | 0.019 | 0.995 | 3923 | 0.722 | 0.009 | 1941 | 0.743 | 0.011 | 0.135 |
| Females in HH are employed | 3163 | 0.698 | 0.015 | 1578 | 0.699 | 0.023 | 0.983 | 3238 | 0.677 | 0.010 | 1618 | 0.692 | 0.015 | 0.399 |
| **Last week activity of unemployed HH head** | | | | | | | | | | | | | | |
| Studying | 293 | 0.010 | 0.006 | 149 | 0.007 | 0.007 | 0.695 | 350 | 0.006 | 0.004 | 190 | 0.005 | 0.005 | 0.946 |
| Taking care of home | 293 | 0.372 | 0.041 | 149 | 0.383 | 0.045 | 0.863 | 350 | 0.600 | 0.027 | 190 | 0.611 | 0.036 | 0.815 |
| Rent earner | 293 | 0.031 | 0.014 | 149 | 0.054 | 0.034 | 0.531 | 350 | 0.020 | 0.008 | 190 | 0.005 | 0.005 | 0.129 |
| Permanently unable to work | **293** | **0.109** | **0.030** | **149** | **0.034** | **0.022** | **0.041** | 350 | 0.051 | 0.013 | 190 | 0.026 | 0.011 | 0.142 |
| Retired | 293 | 0.208 | 0.028 | 149 | 0.228 | 0.042 | 0.695 | 350 | 0.157 | 0.023 | 190 | 0.158 | 0.025 | 0.982 |
| Not working | 293 | 0.263 | 0.039 | 149 | 0.289 | 0.054 | 0.700 | 350 | 0.166 | 0.024 | 190 | 0.195 | 0.033 | 0.477 |
| **Last week activity of unemployed other HH members** | | | | | | | | | | | | | | |
| Looking for work | 981 | 0.014 | 0.004 | 486 | 0.019 | 0.007 | 0.615 | 1092 | 0.007 | 0.002 | 499 | 0.010 | 0.004 | 0.582 |
| Studying | 981 | 0.167 | 0.017 | 486 | 0.177 | 0.024 | 0.739 | 1092 | 0.217 | 0.013 | 499 | 0.232 | 0.025 | 0.589 |
| Taking care of home | 981 | 0.610 | 0.028 | 486 | 0.576 | 0.042 | 0.511 | 1092 | 0.603 | 0.016 | 499 | 0.571 | 0.024 | 0.277 |
| Rent earner | 981 | 0.011 | 0.005 | 486 | 0.031 | 0.016 | 0.253 | **1092** | **0.016** | **0.004** | **499** | **0.006** | **0.003** | **0.073** |
| Permanently unable to work | 981 | 0.019 | 0.005 | 486 | 0.019 | 0.008 | 0.930 | 1092 | 0.013 | 0.004 | 499 | 0.006 | 0.003 | 0.165 |
| Retired | 981 | 0.033 | 0.008 | 486 | 0.047 | 0.012 | 0.303 | 1092 | 0.036 | 0.007 | 499 | 0.050 | 0.011 | 0.276 |
| Not working | 981 | 0.114 | 0.020 | 486 | 0.109 | 0.024 | 0.871 | 1092 | 0.091 | 0.010 | 499 | 0.120 | 0.016 | 0.119 |

| **Primary employment status (over all employed individuals)** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Self-employed | 4901 | 0.068 | 0.008 | 2455 | 0.072 | 0.014 | 0.801 | 4929 | 0.123 | 0.007 | 2479 | 0.112 | 0.009 | 0.331 |
| Employee | 4901 | 0.241 | 0.012 | 2455 | 0.237 | 0.017 | 0.821 | 4929 | 0.321 | 0.010 | 2479 | 0.311 | 0.013 | 0.545 |
| Employer or boss | 4901 | 0.004 | 0.001 | 2455 | 0.004 | 0.003 | 0.949 | 4929 | 0.020 | 0.003 | 2479 | 0.017 | 0.003 | 0.447 |
| Worker with no remuneration | 4901 | 0.000 | 0.000 | 2455 | 0.000 | 0.000 | 0.316 | 4929 | 0.001 | 0.000 | 2479 | 0.000 | 0.000 | 0.472 |
| Day laborer | 4901 | 0.050 | 0.007 | 2455 | 0.051 | 0.010 | 0.897 | 4929 | 0.078 | 0.006 | 2479 | 0.077 | 0.007 | 0.979 |
| Working in household activities or production | 4901 | 0.632 | 0.017 | 2455 | 0.630 | 0.027 | 0.966 | 4929 | 0.456 | 0.012 | 2479 | 0.480 | 0.016 | 0.226 |
| Other | 4901 | 0.005 | 0.001 | 2455 | 0.005 | 0.002 | 0.997 | 4929 | 0.001 | 0.001 | 2479 | 0.002 | 0.001 | 0.399 |
| Monthly salary (in VND millions) | 1781 | 2.127 | 0.108 | 892 | 2.184 | 0.246 | 0.831 | 2659 | 2.439 | 0.064 | 1271 | 2.279 | 0.073 | 0.100 |
| Months worked per year | 4916 | 9.145 | 0.127 | 2448 | 9.268 | 0.180 | 0.576 | … | … | … | … | … | … | … |
| Days worked per month | 4915 | 20.192 | 0.284 | 2447 | 20.592 | 0.397 | 0.412 | 4923 | 21.786 | 0.195 | 2477 | 21.979 | 0.269 | 0.561 |
| Hours worked per day | 4909 | 7.524 | 0.076 | 2440 | 7.578 | 0.102 | 0.667 | **4920** | **7.202** | **0.054** | **2475** | **7.398** | **0.063** | **0.018** |
| HH has non-labor income | 2070 | 0.771 | 0.020 | 1034 | 0.730 | 0.034 | 0.310 | 2070 | 0.857 | 0.012 | 1032 | 0.866 | 0.017 | 0.650 |
| Total HH non-labor income (in VND millions) | 2070 | 2.074 | 0.325 | 1034 | 2.585 | 0.885 | 0.588 | 2070 | 3.854 | 0.503 | 1032 | 3.238 | 0.373 | 0.326 |

**TABLE 2C: COMPARISON OF MEANS TEST FOR HOUSEHOLD ASSETS**

| | **Baseline** | | | | | | | **Endline** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | p- | Treatment | | | Control | | | p- |
| | N | Avg. | SE | N | Avg. | SE | value | N | Avg. | SE | N | Avg. | SE | value |
| Radio, CD, cassette | 2069 | 0.090 | 0.010 | 1033 | 0.108 | 0.014 | 0.300 | 2070 | 0.130 | 0.009 | 1032 | 0.146 | 0.013 | 0.286 |
| Television | 2070 | 0.924 | 0.008 | 1034 | 0.910 | 0.011 | 0.297 | 2070 | 0.953 | 0.005 | 1031 | 0.956 | 0.007 | 0.705 |
| Videocassette, VCR, DVD player | 2070 | 0.609 | 0.019 | 1034 | 0.605 | 0.025 | 0.904 | 2070 | 0.727 | 0.012 | 1032 | 0.694 | 0.019 | 0.147 |
| Computer | 2070 | 0.062 | 0.007 | 1034 | 0.065 | 0.009 | 0.806 | 2070 | 0.094 | 0.008 | 1032 | 0.091 | 0.011 | 0.840 |
| Bicycle | 2070 | 0.752 | 0.021 | 1034 | 0.771 | 0.029 | 0.589 | 2070 | 0.787 | 0.014 | 1032 | 0.803 | 0.018 | 0.476 |
| Motorcycle | 2070 | 0.796 | 0.012 | 1034 | 0.763 | 0.017 | 0.111 | 2070 | 0.838 | 0.010 | 1032 | 0.834 | 0.014 | 0.847 |
| Automobile or truck | 2070 | 0.026 | 0.004 | 1033 | 0.027 | 0.005 | 0.816 | 2070 | 0.029 | 0.004 | 1032 | 0.030 | 0.006 | 0.889 |
| Refrigerator | 2070 | 0.262 | 0.015 | 1034 | 0.246 | 0.017 | 0.468 | 2070 | 0.368 | 0.017 | 1032 | 0.333 | 0.018 | 0.162 |
| Gas stove | 2070 | 0.454 | 0.020 | 1034 | 0.423 | 0.024 | 0.318 | 2070 | 0.663 | 0.017 | 1032 | 0.652 | 0.021 | 0.689 |
| Blender | 2070 | 0.297 | 0.018 | 1034 | 0.290 | 0.025 | 0.833 | 2070 | 0.024 | 0.004 | 1032 | 0.016 | 0.005 | 0.164 |
| Microwave | **2070** | **0.016** | **0.004** | **1034** | **0.007** | **0.002** | **0.030** | 2070 | 0.316 | 0.017 | 1032 | 0.305 | 0.022 | 0.706 |
| Washing machine | 2070 | 0.081 | 0.010 | 1034 | 0.068 | 0.010 | 0.363 | 2070 | 0.038 | 0.005 | 1032 | 0.042 | 0.007 | 0.679 |
| Water boiler, hot water heater | **2070** | **0.235** | **0.023** | **1034** | **0.137** | **0.023** | **0.003** | 2070 | 0.115 | 0.008 | 1032 | 0.118 | 0.013 | 0.827 |
| Machinery, equipment for household business | 2070 | 0.023 | 0.005 | 1034 | 0.025 | 0.006 | 0.767 | 2070 | 0.948 | 0.006 | 1032 | 0.951 | 0.006 | 0.795 |
| Boat | 2070 | 0.029 | 0.008 | 1034 | 0.019 | 0.006 | 0.305 | 2070 | 0.021 | 0.004 | 1032 | 0.016 | 0.005 | 0.457 |
| Telephone (including mobile) | 2070 | 0.771 | 0.017 | 1034 | 0.743 | 0.027 | 0.377 | 2070 | 0.961 | 0.006 | 1032 | 0.967 | 0.008 | 0.545 |
| Air conditioner | 2070 | 0.011 | 0.003 | 1034 | 0.010 | 0.003 | 0.817 | … | … | … | … | … | … | … |
| Electric fan | 2070 | 0.958 | 0.007 | 1034 | 0.949 | 0.009 | 0.389 | … | … | … | … | … | … | … |
| HH owns other piece of land | 2070 | 0.190 | 0.024 | 1034 | 0.170 | 0.031 | 0.608 | 2070 | 0.812 | 0.016 | 1032 | 0.808 | 0.023 | 0.902 |
| HH owns farm equipment | 2070 | 0.186 | 0.019 | 1034 | 0.223 | 0.031 | 0.300 | 2070 | 0.536 | 0.018 | 1032 | 0.571 | 0.025 | 0.262 |
| HH has animals | 2070 | 0.622 | 0.026 | 1034 | 0.668 | 0.039 | 0.319 | **2070** | **0.713** | **0.015** | **1032** | **0.766** | **0.021** | **0.039** |
| Number of different kinds of livestock owned per HH | 2070 | 1.044 | 0.055 | 1034 | 1.140 | 0.077 | 0.310 | **2070** | **1.188** | **0.042** | **1032** | **1.301** | **0.052** | **0.089** |
| Asset base wealth index | 2058 | 1.807 | 0.035 | 1027 | 1.768 | 0.050 | 0.529 | 2070 | 4.203 | 0.027 | 1031 | 4.189 | 0.038 | 0.760 |

**TABLE 2D: COMPARISON OF MEANS TEST FOR CLEANLINESS OF CAREGIVER HANDS**

| | Baseline | | | | | | | Endline | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | p- | Treatment | | | Control | | | p- |
| | N | Avg. | SE | N | Avg. | SE | value | N | Avg. | SE | N | Avg. | SE | value |
| Nails, palms, fingerpads | 1961 | 8.097 | 0.077 | 982 | 8.143 | 0.125 | 0.758 | **2107** | **7.612** | **0.060** | **1046** | **7.355** | **0.090** | **0.017** |
| Nails | 2078 | 0.587 | 0.026 | 1035 | 0.628 | 0.036 | 0.348 | **2109** | **0.523** | **0.016** | **1047** | **0.453** | **0.020** | **0.006** |
| Palms | 2078 | 0.739 | 0.024 | 1035 | 0.754 | 0.031 | 0.712 | **2109** | **0.694** | **0.015** | **1047** | **0.644** | **0.021** | **0.054** |
| Fingerpads | 2078 | 0.732 | 0.023 | 1035 | 0.753 | 0.031 | 0.601 | **2109** | **0.701** | **0.016** | **1047** | **0.631** | **0.022** | **0.010** |

**TABLE 2E: COMPARISON OF MEANS TEST FOR HANDWASHING SELF-REPORTED BEHAVIOR**

| | Baseline | | | | | | | Endline | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | p- | Treatment | | | Control | | | p- |
| | N | Avg. | SE | N | Avg. | SE | value | N | Avg. | SE | N | Avg. | SE | value |
| Washed hands with soap during the last 24 hours | **1963** | **0.934** | **0.014** | **987** | **0.965** | **0.009** | **0.073** | 2109 | 0.984 | 0.003 | 1047 | 0.978 | 0.006 | 0.325 |
| **Washed hands with soap during the last 24 hours in the following instances:** | | | | | | | | | | | | | | |
| After fecal contact | 2080 | 0.601 | 0.024 | 1040 | 0.594 | 0.036 | 0.869 | 2111 | 0.692 | 0.011 | 1048 | 0.681 | 0.018 | 0.628 |
| Before food preparation | 2080 | 0.295 | 0.026 | 1040 | 0.310 | 0.038 | 0.746 | 2111 | 0.346 | 0.013 | 1048 | 0.311 | 0.018 | 0.117 |
| Before feeding / breastfeeding child | 2080 | 0.307 | 0.023 | 1040 | 0.336 | 0.037 | 0.516 | 2111 | 0.392 | 0.016 | 1048 | 0.363 | 0.019 | 0.224 |
| Before eating | 2080 | 0.182 | 0.022 | 1040 | 0.222 | 0.038 | 0.360 | 2111 | 0.156 | 0.009 | 1048 | 0.162 | 0.016 | 0.728 |
| Because hands look or feel dirty | 2080 | 0.451 | 0.031 | 1040 | 0.467 | 0.043 | 0.756 | 2111 | 0.214 | 0.013 | 1048 | 0.194 | 0.017 | 0.327 |
| After or while doing laundry | 2080 | 0.415 | 0.033 | 1040 | 0.484 | 0.046 | 0.230 | 2111 | 0.352 | 0.013 | 1048 | 0.351 | 0.021 | 0.973 |

**TABLE 2F: COMPARISON OF MEANS TEST FOR AVAILABILITY OF HANDWASHING FACILITIES**

| | Baseline | | | | | | | Endline | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | p-value | Treatment | | | Control | | | p-value |
| | N | Avg. | SE | N | Avg. | SE | | N | Avg. | SE | N | Avg. | SE | |
| Soap present anywhere in the home | 2070 | 0.964 | 0.006 | 1034 | 0.957 | 0.010 | 0.591 | 2070 | 0.986 | 0.003 | 1032 | 0.982 | 0.005 | 0.499 |
| Soap & water present, HW place used post-defecation | 2038 | 0.802 | 0.021 | 1011 | 0.817 | 0.027 | 0.654 | 2067 | 0.910 | 0.007 | 1031 | 0.890 | 0.012 | 0.161 |
| Soap & water present, HW place used before food prep in different place | 2056 | 0.296 | 0.022 | 1031 | 0.292 | 0.029 | 0.907 | 2070 | 0.340 | 0.015 | 1032 | 0.333 | 0.022 | 0.811 |
| Soap & water present, HW place used before food prep in same place | 2038 | 0.466 | 0.029 | 1011 | 0.503 | 0.038 | 0.433 | 2067 | 0.564 | 0.014 | 1031 | 0.555 | 0.020 | 0.718 |
| Soap & water present, HW place used before food prep. | 2067 | 0.754 | 0.023 | 1033 | 0.784 | 0.028 | 0.404 | 2070 | 0.902 | 0.007 | 1032 | 0.888 | 0.011 | 0.245 |
| Soap & water present, anywhere in HH | 2070 | 0.806 | 0.020 | 1034 | 0.815 | 0.027 | 0.789 | 2070 | 0.937 | 0.006 | 1032 | 0.930 | 0.010 | 0.567 |

**TABLE 2G: COMPARISON OF MEANS TEST FOR HANDWASHING FACILITIES (TOILET)**

| | Baseline | | | | | | | Endline | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | p- | Treatment | | | Control | | | p- |
| | N | Avg. | SE | N | Avg. | SE | value | N | Avg. | SE | N | Avg. | SE | value |
| **Location of handwashing device, toilet** | | | | | | | | | | | | | | |
| Inside toilet facility | 2027 | 0.239 | 0.020 | 1008 | 0.222 | 0.026 | 0.611 | 2060 | 0.214 | 0.015 | 1026 | 0.213 | 0.023 | 0.982 |
| Inside food preparation area | 2027 | 0.052 | 0.012 | 1008 | 0.029 | 0.008 | 0.103 | 2060 | 0.018 | 0.003 | 1026 | 0.023 | 0.006 | 0.415 |
| In yard, less than 1 meter from toilet facility (pond/stream or wash basin) | 2027 | 0.168 | 0.026 | 1008 | 0.173 | 0.035 | 0.911 | 2060 | 0.073 | 0.006 | 1026 | 0.071 | 0.008 | 0.873 |
| In yard, between 1 and 3 meters from toilet facility (pond/stream or wash basin) | 2027 | 0.108 | 0.015 | 1008 | 0.126 | 0.022 | 0.491 | 2060 | 0.139 | 0.009 | 1026 | 0.132 | 0.014 | 0.658 |
| In yard, more than 3 meters from toilet facility (pond/stream or wash basin) | 2027 | 0.338 | 0.029 | 1008 | 0.352 | 0.039 | 0.776 | 2060 | 0.554 | 0.019 | 1026 | 0.558 | 0.026 | 0.923 |
| **Type of handwashing device, toilet** | | | | | | | | | | | | | | |
| Tap, faucet | 1831 | 0.252 | 0.028 | 908 | 0.309 | 0.045 | 0.281 | 2056 | 0.632 | 0.023 | 1022 | 0.606 | 0.029 | 0.474 |
| Homemade water tap | 1831 | 0.438 | 0.033 | 908 | 0.437 | 0.048 | 0.989 | . | . | . | . | . | . | . |
| Basin, bucket | 1831 | 0.208 | 0.023 | 908 | 0.163 | 0.026 | 0.196 | 2056 | 0.344 | 0.021 | 1022 | 0.361 | 0.027 | 0.626 |
| Other container from which water is poured | 1831 | 0.092 | 0.018 | 908 | 0.085 | 0.024 | 0.802 | 2056 | 0.017 | 0.004 | 1022 | 0.013 | 0.003 | 0.444 |
| Other | 1831 | 0.010 | 0.003 | 908 | 0.006 | 0.004 | 0.379 | **2056** | **0.007** | **0.002** | **1022** | **0.021** | **0.005** | **0.015** |
| Water is available at the place for handwashing, toilet | 1810 | 0.980 | 0.005 | 891 | 0.980 | 0.006 | 0.969 | 2055 | 0.979 | 0.004 | 1023 | 0.987 | 0.004 | 0.158 |
| **Soaps available at the place for handwashing, toilet** | | | | | | | | | | | | | | |
| Multipurpose bar soap | 1835 | 0.498 | 0.022 | 909 | 0.536 | 0.025 | 0.248 | **2056** | **0.529** | **0.015** | **1023** | **0.482** | **0.020** | **0.063** |
| Powder soap, detergent | 1835 | 0.673 | 0.028 | 909 | 0.726 | 0.035 | 0.237 | 2056 | 0.613 | 0.015 | 1023 | 0.600 | 0.020 | 0.609 |
| Liquid soap | 1835 | 0.183 | 0.022 | 909 | 0.221 | 0.035 | 0.365 | **2056** | **0.526** | **0.014** | **1023** | **0.473** | **0.019** | **0.022** |
| No soap observed | 1835 | 0.076 | 0.015 | 909 | 0.046 | 0.014 | 0.153 | **2056** | **0.062** | **0.006** | **1023** | **0.089** | **0.011** | **0.030** |

**TABLE 2H: COMPARISON OF MEANS TEST FOR HANDWASHING FACILITIES (FOOD PREPARATION)**

| | Baseline | | | | | | | Endline | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | | Treatment | | | Control | | | p- |
| | N | Avg. | SE | N | Avg. | SE | p-value | N | Avg. | SE | N | Avg. | SE | value |
| **Location of handwashing device, food preparation** | | | | | | | | | | | | | | |
| Inside toilet facility | 1988 | 0.032 | 0.006 | 999 | 0.037 | 0.008 | 0.593 | 2057 | 0.016 | 0.003 | 1021 | 0.017 | 0.004 | 0.901 |
| Inside food preparation area | 1988 | 0.172 | 0.019 | 999 | 0.126 | 0.021 | 0.114 | 2057 | 0.138 | 0.010 | 1021 | 0.162 | 0.016 | 0.202 |
| **Type of handwashing device, food preparation** | | | | | | | | | | | | | | |
| Tap, faucet | 669 | 0.450 | 0.042 | 326 | 0.482 | 0.063 | 0.674 | **778** | **0.724** | **0.024** | **390** | **0.618** | **0.038** | **0.019** |
| Tippy Tap | 669 | 0.302 | 0.038 | 326 | 0.368 | 0.056 | 0.329 | . | . | . | . | . | . | . |
| Basin, bucket | 669 | 0.152 | 0.028 | 326 | 0.117 | 0.037 | 0.440 | **778** | **0.252** | **0.023** | **390** | **0.351** | **0.036** | **0.019** |
| Other container from which water is poured | **669** | **0.085** | **0.019** | **326** | **0.034** | **0.011** | **0.017** | 778 | 0.021 | 0.006 | 390 | 0.018 | 0.007 | 0.778 |
| Other | **669** | **0.010** | **0.004** | **326** | **0.000** | **0.000** | **0.015** | 778 | 0.004 | 0.002 | 390 | 0.013 | 0.007 | 0.197 |
| Water is available at the place for handwashing, food preparation | 670 | 0.979 | 0.008 | 327 | 0.982 | 0.007 | 0.811 | 778 | 0.990 | 0.004 | 390 | 0.990 | 0.005 | 0.997 |
| **Soaps available at the place for handwashing, food preparation** | | | | | | | | | | | | | | |
| Multipurpose bar soap | 670 | 0.551 | 0.036 | 327 | 0.538 | 0.053 | 0.845 | 778 | 0.201 | 0.017 | 390 | 0.208 | 0.025 | 0.815 |
| Powder soap, detergent | 670 | 0.610 | 0.038 | 327 | 0.636 | 0.062 | 0.725 | 778 | 0.338 | 0.018 | 390 | 0.367 | 0.032 | 0.435 |
| Liquid soap | 670 | 0.279 | 0.043 | 327 | 0.388 | 0.067 | 0.170 | **778** | **0.771** | **0.017** | **390** | **0.718** | **0.027** | **0.099** |
| No soap observed | 670 | 0.054 | 0.013 | 327 | 0.052 | 0.022 | 0.946 | 778 | 0.087 | 0.011 | 390 | 0.118 | 0.017 | 0.134 |

**TABLE 2I: COMPARISON OF MEANS TEST FOR CHILD HEALTH SYMPTOMS 7-DAY PERIOD PREVALENCE (% OF CHILDREN <5)**

| | Baseline | | | | | | | Endline | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | p-value | Treatment | | | Control | | | p-value |
| | N | Avg. | SE | N | Avg. | SE | | N | Avg. | SE | N | Avg. | SE | |
| Diarrhea | 2594 | 0.010 | 0.002 | 1303 | 0.016 | 0.005 | 0.203 | **2483** | **0.029** | **0.004** | **1236** | **0.047** | **0.007** | **0.038** |
| Acute respiratory infection | 2594 | 0.152 | 0.010 | 1303 | 0.160 | 0.015 | 0.686 | **2483** | **0.331** | **0.012** | **1236** | **0.375** | **0.019** | **0.052** |
| Fever | 2594 | 0.170 | 0.010 | 1303 | 0.177 | 0.017 | 0.721 | **2483** | **0.193** | **0.010** | **1236** | **0.227** | **0.015** | **0.062** |
| Cough in previous week | 2594 | 0.150 | 0.010 | 1303 | 0.156 | 0.015 | 0.733 | 2483 | 0.288 | 0.011 | 1236 | 0.308 | 0.016 | 0.308 |
| Congestion/coryza | 2594 | 0.152 | 0.010 | 1303 | 0.154 | 0.017 | 0.922 | **2483** | **0.343** | **0.014** | **1236** | **0.434** | **0.018** | **0.000** |
| Difficulty breathing | 2594 | 0.012 | 0.003 | 1303 | 0.015 | 0.003 | 0.492 | **2483** | **0.119** | **0.008** | **1236** | **0.164** | **0.015** | **0.008** |
| Cramps | 2594 | 0.002 | 0.001 | 1303 | 0.002 | 0.001 | 0.996 | **2483** | **0.039** | **0.004** | **1236** | **0.069** | **0.007** | **0.001** |
| Nausea | 2594 | 0.001 | 0.001 | 1303 | 0.002 | 0.001 | 0.276 | **2483** | **0.026** | **0.003** | **1236** | **0.055** | **0.007** | **0.000** |
| Vomiting | 2594 | 0.007 | 0.002 | 1303 | 0.008 | 0.003 | 0.532 | **2483** | **0.043** | **0.005** | **1236** | **0.066** | **0.008** | **0.020** |
| Three or more bowel movements | 2594 | 0.018 | 0.003 | 1303 | 0.024 | 0.005 | 0.371 | **2483** | **0.033** | **0.004** | **1236** | **0.052** | **0.007** | **0.024** |
| Watery or soft stool | 2594 | 0.013 | 0.002 | 1303 | 0.021 | 0.005 | 0.131 | **2483** | **0.031** | **0.004** | **1236** | **0.053** | **0.007** | **0.011** |
| Mucus or blood in stool | 2594 | 0.004 | 0.001 | 1303 | 0.004 | 0.002 | 0.993 | **2483** | **0.010** | **0.002** | **1236** | **0.018** | **0.004** | **0.084** |
| Refusal to eat | 2594 | 0.023 | 0.005 | 1303 | 0.029 | 0.008 | 0.510 | **2483** | **0.166** | **0.010** | **1236** | **0.203** | **0.015** | **0.033** |
| Bruising | 2594 | 0.004 | 0.001 | 1303 | 0.002 | 0.001 | 0.419 | **2483** | **0.066** | **0.006** | **1236** | **0.104** | **0.012** | **0.003** |
| Itching | 2594 | 0.009 | 0.003 | 1303 | 0.008 | 0.003 | 0.773 | **2483** | **0.061** | **0.005** | **1236** | **0.078** | **0.009** | **0.083** |
| Anemic: Hb level < 11 g/dl | 1961 | 0.322 | 0.015 | 965 | 0.307 | 0.022 | 0.571 | . | . | . | . | . | . | . |

**TABLE 2J: COMPARISON OF MEANS TEST FOR CHILD GROWTH MEASURES (Z-SCORES)**

| | Baseline | | | | | | | Endline | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | p- | Treatment | | | Control | | | |
| | N | Avg. | SE | N | Avg. | SE | value | N | Avg. | SE | N | Avg. | SE | p-value |
| Child weight (to 0.1 kg) | 2131 | 9.580 | 0.053 | 1057 | 9.668 | 0.074 | 0.334 | . | . | . | . | . | . | . |
| Child height (to 0.1 cm) | 2129 | 77.180 | 0.199 | 1054 | 77.680 | 0.275 | 0.141 | . | . | . | . | . | . | . |
| Child arm circumference (to 0.1 cm) | 2131 | 14.935 | 0.057 | 1057 | 14.903 | 0.063 | 0.705 | . | . | . | . | . | . | . |
| Child head circumference (to 0.1 cm) | 2131 | 45.281 | 0.067 | 1057 | 45.327 | 0.098 | 0.699 | . | . | . | . | . | . | . |
| Weight-for-age z-score | 2093 | -0.647 | 0.030 | 1039 | -0.578 | 0.046 | 0.205 | . | . | . | . | . | . | . |
| Length/height-for-age z-score | **2086** | **-0.760** | **0.045** | **1035** | **-0.609** | **0.072** | **0.075** | . | . | . | . | . | . | . |
| BMI-for-age z-score | 2074 | -0.236 | 0.036 | 1025 | -0.298 | 0.054 | 0.342 | . | . | . | . | . | . | . |
| Weight-for-length/height z-score | 2086 | -0.324 | 0.033 | 1034 | -0.368 | 0.049 | 0.455 | . | . | . | . | . | . | . |
| Arm circumference-for-age z-score | 2094 | 0.111 | 0.036 | 1043 | 0.157 | 0.049 | 0.452 | . | . | . | . | . | . | . |
| Head circumference-for-age z-score | 2104 | -0.651 | 0.035 | 1044 | -0.599 | 0.051 | 0.395 | . | . | . | . | . | . | . |

**TABLE 3A: HOUSEHOLD AND CAREGIVER ATTRITION (n=3102)**

| | Treatment | | | Control | | | |
|---|---|---|---|---|---|---|---|
| | N | Avg. | SE | N | Avg. | SE | p-value |
| Household followed up at endline | 2069 | 0.943 | 0.006 | 1033 | 0.942 | 0.009 | 0.884 |
| Primary caregiver followed up at endline | 2085 | 0.747 | 0.012 | 1043 | 0.730 | 0.017 | 0.399 |

**TABLE 3B: COMPARISON OF MEANS TEST FOR PANEL HOUSEHOLDS (n=2925)**

| | **Baseline** | | | | | | |
|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | |
| | N | Avg. | SE | N | Avg. | SE | p-value |
| HH size | 1952 | 4.639 | 0.043 | 973 | 4.599 | 0.058 | 0.583 |
| Employment status of HH head | 1939 | 0.858 | 0.010 | 969 | 0.852 | 0.014 | 0.740 |
| Years of school of HH head | 1871 | 7.688 | 0.119 | 921 | 7.657 | 0.153 | 0.873 |
| HH head is male | 1952 | 0.870 | 0.011 | 973 | 0.858 | 0.014 | 0.499 |
| Age of HH head | 1952 | 41.964 | 0.505 | 973 | 42.569 | 0.742 | 0.500 |
| Total HH income | 1952 | 2.104 | 0.341 | 973 | 2.674 | 0.934 | 0.567 |
| HH wealth score | 1941 | 1.810 | 0.036 | 966 | 1.777 | 0.051 | 0.595 |
| HH has non-labor income | 1952 | 0.766 | 0.021 | 973 | 0.733 | 0.035 | 0.410 |
| Number livestock owned by HH | 1952 | 1.049 | 0.055 | 973 | 1.156 | 0.078 | 0.264 |
| Soap and water at/near toilet | 1920 | 0.802 | 0.021 | 953 | 0.817 | 0.028 | 0.657 |
| Soap and water at/near food preparation facility | 1949 | 0.755 | 0.023 | 972 | 0.785 | 0.028 | 0.414 |
| Soap observed somewhere in HH | 1952 | 0.966 | 0.006 | 973 | 0.962 | 0.009 | 0.731 |

**TABLE 3C: COMPARISON OF MEANS TEST FOR REPLACEMENT HOUSEHOLDS (n=177)**

| | Endline | | | | | | |
|---|---|---|---|---|---|---|---|
| | Treatment | | | Control | | | |
| | N | Avg. | SE | N | Avg. | SE | p-value |
| HH size | 118 | 4.864 | 0.157 | 59 | 4.915 | 0.230 | 0.855 |
| Employment status of HH head | 117 | 0.855 | 0.032 | 59 | 0.831 | 0.062 | 0.730 |
| Years of school of HH head | 115 | 6.835 | 0.228 | 56 | 6.571 | 0.453 | 0.604 |
| HH head is male | 118 | 0.831 | 0.034 | 59 | 0.847 | 0.043 | 0.756 |
| Age of HH head | 118 | 42.246 | 1.219 | 59 | 46.102 | 2.151 | 0.119 |
| Total HH income | 118 | 2.543 | 0.387 | 59 | 2.707 | 0.588 | 0.816 |
| HH wealth score | 118 | 4.178 | 0.063 | 59 | 4.322 | 0.093 | 0.201 |
| HH has non-labor income | 118 | 0.873 | 0.035 | 59 | 0.864 | 0.047 | 0.885 |
| **Number livestock owned by HH** | **118** | **1.169** | **0.116** | **59** | **1.475** | **0.104** | **0.050** |
| **Soap and water at/near toilet** | **118** | **0.881** | **0.027** | **59** | **0.949** | **0.028** | **0.082** |
| Soap and water at/near food preparation facility | 118 | 0.915 | 0.025 | 59 | 0.915 | 0.038 | 1.000 |
| **Soap observed somewhere in HH** | **118** | **0.966** | **0.017** | **59** | **1.000** | **0.000** | **0.040** |

**TABLE 3D: COMPARISON OF MEANS TEST FOR PANEL + REPLACEMENT HOUSEHOLDS (n=3102)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HH size | 2070 | 4.983 | 0.039 | 1032 | 4.947 | 0.060 | 0.618 |
| Employment status of HH head | 2058 | 0.830 | 0.010 | 1029 | 0.815 | 0.014 | 0.400 |
| Years of school of HH head | 1982 | 7.048 | 0.079 | 982 | 6.910 | 0.120 | 0.335 |
| HH head is male | 2070 | 0.835 | 0.011 | 1031 | 0.834 | 0.013 | 0.949 |
| Age of HH head | 2070 | 43.048 | 0.414 | 1031 | 43.164 | 0.596 | 0.873 |
| Total HH income (VND millions) | 2070 | 3.854 | 0.503 | 1032 | 3.238 | 0.373 | 0.326 |
| HH wealth score | 2070 | 4.203 | 0.027 | 1031 | 4.189 | 0.038 | 0.760 |
| HH has non-labor income | 2070 | 0.857 | 0.012 | 1032 | 0.866 | 0.017 | 0.650 |
| **Number livestock owned by HH** | **2070** | **1.188** | **0.042** | **1032** | **1.301** | **0.052** | **0.089** |
| HH has improved sanitation facility (JMP) | 2070 | 0.669 | 0.023 | 1032 | 0.690 | 0.026 | 0.540 |
| **HH has improved water source (JMP)** | **2070** | **0.952** | **0.008** | **1032** | **0.971** | **0.008** | **0.087** |

**Table 4: Household exposure to HWIPC campaign**

| | Mean effect of treatment | |
|---|---|---|
| | Midterm (July 2010) Control Mean (SD) | Unadjusted model |
| Number of channels of exposure | 2.822 | **0.324*** |
| | 1.356 | (0.101) |
| High exposure (More than 3 channels) | 0.459 | **0.096*** |
| | 0.499 | (0.040) |
| Medium exposure (2 - 3 channels) | 0.354 | -0.032 |
| | 0.479 | (0.040) |
| Low exposure (1 or fewer channels) | 0.186 | **-0.064*** |
| | 0.390 | (0.029) |
| Exposure to IPC by Women's Union | 0.347 | **0.217*** |
| | 0.476 | (0.041) |
| N observations | | 2919 |
| Control variables | | No |

+ p<0.10, * p<0.05
[1] All models include matched triplet dummies. Robust standard errors clustered at commune level in parenthesis

**Table 5: Caregiver knowledge**

| | Mean effect of treatment | | |
|---|---|---|---|
| | Control Mean (SD) | Unadjusted model | Full model |
| Number of spontaneous mentions of critical times for HWWS | 2.236 | **0.042+** | **0.048+** |
| | 1.122 | (0.025) | (0.028) |
| Knowledge of critical time: After using toilet | 0.774 | 0.007 | 0.001 |
| | 0.419 | (0.029) | (0.031) |
| Knowledge of critical time: After washing baby's bottom/changing diaper | 0.385 | -0.034 | 0.010 |
| | 0.488 | (0.040) | (0.041) |
| Knowledge of critical time: Before preparing food | 0.296 | **0.118*** | **0.109*** |
| | 0.458 | (0.037) | (0.040) |
| Knowledge of critical time: Before feeding/breastfeeding baby | 0.389 | 0.038 | 0.022 |
| | 0.489 | (0.038) | (0.041) |
| What is best way to wash hands? With soap | 0.973 | 0.004 | 0.005 |
| | 0.161 | (0.005) | (0.006) |
| Does not HWWS cause diarrhea? Yes | 0.849 | 0.013 | **0.029*** |
| | 0.358 | (0.012) | (0.014) |
| Does not HW cause diarrhea? Yes | 0.834 | 0.020 | **0.035*** |
| | 0.372 | (0.014) | (0.015) |
| Do changes in weather cause diarrhea? Yes | 0.427 | -0.028 | -0.019 |
| | 0.495 | (0.018) | (0.020) |
| N observations | | 3159 | 3078 |
| Control variables | | No | Yes |

+ p<0.10, * p<0.05

[1] All models include matched triplet dummies. Robust standard errors clustered at commune level in parenthesis

[2] Control variables include caregiver education, age, sex, month of interview and province dummies

**Table 6A: Caregiver attitudes, practices and beliefs about handwashing**

| | | Mean effect of treatment | |
|---|---|---|---|
| | Control Mean (SD) | Unadjusted model | Full model |
| ***% Agree or Strongly Agree*** | | | |
| You wash your hands with soap without needing to remind your self | 0.900 | -0.002 | -0.014 |
| | 0.301 | (0.010) | (0.012) |
| When washing your hands with soap, you know you are protecting your children's health | 0.980 | 0.005 | -0.001 |
| | 0.139 | (0.005) | (0.005) |
| Handwashing with soap is something you can do to prevent your children from getting sick | 0.966 | 0.005 | 0.005 |
| | 0.180 | (0.006) | (0.007) |
| Handwashing with soap is something you can do for your child's development | 0.975 | 0.000 | -0.000 |
| | 0.155 | (0.005) | (0.006) |
| You start washing your hands before you realize you are doing it | 0.435 | **0.032+** | **0.043*** |
| | 0.496 | (0.018) | (0.018) |
| You feel strange when you do not wash hands with soap | 0.700 | 0.025 | 0.004 |
| | 0.459 | (0.015) | (0.017) |
| You wash your hands with soap automatically | 0.959 | **0.013*** | **0.015*** |
| | 0.199 | (0.006) | (0.006) |
| You have been washing your hands with soap for a long time | 0.920 | 0.015 | 0.008 |
| | 0.271 | (0.009) | (0.010) |
| You often wash your hands with soap | 0.917 | **0.019*** | 0.009 |
| | 0.275 | (0.009) | (0.011) |
| Washing your hands with soap is typically "you" | 0.906 | -0.001 | -0.006 |
| | 0.292 | (0.010) | (0.012) |
| You would feel uncomfortable if you didn't wash your hands | 0.907 | 0.011 | -0.006 |
| | 0.290 | (0.009) | (0.010) |
| N observations | | 3052 | 2971 |
| Control variables | | No | Yes |

+ p<0.10, * p<0.05

[1] All models include matched triplet dummies. Robust standard errors clustered at commune level in parenthesis

[2] Control variables include caregiver education, age and sex of caregiver, month of interview and province dummies

**Table 6B: Caregiver attitudes, practices and beliefs about handwashing**

| | | Intention to treat (ITT) | |
|---|---|---|---|
| | Control Mean (SD) | Unadjusted model | Full model |
| ***% Disagree or Strongly Disagree*** | | | |
| Washing your hands with soap requires effort | 0.139 | -0.003 | -0.001 |
| | 0.346 | (0.013) | (0.014) |
| You only need to wash your hands with soap, if they look dirty or smell bad | 0.412 | 0.016 | **0.037+** |
| | 0.492 | (0.019) | (0.022) |
| It is not necessary to wash hands with soap before cooking as germs on hands are killed when the food is cooked | 0.801 | 0.019 | **0.030+** |
| | 0.399 | (0.015) | (0.016) |
| It is easy to forget to wash hands with soap after going to the toilet if you do not see soap | 0.737 | -0.015 | -0.008 |
| | 0.440 | (0.017) | (0.019) |
| Washing hands with soap before feeding children is only important if you use your hands to feed them | 0.624 | -0.014 | 0.016 |
| | 0.485 | (0.021) | (0.021) |
| Diarrhea in children is unpreventable | 0.595 | -0.015 | -0.029 |
| | 0.491 | (0.019) | (0.021) |
| Cough and cold are normal symptoms during the growth process of children and do not affect their long term health | 0.568 | **0.046*** | 0.020 |
| | 0.496 | (0.018) | (0.020) |
| You forget to wash your hands with soap when you are busy | 0.644 | -0.006 | -0.011 |
| | 0.479 | (0.018) | (0.020) |
| Diarrhea is a normal symptom during the growth process of children and does not affect their long term health | 0.754 | **0.058*** | **0.045*** |
| | 0.431 | (0.017) | (0.018) |
| Washing hands with soap is not part of your daily routine | 0.791 | 0.010 | 0.019 |
| | 0.407 | (0.016) | (0.019) |
| You only need to wash your hands with soap if you touch unhygienic objects | 0.432 | **0.046*** | **0.062*** |
| | 0.496 | (0.019) | (0.022) |
| You have to think about it, each time you wash your hands with soap | 0.739 | 0.007 | **0.026+** |
| | 0.439 | (0.015) | (0.015) |
| It is not necessary to wash hands with soap after cleaning children's bottom as their feces is not dangerous | 0.925 | 0.006 | 0.011 |
| | 0.263 | (0.011) | (0.012) |
| You always have to remind yourself to wash your hands with soap | 0.083 | -0.004 | 0.005 |
| | 0.275 | (0.009) | (0.010) |
| N observations | | 3052 | 2971 |
| Control variables | | No | Yes |

+ p<0.10, * p<0.05

[1] All models include matched triplet dummies. Robust standard errors clustered at commune level in parenthesis

[2] Control variables include caregiver education, age and sex of caregiver, month of interview and province dummies

**Table 7: Handwashing facilities and cleansing agents in household**

| | | Mean effect of treatment | | | | |
|---|---|---|---|---|---|---|
| | Baseline Mean (SD) | Control Mean (SD) | Unadjusted model | Lag dependent | Full Model | DID |
| Soap and Water available at HW place used after defecation | 0.807 | 0.890 | **0.020+** | **0.026*** | **0.026*** | 0.036 |
| | 0.395 | 0.313 | (0.011) | (0.011) | (0.011) | (0.034) |
| Soap and Water available at HW place used before food preparation | 0.764 | 0.888 | 0.015 | 0.017 | 0.016 | 0.045 |
| | 0.425 | 0.316 | (0.010) | (0.010) | (0.010) | (0.038) |
| Soap present anywhere in the home | 0.962 | 0.982 | 0.004 | 0.006 | 0.006 | -0.002 |
| | 0.192 | 0.134 | (0.005) | (0.005) | (0.005) | (0.013) |
| N observations | | | 3102 | 2927 | 2927 | 6206 |
| Lag dependent variable | | | No | Yes | Yes | No |
| Province dummies | | | No | No | Yes | No |
| Double difference | | | No | No | No | Yes |

+ p<0.10, * p<0.05

[1] All models include matched triplet dummies. Robust standard errors clustered at commune level in parenthesis

**Table 8: Self-reported handwashing with soap and Observed hand cleanliness**

| | | Mean effect of treatment | | | | |
|---|---|---|---|---|---|---|
| | Baseline Mean (SD) | Control Mean (SD) | Unadjusted model | Lag dependent | Full model | DID |
| Self-reported HWWS after fecal contact in past 24 hours | 0.599 | 0.681 | 0.011 | 0.013 | **0.049*** | 0.004 |
| | 0.490 | 0.466 | (0.018) | (0.019) | (0.021) | (0.046) |
| Self-reported HWWS before food preparation in past 24 hours | 0.300 | 0.311 | **0.032+** | 0.029 | 0.030 | 0.051 |
| | 0.458 | 0.463 | (0.019) | (0.019) | (0.021) | (0.050) |
| Self-reported HWWS before feeding/breastfeeding child in past 24 hours | 0.317 | 0.363 | 0.032 | 0.022 | **0.051*** | 0.060 |
| | 0.465 | 0.481 | (0.020) | (0.020) | (0.023) | (0.049) |
| Clean hands index (observed) | 8.111 | 7.355 | **0.264*** | **0.259*** | 0.044 | **0.309+** |
| | 1.397 | 1.876 | (0.066) | (0.070) | (0.077) | (0.168) |
| Clean fingernails (observed) | 0.600 | 0.453 | **0.073*** | **0.069*** | 0.024 | **0.113*** |
| | 0.490 | 0.498 | (0.018) | (0.018) | (0.020) | (0.048) |
| Clean palms (observed) | 0.744 | 0.644 | **0.051*** | **0.049*** | 0.008 | 0.065 |
| | 0.437 | 0.479 | (0.017) | (0.018) | (0.020) | (0.044) |
| Clean fingerpads (observed) | 0.739 | 0.631 | **0.070*** | **0.067*** | 0.026 | **0.090*** |
| | 0.439 | 0.483 | (0.017) | (0.018) | (0.020) | (0.043) |
| N observations | | | 3159 | 2912 | 2838 | 6281 |
| Lag dependent variable | | | No | Yes | Yes | No |
| Control variables | | | No | No | Yes | No |
| Double difference | | | No | No | No | Yes |

+ p<0.10, * p<0.05

[1] All models include matched triplet dummies. Robust standard errors clustered at commune level in parenthesis

[2] Control variables include caregiver education, age and sex of caregiver, month of interview and province dummies

**Table 9: Structured observations of handwashing (Caregivers)**

| | Mean effect of treatment | | | | |
|---|---|---|---|---|---|
| | Control Mean (SD) | Unadjusted model | N | Full model | N |
| Rinse after fecal contact | 0.359 | 0.011 | 911 | 0.051 | 873 |
| | 0.481 | (0.032) | | (0.039) | |
| Rinse before food preparation | 0.194 | **0.052+** | 1103 | 0.019 | 1071 |
| | 0.396 | (0.028) | | (0.032) | |
| Rinse before feeding a child | 0.119 | 0.030 | 765 | 0.029 | 743 |
| | 0.324 | (0.022) | | (0.027) | |
| HW with soap after fecal contact | 0.240 | 0.015 | 911 | -0.030 | 873 |
| | 0.428 | (0.030) | | (0.035) | |
| HW with soap before food preparation | 0.071 | 0.000 | 1103 | 0.003 | 1071 |
| | 0.258 | (0.018) | | (0.021) | |
| HW with soap before feeding a child | 0.046 | 0.017 | 765 | 0.019 | 743 |
| | 0.210 | (0.017) | | (0.019) | |
| Percent of exposure events accompanied by handwashing and/or soap use | 0.293 | **0.041*** | 4295 | 0.024 | 4159 |
| | 0.455 | (0.016) | | (0.018) | |
| Control variables | | No | | Yes | |

+ p<0.10, * p<0.05

[1] All models include matched triplet dummies. Robust standard errors clustered at commune level in parenthesis

[2] Control variables include caregiver education, age, sex, month of interview and province dummies

**Table 10: Child illness symptoms (7-day recall)**

| | | Mean effect of treatment | | |
|---|---|---|---|---|
| | Baseline Mean (SD) | Control Mean (SD) | Unadjusted model | Full model |
| Diarrhea (Caregiver defined) | . | 0.054 | **-0.020*** | -0.009 |
| | . | 0.227 | (0.006) | (0.007) |
| Diarrhea (Symptom defined) | 0.012 | 0.047 | **-0.017*** | -0.004 |
| | 0.108 | 0.212 | (0.006) | (0.007) |
| ARI | 0.155 | 0.375 | **-0.044*** | 0.001 |
| | 0.362 | 0.484 | (0.017) | (0.018) |
| Symptoms of ALRI (short breath with cough or difficulty breathing) | . | 0.044 | **-0.021*** | **-0.015+** |
| | . | 0.206 | (0.007) | (0.008) |
| Abrasions, scrapes, bruising | 0.003 | 0.104 | **-0.037*** | **-0.029*** |
| | 0.058 | 0.306 | (0.009) | (0.010) |
| Itch | 0.008 | 0.078 | **-0.017*** | -0.005 |
| | 0.092 | 0.269 | (0.008) | (0.009) |
| **Treatment seeking behavior** | | | | |
| Sought medical care in past 7-days | 0.239 | 0.469 | **-0.052*** | -0.023 |
| | 0.427 | 0.499 | (0.018) | (0.020) |
| Treated for ARI symptoms | 0.934 | 0.873 | 0.016 | -0.001 |
| | 0.248 | 0.334 | (0.013) | (0.015) |
| Treated for gastrointestinal symptoms | 0.611 | 0.672 | 0.005 | 0.023 |
| | 0.489 | 0.471 | (0.042) | (0.044) |
| **Caregiver productivity** | | | | |
| Cases of lost hours for child care due to illness | 0.147 | 0.110 | -0.015 | -0.004 |
| | 0.354 | 0.314 | (0.011) | (0.013) |
| N observations | | | 3719 | 3618 |
| Control variables | | | No | Yes |
| Date of interview dummies | | | No | Yes |

+ p<0.10, * p<0.05

[1] All models include matched triplet dummies. Robust standard errors clustered at commune level in parenthesis

[2] Control variables include caregiver education, age and sex of child and province dummies