HEALTH ECONOMICS
Health Econ. (2015)
Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/hec.3273

PROMOTING HANDWASHING BEHAVIOR: THE EFFECTS OF LARGE-SCALE COMMUNITY AND SCHOOL-LEVEL INTERVENTIONS[†]

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ABSTRACT

This paper analyzes a randomized experiment that uses novel strategies to promote handwashing with soap at critical points in time in Peru. It evaluates a large-scale comprehensive initiative that involved both community and school activities in addition to communication campaigns. The analysis indicates that the initiative was successful in reaching the target audience and in increasing the treated population's knowledge about appropriate handwashing behavior. These improvements translated into higher self-reported and observed handwashing with soap at critical junctures. However, no significant improvements in the health of children under the age of 5 years were observed. Copyright © 2015 John Wiley & Sons, Ltd.

Received 26 January 2015; Revised 5 July 2015; Accepted 2 September 2015

JEL Classification: I18

KEY WORDS: hygiene; handwashing; behavior change; hygiene; randomized evaluation

1. INTRODUCTION

Handwashing with soap is generally easy and relatively cheap, and the medical evidence of its benefits is conclusive (significant reduction in diarrhea and respiratory illnesses in children).

[1]However, only 3 to 34% of the population in developing countries routinely washes their hands with soap at critical junctures during the day. Therefore, the main challenge is to find an efficient way to bring about a behavioral change towards better hygiene practices. This paper documents a study of a large-scale handwashing promotion campaign carried out in Peru between 2008 and 2010 that introduced an innovative mix of communication strategies designed to induce handwashing with soap at critical points in time. Efforts to change handwashing behavior involve dealing with a complex matrix of personal habits that have multiple economic, cultural, social, and other determinants. A handwashing campaign will be effective if it can provide a 'nudge'[2] by giving people information about the positive (and usually underestimated) effects of handwashing habits and achieving a behavioral change towards increased handwashing at critical times.

We analyze the Global Scaling Up Handwashing Project in Peru, a large-scale initiative that aims to convince mothers, caregivers and children up to 12 years of age in rural households to wash their hands with soap

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[†]This trial is registered, number NCT01465204 and AEARCTR-0000318.
[1]See, Luby *et al.* (2005).
[2]Thaler and Sunstein (2009) define a 'nudge' as any action that 'alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives'.

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at critical points in time. The results of this evaluation show that these community district-level interventions were effective in reaching the targeted audience with handwashing promotional messages. The community-level treated group was 19.4% more likely to report having received the intervention messages through at least one communication channel than the control group. Handwashing campaigns and promotional events at the community level and one-to-one activities seemed to have successfully communicated the importance of handwashing with soap. Not only did the message reach the treated population but it also brought about a 6% improvement in caregivers' knowledge about the best way to wash hands and increased the availability of soap and water in the household by 8.4%. These improvements led to a statistically significant increase in self-reported and observed handwashing with soap before food contact as compared with the behavior of the control groups. However, this change in behavior did not translate into better child health. No significant impact was found on parasite or bacterial prevalence in stools and drinking water (respectively); this is consistent with the finding that there were no treatment effects in terms of diarrhea, nutrition or anemia.[3]

The rest of the paper is organized as follows. Section 2 details the program components. In Section 3, we explain the experimental design. Section 4 describes relevant issues concerning the data and sampling procedure. Section 5 describes the results of the baseline balance checks and of the panel sample attrition. Section 6 describes the methodological framework. In Section 7, we present and interpret the main results of the study. Section 8 concludes.

2. BACKGROUND AND DESCRIPTION OF THE PROGRAM

The Global Scaling Up Handwashing Project implemented in Peru borrowed from commercial and social marketing techniques to promote better hygiene. Communication campaigns and messages developed for this project were designed and strategically delivered across multiple integrated channels and in various settings in order to 'surround' target audiences with handwashing promotional messages. Formative research conducted in 2007 demonstrated that hand soap was not available to mothers and caregivers in most households in Peru, that there was a common belief that washing hands only with water was sufficient, and that people did not know what the critical times for washing their hands with soap were.[4]

The project was implemented in a total of approximately 800 districts randomly selected (in 104 provinces) across the country. Its primary target audience consisted of mothers of reproductive age (15 to 49 years) and caregivers for children under 12 years of age. The project's objective was to improve handwashing behavior among the target audience in order to improve specifically the health of children under 5 years. These infections are usually transferred from dirty hands to food or water sources or by direct contact with the mouth. Diarrheal disease and respiratory infection among children under 5 years of age can be prevented if their mothers/caregivers wash their hands with soap at critical times, such as before feeding a child, cooking, or eating.

The intervention comprised two main components that were delivered at different administrative levels: a mass media campaign at the province level and a more comprehensive district-level community treatment that included, in addition to media campaigns, training of community agents; capacity-building for mothers, caregivers, and children; and the inclusion of handwashing promotion as part of primary school curricula. In this paper, we focus solely on the district-level intervention, which not only had a better experimental design (because both treatment and control communities were randomized in the same provinces), but, more importantly, also points to a low-cost way of scaling up proven intensive strategies that are effective but not cost-effective.[5] The community intervention was conducted at the district level and consisted of the following:[6]

(a) A mass-media plus a direct consumer contact campaign;

[3]For a more detailed review of the literature, see Galiani *et al* (2014).
[4]World Bank (2005).
[5]For the results of the mass-media campaign at the province level, see Galiani *et al*. (2012).
[6]For a more detailed explanation of the campaigns, please see Galiani *et al*. (2014).

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DOI: 10.1002/hec

(b) Training of trainers for community-based agents of change such as teachers, medical professionals, and community leaders;
(c) Capacity-building and the provision of educational handwashing sessions for mothers, caregivers, and children; and
(d) Handwashing curricula in selected primary schools.

3. EVALUATION DESIGN

We carried out a controlled randomized trial at the district-level while taking into consideration the general community treatment and its school component. The targeted areas were districts with populations ranging from 1500 to 100,000 inhabitants. Figure 1 illustrates the experiment's design. From the 193[7] provinces, 40 were randomly selected to participate in the evaluation of the district-level interventions. From these provinces, 85 districts (with between 1500 and 100,000 inhabitants) were randomly selected, with 44 randomly assigned to receive the district-level community treatment and the other 41 randomly assigned to serve as the control group.[8] In addition, for the 44 districts that were randomly assigned to the community treatment, the main school in each district was selected to receive the school treatment. To create a counterfactual for the subgroup of households with children attending the main school in the treated districts, we also chose a subsample clustered around the main schools in the districts of the control group to serve as a control group for the school intervention.[9]

In what follows, we will refer to the households that were used to explore the community treatment as the *community sample* and to the households used to investigate the school component of the community treatment as the *school sample*.

4. DATA COLLECTION

The baseline survey was held from May through August 2008 and covered a total of 3576 households. The follow-up survey was conducted following the completion of the project activities (March–June 2011). We located 2847 of the original households interviewed for the baseline survey during the follow-up round. We replaced the households that we could not find with new households that fit the following criteria: the family had lived in the dwelling for at least the 2 preceding years (e.g., when the intervention took place) and included a child who was under 2 years of age at the time of the baseline survey.

For the household-level sampling, in each district allocated to treatment and control groups, we target to randomly select between 15 and 20 households from a census conducted prior to our baseline survey that listed all households with children under 2 years of age. From the districts assigned to the community treatment, we also target to randomly select an additional set of from 15 to 20 households with children under 2 years of age and with at least one sibling who attended the main treated schools in each district, so that we could assess the effect of the school subcomponent of the district-level intervention. To serve as a counterfactual for this last group, in each of the districts allocated to the control group, we target to randomly select a second set of from 15 to 20 households with children under 2 years of age and with at least one sibling who attended a school similar to the main treated school in the treatment districts.

[7]The province of Pisco was excluded because an earthquake had just hit the area. The province of Lima was excluded because most of its districts are too large for this type of intervention and its inhabitants are relatively wealthy.
[8]Note that, because every district had the same probability of being selected for the evaluation, small, poor districts were overrepresented in the sample. This was desired, however, because the program was targeting poor sectors of the population.
[9]Districts were assigned with replacements in case fewer households were found in the originally selected districts. Thus, during the data collection process, a district was randomly added in the 'Control School' arm of the study.

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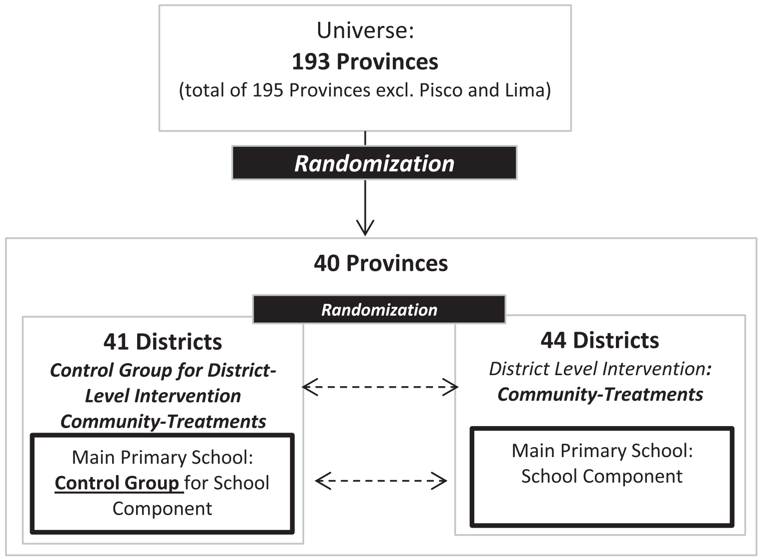

Figure 1. Design of the experiment

4.1. Variables of interest and measurement

Data were collected from different sources. First, a comprehensive household survey was conducted that provided information on dwelling characteristics, household assets, education, income, labor outcomes, water sources, sanitation, and toilet and handwashing facilities, and so on (see the online Appendix 1 in Galiani *et al*. (2014) for the complete list). Also included were questions on exposure to handwashing campaigns, determinants of handwashing behavior—handwashing knowledge, beliefs, and access to and placement of soap and water—and caregiver self-reported handwashing behavior. To complement the handwashing behavior module, structured observations, during which a family's handwashing behavior within the household was observed for a period lasting from 4 to 5 h, were conducted on another day following the survey.[10] In addition, in order to measure environmental contamination, drinking water microbiology samples were collected inside the households at the time of the survey and analyzed in the field using a membrane filtration technique to determine the presence of *Escherichia coli* and other types of coliforms.

We were interested in symptoms directly or indirectly related to poor handwashing habits. We asked about diarrhea and Acute Lower Respiratory Infections (ALRI) prevalence in the last 48 h and in the last week and illnesses mainly transmitted through the hands. We also performed anthropometric measurements of children following standard international procedures. An assessment of the presence of intestinal parasitic infestations in children was achieved through a laboratory analysis of children's stools. Parasitic infestations pose serious threats to young children's health because the associated diarrhea and micronutrient malnutrition often lead to iron-deficiency anemia.[11] We therefore also measured anemia in children between 6 months and 5 years of age.

4.2. Descriptive statistics

Peru is a middle-income country with an estimated per capita income of $US5195 in 2010. Peru has a high human development index score of 0.725 based on 2011 data (the average index for Latin America and the

[10]Structured observations were made only for the target and control samples of the school treatment.
[11]See Hesham *et al*. (2004).

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Caribbean is 0.731 and for the world is 0.682). One-third of the population is poor (31.3%), and 9.8% is extremely poor. The wealthiest region of the country is Lima, Peru's capital city, which is excluded from this study. The mean years of schooling for adults older than 25 is 8.9. Most children attend school (93% attend primary school, and 76% attend high school) according to 2010 data.

Our baseline survey results indicate that the households covered by the survey have an average of 5.6 members, with 1.45 children under the age of 5 years. Around 90% of household heads had completed their primary education, 30% had a secondary education, and most (95%) were employed. The population included in the study was poorer, on average, than the general population of Peru, because poverty is concentrated in the smaller districts and because we restricted our sample to families that had at least one child under 2 years of age.

Three-quarters of the households had access to improved sources of drinking water, and over 40% of the households had improved sanitation. More than 20% of all households had no sanitation facilities of any type. The habit of washing hands with soap was not prevalent among the interviewed households. Although almost all caregivers reported having washed their hands with soap at least once during the previous 24 h, fewer than half confirmed having carried out so at times of fecal contact (39% of caregivers associated handwashing with soap with toilet use and 34% with cleaning up after children). Self-reported handwashing-with-soap was higher at times of cooking or food preparation (68%), but lower when feeding a child (31%). The rate of structured observations of the use of soap was substantially lower than self-reported rates. Handwashing with soap was observed in only 16% of the events that required it. For instance, handwashing with soap was observed in only 20% of fecal contact events, 25% of eating events, 6% of child feeding events, and 10% of food preparation events.

In 60% of the households, a handwashing facility—a designated place for handwashing—stocked with soap and water was observed within the dwelling or the yard. The higher the income, the closer the handwashing station was to the toilet or kitchen facility. In all, 44% of the caregivers appeared to have clean fingernails, and approximately 56% had clean hands or finger pads, whereas 66% of the children looked clean at first sight, but 55% had dirty fingernails. Households with access to improved sanitation and water sources had lower counts of bacteria in their drinking water. When accounting for income levels, there was a declining trend of *E. coli* counts with increased income.[12]

Parasitological analysis shows that, on average, parasites were detected in 15% of the stool samples collected from children under 2 years of age (the most frequent were Giardia and Blastocystis). The prevalence of parasites was lower among households with access to improved sanitation (9%) and water (14%) than those with unimproved sanitation (20%) or unimproved water (21%). The lowest prevalence of parasites was found in households with a handwashing station stocked with soap and water (8%) and highest in those without (25%).

In all, 9% of children under the age of 5 years were reported by their caregivers to have had diarrheal symptoms in the previous 48 h, and another 15% were reported to have had such symptoms in the past 7 days. The prevalence of diarrhea was greater in households with unimproved sanitation (9%) and slightly lower in those with improved sanitation (8%); however, the prevalence of diarrhea was not significantly lower in households with access to a handwashing station equipped with soap and water or in households with access to improved water sources than it was in those without access to those facilities. The prevalence of diarrhea appeared to be uncorrelated with income, but it varied noticeably by geographic location. On average, 4% of children had presented ALRI symptoms in the previous 48 h and 5.5% in the preceding 7 days. ALRI prevalence increased for children living in households with unimproved sanitation and those with unimproved water sources. As with diarrhea, similar percentages of households had presented ALRI symptoms in the previous 7 days, irrespective of whether or not they had a handwashing station stocked with soap and water. In addition, three-quarters of the

[12]For a subsample of 159 households, we also analyzed samples from sources other than drinking water. Households with access to improved sanitation also presented lower bacterial counts in the water used to rinse hands and for sentinel objects. Water and caregivers' handrinsed samples from households with a handwashing station equipped with soap and water had lower bacterial counts.

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DOI: 10.1002/hec

samples taken from children below 2 years of age pointed to the presence of anemia (the proportion was slightly lower for households with improved sanitation).

Finally, the average child was breastfed for 12 months, but half of all caregivers gave their children instant formula during the first 3 days of life. Vitamin A was given to 35% of the children and iron supplements to 23%. On average, children living in dwellings without improved sanitation, an improved water source, or soap and water at a handwashing station tended to have a lower average *Z*-score for each anthropometric measurement included in the analysis.

5. BALANCE AND ATTRITION

5.1. Baseline balance

In Online Appendix 2 in Galiani *et al*. (2014), we present the mean comparison tests[13] across treatment/control groups for an exhaustive set of variables included in the baseline survey. We compare the characteristics of households allocated to each treatment with the households of the corresponding control groups.

The proportion of unbalanced variables for the treatment and control comparison for the district-level intervention was in line with the levels considered acceptable in randomized trials. Furthermore, the differences between treatment and control groups go in either direction without any clear pattern.

5.2. Attrition analysis

Our surveys records show an overall attrition rate of 20% after 3 years, in line with similar randomized studies.[14] In addition to the fact that the sample is smaller, when attrition is systematically related to the outcomes under study or to the program itself, it may skew the estimates of the causal effects of the interventions.

To address this potential problem, we first show in Online Appendix 3 in Galiani *et al*. (2014) that the proportion of households that stayed in each group ranges from 0.72 to 0.804, and we cannot reject the null hypothesis of equal levels of attrition for the control and treatment groups at conventional significance levels in any of the samples studied.

The fact that there was no differential attrition in the treatment and comparison groups is consistent with the hypothesis that attrition could be ignorable, and it suggests that the estimate of the treatment effects will not be biased unless different types of households dropped out of the sample in the treatment and the comparison groups.[15] Baseline balance was achieved for the entire initial sample in most of the variables, and in Online Appendix 3 in Galiani *et al*. (2014), we can see that the sample of non-attriters is also well balanced at baseline. This implies that those remaining in the sample and the attriters were statistically balanced in terms of observable characteristics.

To make up for the loss in sample size due to attrition, we included 688 new households in the follow-up survey to replace households that had dropped out. Note that this poses no problem so long as the intervention is at the area level rather than at the individual level, assuming that attrition is statistically ignorable. To confirm that the characteristics of the replacement households in the treatment and control groups were balanced, we selected 32 variables that were presumably independent of the treatment and affected by more structural patterns. In most of these cases, we could not reject the null hypothesis of equality of means at conventional significance levels (see Online Appendix 3 in Galiani *et al*. (2014)).

[13]The standard errors used in these tests were clustered at the district level, allowing for the possibility of an intra-district correlation.
[14]For example, Banerjee *et al*. (2007) find attrition rates of 17% and 18%, respectively, in the comparison and treatment groups in Vadodara (India) in the first year that they evaluated the *Balsakhi* education program in India.
[15]Angrist (1996).

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6. METHODOLOGY

The treatment assignment in this study was random, and as discussed in Section 5, the randomization produced comparable groups in terms of observables for all the groups studied. Furthermore, the discussion in the previous section also suggests that attrition is unlikely to bias the estimator of the parameters of interest. Therefore, in the context of this randomized experiment, we can assess the average intention to treatment effect on the outcomes of interest by estimating the following simple regression model:

$$Y_{ij} = \alpha + \gamma T_j + \beta X_{ij} + \varepsilon_{ij} \tag{1}$$

where i indexes households or individuals and j indexes districts; Y is any of the outcomes under study; T is the dummy variable indicating treatment assignment (equal to 1 for units in treated groups); γ is the parameter of interest, which captures the causal effect of the intervention considered on the outcome of interest (Y); X is a vector of control variables; and ε is the error term. Because the intervention is at the area level, we refer to the parameter of interest as the intention-to-treat effect of the program on the outcomes of interest. We estimate robust standard errors clustered at the district level throughout the analysis.

The X vector comprises the following control variables: gender and education of the head of household, dummy variables for children's ages in months, gender of the children, an indicator variable for the mother living in the home, rainfall[16] (at the district level), and geographical dummies for the region concerned (jungle, coast, and mountain).

For the results presented in the main text of the paper, we also follow Kling *et al*. (2007) to construct summary indexes by family group of outcome variables in the analysis. These summary indexes, aggregating information across related outcomes, are not only useful summary statistics but might also improve the statistical power to detect effects of the intervention that are consistent across groups of outcomes when they have idiosyncratic variation. We first impute missing values using the mean of the settlement by intention-to-treat status. Then, we standardize each outcome variable by subtracting the mean value of the control group and by dividing by its standard deviation. Finally, the summary index is computed as the sum of standardized outcome variables in the group, with the sign of each measure oriented so that more beneficial outcomes have higher scores divided by the number of outcome variables.

The results presented throughout the paper are estimates of model (1) and are generally robust to two alternative models: dropping all the control variables and dropping only the geographical dummies. Online Appendix 4 in Galiani *et al*. (2014) presents the results for the three model specifications as robustness checks.

7. RESULTS

In this section, we present the results for the relevant outcomes of the hypothesized causal chain: exposure to handwashing promotion, effects on handwashing determinants (handwashing knowledge and beliefs and access to and placement of soap and water), handwashing behavior (self-reported and observed handwashing and hand cleanliness), environmental contamination (bacterial prevalence in drinking water), and child health (prevalence of diarrhea, ALRI, anemia, parasites in stools, nutrition, and anthropometric measurements).[17]

We are also interested in studying the effect of the school handwashing curricula component, which is part of the community intervention, separately. Thus, in Tables I–V, the heading 'community treatment sample' refers to the sample of households used to explore the effects of the comprehensive community treatment, while

[16]Rainfall is measured as the maximum rainfall per district, on average, for January, February, March and April 2011.

[17]We do not pursue the study of child development outcomes because the health results suggest that they cannot be causally interpreted as a response to the interventions.

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Table I. Effect of exposure to handwashing promotion interventions

	Community treatment sample		School component sample	
	Control mean	Effect of treatment	Control mean	Effect of treatment
Exposure[a]				
High exposure to the treatments (HW message through three channels)	0.147	0.055 (0.037) 37.41%	0.200	−0.027 (0.041) −13.50%
Medium exposure to the treatments (HW message through two channels)	0.432	0.145*** (0.051) 33.56%	0.499	0.065 (0.050) 13.03%
Low exposure to the treatments (HW message through one channel)	0.674	0.106** (0.045) 15.73%	0.717	0.063* (0.042) 8.79%

HW, handwashing.
Clustered standard errors in parentheses.
[a]Channels: mass media (radio and/or printed materials), promotional events, and personal training/educational sessions.
Clustered standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Table II. Effect of the interventions on handwashing determinants

	Community treatment sample		School component sample	
	Control mean	Effect of treatment	Control mean	Effect of treatment
Knowledge				
Events that require handwashing (summary index)	0.225	0.009 (0.020) 4.00%	0.222	0.008 (0.019) 3.60%
Best method to wash hands	0.879	0.051* (0.027) 5.80%	0.882	0.044** (0.021) 4.99%
Not washing hands with water and soup is main cause of diarrhea	0.940	0.031** (0.012) 3.30%	0.940	0.011 (0.014) 4.68%
Knowledge index	0.000	0.11** (0.053)	0.000	0.0887* (0.049)

Clustered standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

the heading 'school component sample' refers to the households that were sampled in order to investigate the community treatment's school component. In the remainder of the paper, we will use *school component* and *school treatment* interchangeably.

7.1. Exposure to handwashing promotion

The Global Scaling Up Handwashing Project in Peru uses a behavior-change approach. Thus, we asked mothers and caregivers whether they had received handwashing promotional messages during the past 12 months through any of the three channels used by the intervention: radio and printed materials, promotional events, and educational sessions.

The intervention was successful in exposing the target audience to the handwashing-with-soap message. The proportion of mothers or caregivers who reported having received handwashing messages through at least one

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DOI: 10.1002/hec

(two) of the communications channels was 15.7% (33.5%) higher in the intention-to-treat group than in the non-intention-to-treat group.[18]

We are also interested in assessing whether the messages imparted at schools reached the children who were in attendance, even though those children and their mothers/caregivers might also have been exposed to the other community-level activities. Table I shows that the school component increased the probability of low exposure to the treatment (that is, receiving the messages through only one channel) by 8.9%.

7.2. Treatment effects on handwashing determinants

In order to improve handwashing behavior, the factors that motivate that behavior have to be changed. These factors are known as *handwashing determinants*, and they include knowledge about the best way to wash hands, beliefs about whether soap is needed for effective handwashing, and the availability and placement of soap and water. Caregivers were asked about their knowledge of effective handwashing habits as well as the availability of water or soap in the household. This would constitute the second link—after exposure to information—in determining whether the project could trigger a behavioral change.

Table II also shows that the district-level interventions not only increased exposure to the treatment but also enhanced the knowledge of mothers and caregivers regarding handwashing practices. For instance, in the treated districts, there was a significant increase (around 5%) in the proportion of respondents who answered that the best method for washing their hands was to use water and soap. In addition, the members of 3.3% more households in the treated districts knew that insufficient handwashing is the main cause of diarrhea.[19]

It is important to note that the mean of the control group for these knowledge variables is high: 88% of the caregivers answered that the best method for washing hands is with water and soap, and 94% of the interviewees claimed that improper handwashing is the main cause of diarrhea. These variables reflect a fairly modest gap of 12 and 6 percentage points, respectively, relative to total knowledge. If we measure the effectiveness of the community intervention in closing the knowledge gap, we can see that the program reduced this gap by as much as 50% (the gap in terms of the level of knowledge regarding the best method for washing hands was reduced by 42%, and the gap regarding the influence of improper or insufficient handwashing as a cause of diarrhea was reduced by 50%).[20]

Finally, the community treatment increased the availability of water and soap in households by 8.4% (among the school component sample). Again, it is worth mentioning that the level of availability of soap and water anywhere in the dwelling was also quite high in the control group (e.g., 77% of the households in the control group for the school component of the community treatment have water and soap somewhere in the dwelling). Thus, the treatment reduced the gap by 28%, which constitutes remarkable progress.

7.3. Treatment effects on handwashing behavior

The next step in the causal chain is to assess whether the improvements in knowledge about the benefits of handwashing and the availability of water and soap brought about by the community treatment translated into behavioral changes in handwashing. Ideally, multiple methods should be used to obtain a more reliable measurement of true handwashing behavior because respondents tend to over-report their behavior if they think

[18]Note, however, that the control group also reports high levels of exposure to similar messages. Although this might largely reflect measurement error, it might also reflect the fact that other, less intensive campaigns could have been implemented elsewhere and/or that some radio messages in treatment areas also reached some control areas even though the implementers of the intervention took special care to forestall this type of situation; see also footnote 18.

[19]We also conducted a before and after comparison among both control groups for these two outcome variables (best method to wash hands and not washing hands with soap is main cause of diarrhea) in order to evaluate whether the self-reported exposure to handwashing information by the control group correlated with their behavioral change and did not find any significant change.

[20]Note, however, that even if the level of knowledge is high, handwashing campaigns can change people's attitudes towards handwashing with soap and hence their behavior.

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DOI: 10.1002/hec

Table III. Effect of the Interventions in terms of behavioral change

	Community treatment sample		School component sample	
	Control mean	Effect of treatment	Control mean	Effect of treatment
Handwashing facilities				
HW facilities stocked with water and soap	0.653	0.032 (0.048) 4.90%	0.67	0.062 (0.043) 9.25%
Water and soap anywhere in the house	0.787	0.026 (0.037) 3.30%	0.768	0.065** (0.032) 8.46%
Handwashing facilities index	0.000	0.0801 (0.095)	0.000	0.14* (0.082)
HW hand cleanliness				
Hands cleanliness index	7.527	0.278* (0.161) 3.69%	7.403	0.210 (0.151) 0.88%
Self-reported handwashing behavior				
HW with soap and water previous to eat	0.415	0.025 (0.046) 6.02%	0.402	0.095** (0.044) [23.6%]
HW with soap and water before food preparation	0.653	0.027 (0.036) 4.13%	0.694	−0.042 (0.039) −6.05%
HW with soap and water after fecal contact	0.654	0.025 (0.042) 6.02%	0.656	0.019 (0.043) 6.02%
HW with soap and water before feeding child	0.206	0.004 (0.034) 1.94%	0.194	0.054* (0.030) 27.80%
Behavior index	0.000	0.0454 (0.040)	0.000	0.0694 (0.046)
Structured observations				
Observed HW with soap and water previous to eat	–	–	0.189	0.115** (0.049) 60.80%
Observed HW with soap and water before food preparation	–	–	0.099	0.068* (0.038) 68.60%
Observed HW with soap and water after fecal contact	–	–	0.342	−0.022 (0.056) −6.43%
Observed HW with soap and water before feeding baby	–	–	0.076	0.040 (0.060) 52.63%
Structured observations index	–	–	0.000	0.0643 (0.131)

HW, handwashing.
Clustered standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

handwashing with soap is the right thing to do. This study uses four different measurement methods, along with proxies that vary in their degree of validity, reliability, and cost, to obtain accurate rates of handwashing.[21] These measurements include observations of handwashing facilities in the households, cleanliness of caregivers' hands, self-reported handwashing with soap, and direct structured observations of handwashing. Table III summarizes the results for these four metrics.

[21]Ram (2010).

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DOI: 10.1002/hec

Table IV. Effect of the interventions in terms of environmental contamination

	Community treatment sample		School component sample	
	Control mean	Effect of treatment	Control mean	Effect of treatment
Water analysis				
Prevalence of *Escherichia coli* (percentage)	–	–	0.804	−0.041 (0.061) −5.10%
Prevalence of total coliforms (percentage)	–	–	0.793	−0.04 (0.062) −5.04%
Microbiology index			0.000	−0.094 (0.139)

Clustered standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Observations of handwashing facilities were conducted in all households. The mother or caregiver was asked to identify the place(s) in the household that were designated for handwashing after fecal contact or before food contact. When the answer was positive, the enumerator noted all the details about the handwashing facility (type, distance from the toilet or kitchen, availability of water and soap, and type of soap). At baseline, the proportion of households with at least one handwashing facility near the toilet or kitchen was quite high (66%). The community treatment increased the share of households with handwashing facilities by 4.9% (9.2% for the school component sample), but the increase was not statistically significant at conventional levels. The enumerators also observed the hands of mothers and caregivers and recorded the cleanliness of their nails, palms, and finger pads. These observations were used to create a hand cleanliness index.[22] The intervention had a positive and significant effect on the cleanliness of mothers' hands, as the treatment group was 3.6% more likely to have clean hands than those in the control group.

Self-reported handwashing behavior was measured by asking mothers and caregivers under what circumstances they had washed their hands with soap in the previous 24 h. Respondents were asked to recall every time that they had used soap during handwashing. Analysis of the responses focused on self-reported handwashing-with-soap behavior during any of the critical junctures. As Table III shows, self-reported handwashing-with-soap behavior improved in the district-level interventions at almost all the critical junctures, but it was statistically significant only in the school treatment. Among the school component sample, 23.6% more respondents in the treatment group reported having washed their hands with soap before eating, and 27.8% more reported having washed their hands with soap before feeding a child, relative to the control group.

In order to triangulate the results, the study included structured observations of handwashing in a subsample of 600 households; direct observations were conducted in the school component and its control group during a 4-h to 5-h period on the day after the main questionnaire was administered. The enumerators observed events that should be followed by handwashing and recorded whether the caregiver had actually washed his or her hands, the time of the event, whether water and soap were used, whether hands were dried and, if so, what was used to dry them. The district-level intervention had a significant and large effect on observed handwashing at two of the four main critical junctures. Sixty-one percent more household members in the treatment group washed their hands with soap before eating than those in the control group. Similarly, members of treated households were 69% more likely to wash their hands before food preparation than non-treated

[22]The hand cleanliness index comprises the following components: (a) Nails: +1 if visibly dirty, +2 if apparently dirty, +3 if clean; (b) Palms: +1 if visibly dirty, +2 if apparently dirty, +3 if clean; and (c) Finger pads: +1 if visibly dirty, +2 if apparently dirty, +3 if clean. The index ranges from ratings of from 3 to 9, with higher scores indicating greater cleanliness.

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DOI: 10.1002/hec

Table V. Effect of the interventions on child health

	Community treatment sample		School component sample	
	Control mean	Effect of treatment	Control mean	Effect of treatment
Child health				
Diarrhea prevalence 48 h	0.040	−0.002	0.033	0.001
		(0.011)		(0.009)
		−5.00%		3.64%
Diarrhea prevalence 7 days	0.060	0.001	0.069	-0.005
		(0.015)		(0.014)
		1.67%		−7.25%
ALRI prevalence 48 h	0.041	−0.011	0.049	−0.018
		(0.018)		(0.020)
		−26.83%		−37.35%
ALRI prevalence 7 days	0.051	−0.016	0.056	−0.021
		(0.022)		(0.023)
		−31.37%		−37.50%
Weight-for-age *Z*-score	−0.690	0.000	−0.820	0.107
		(0.085)		(0.087)
		0.00%		−13.05%
Length/height-for-age *Z*-score	−1.453	−0.056	−1.619	0.083
		(0.079)		(0.088)
		3.85%		−5.13%
Weight-for-length/height *Z*-score	0.203	0.076	0.165	0.106
		(0.078)		(0.083)
		37.44%		64.24%
Anemia (Hb < 110 g/l)	0.283	−0.026	0.278	−0.022
		(0.033)		(0.029)
		−9.33%		−8.02%
Health index	0.000	−0.035	0.000	0.011
		(0.042)		(0.043)
Parasites in child stools				
Prevalence of parasites	–	–	0.222	−0.048
				(0.042)
				−21.62%
Parasite count	–	–	0.289	−0.078
				(0.052)
				−26.99%
Parasites index			0.000	−0.119
				(0.009)

Clustered standard errors in parentheses.
The *Z*-scores for the anthropometric measurements were calculated by discarding the lower and upper 1% of the distribution.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

households (Table III). There is a possible caveat regarding the results of the structured observations, as individuals may have changed their behavior because they were being observed (Clasen *et al*., 2012, for example). In the context of this handwashing campaign, that type of change in behavior could be occurring in both the control and the treatment groups. However, rates of handwashing with soap as measured by structured observations are substantially lower than self-reported rates, so, by this measure, there does not seem to be any substantial degree of over-reaction to the presence of an observer. What could, however, bias our causal estimates would be a situation in which the treated group would react differently to the observer's presence than the control group would, but still our results would confirm that the members of the treated group had received the messages and knew when to wash their hands with soap.

7.4. Treatment effects on environmental contamination

Medical evidence suggests that the transmission of diarrhea and respiratory infections occurs mainly through people's hands. It is expected that people who wash their hands with soap at key junctures will have fewer

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DOI: 10.1002/hec

bacteria such as *E. coli* or total coliforms on their hands, thereby reducing the risk of contamination when handling, preparing, or serving drinking water at home. Thus, the study collected samples of drinking water[23] from a subsample of 600 households in the school component sample and its control group. Consistent with previous results, the microbiological analysis of drinking water samples summarized in Table IV shows that the prevalence of *E. coli* and of total coliforms was lower in the treated households than in those of the control group, but none of the effects are statistically significant at conventional levels.

7.5. Treatment effects on child health

The last step in the causal chain is to assess whether the positive results generated by exposure to the campaign—knowledge of appropriate handwashing practices, access to soap and water, and handwashing with soap—resulted in health improvements. Table V shows that, overall, none of the treatments had a significant effect on those variables.

For the district-level intervention, the improvements in terms of knowledge and behavioral change do not seem to have resulted in better health for the children concerned. There are no statistically significant differences between the prevalence of diarrhea or ALRI among children in treated households and those in groups that were not treated, although one should also note that the prevalence levels of these outcomes are not high in the control groups (much lower than at baseline). Nor do we observe any major improvement in anthropometric measurements[24] or anemia indicators. The prevalence of parasites and the parasite counts obtained from stool samples (of children under 5 years of age) are not significantly different in the control and treatment groups. These results are consistent with the fact that the treatments had no effect on diarrhea, micronutrient malnutrition, or anemia, as these health problems are usually related to parasitic infestations.

8. CONCLUSION

Changing handwashing behavior is a complex phenomenon involving personal habits that has multiple (economic, cultural, social, etc.) determinants.[25] This paper focuses on a large-scale handwashing promotion intervention that took place in Peru between 2008 and 2010 and that introduced an innovative mix of communication strategies to induce handwashing with soap at critical points in times. The study examined the effect of two different district-level treatments—a community treatment and an additional school component— on several outcomes: exposure to the program, handwashing determinants, handwashing behavior, environmental contamination, and child health.

The community intervention that has been studied here proved to be effective in reaching the targeted audience with its handwashing promotion message, and it significantly increased the proportion of mothers and caregivers who reported receiving it. The treated community group reported receiving the message through at least one communication channel more than 15% more often than the control group did. This more comprehensive treatment seems to have successfully transmitted the key messages related to handwashing with soap. Increased exposure to the campaign and educational sessions translated into observable learning about best handwashing practices. This improvement in knowledge led, in turn, to statistically significant behavioral changes in key areas, such as an 8.4% increase in the availability of water and soap in the household, hand cleanliness, and observed and caregiver self-reported handwashing behavior before eating, feeding a child, and preparing food. In addition, observed handwashing with soap increased among the treated households by 61% before eating and by 69% before preparing food, as compared with the control groups. However, these behavioral changes did not translate into better child health. Overall, no impact was found in terms of the

[23]Drinking water is not the water at source, but rather the water that the household drinks directly. Drinking water can be boiled or treated and is usually stored in containers or jars inside the household.
[24]The *Z*-scores for the anthropometric measurements were calculated by discarding the lower and upper 1% of the distribution.
[25]Chapman (2010).

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DOI: 10.1002/hec

prevalence of parasites or bacteria in stool and drinking water samples (respectively), which is consistent with the fact that there were no effects on the incidence of diarrhea, micronutrient malnutrition, or anemia.

The results of this evaluation indicate that more intensive interventions that, in addition to mass media promotional methods, include more personalized treatments (in this case, community activities and changes in school curricula) are effective in reaching target audiences and increasing the knowledge of mothers and caregivers about the benefits of handwashing with soap. Furthermore, there is evidence of behavioral change in regard to certain variables as measured by self-reported behaviors and structured observations. This is a step forward in comparison with the reported achievements of other mass media campaigns (e.g., the work of Babor *et al*. (2003) alcohol-abuse prevention campaigns; the work of Madajewicz *et al*. (2007) on arsenic in the water supply in Bangladesh; the review prepared by Banerjee and Duflo (2011) on vaccination campaigns in Zambia;[26] and the work of Campbell *et al*. (2001) and Summerbell *et al*. (2007) on obesity prevention campaigns[27]).

ACKNOWLEDGEMENTS

We thank A. Drenik, L. Jaitman and M.L. Yanguas for their excellent research assistance. We are also grateful for the useful comments made by B. Arnold, B. Briceno, J. Colford, R. Flores and participants at the seminars held in Cuernavaca (2011) and UC Berkeley (2012). This project was funded by the Melissa and Bill Gates Foundation through WSP, World Bank.

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[26]Banerjee and Duflo (2011) review, among others, a case in Zambia in which a large nongovernmental organization distributed subsidized chlorine tablets widely and, by this means, informed the population about the importance of clean drinking water (98% identified the tablets as a good way to purify drinking water). However, only 10% of the families actually use the tablets. In addition, Banerjee *et al*. (2010) show that immunization campaigns in rural India are more effective when the poor are given small incentives apart from the vaccines (in this case, lentils and metal plates for having completed their immunization).

[27]The authors find only modest evidence that diet education impacts the BMIs and consumption habits of schoolchildren, especially in the short term.

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DOI: 10.1002/hec

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