Title: Can social motivators improve handwashing behavior among children? Evidence from a cluster randomized trial of a school hygiene intervention in the Philippines

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Abbreviations:

HWWS Handwashing with Soap
Evo-Eco Evolutionary Ecological theory of behavior change
Hi-Five Hi-Five for Hysan (Hygiene and Sanitation)
DepEd Philippine Department of Education
RCT Randomized Controlled Trial
IWC International Water Center
WASH Water, Sanitation, and Hygiene
p.p. Percentage points
Abstract

**Introductions:** Generating sustained improvements in handwashing behavior is an enduring public health challenge. Whereas many handwashing promotion interventions focus on closing knowledge and accessibility gaps, a relatively new approach uses motivators rooted in social psychology. This study reports the impact of the HiFive program, a six-week handwashing campaign that targets social motivators to improve student handwashing in primary schools in the Philippines.

**Methods:** We designed a clustered randomized trial to evaluate the impact of the HiFive intervention on student handwashing behavior, motivation, and access. Out of our sample of 196 primary schools located in two districts, half were randomly assigned to receive the HiFive intervention. Data were collected three months after the conclusion of the campaign. We observed student handwashing behavior for 5,296 students, administered surveys to 4,295 students, and inspected 4,187 handwashing facilities.

**Results:** Rates of student handwashing are strikingly low. In control schools, 2.5 percent of students were observed washing their hands with soap and water, our primary outcome, and 14.8 percent were observed washing their hands with at least water. HiFive led to a 3.7 percentage point increase (+148%) in the rate of handwashing with soap and water and 5.6 percentage point increase (+38%) in handwashing with at least water after toilet use. HiFive also led to a 10.5 percentage point (18.9%) increase in the number of handwashing facilities stocked with soap. However, the program had limited impact on the social motivators targeted by the program, suggesting that the marginal improvements in handwashing may have been driven by the increases in the already high levels of soap availability.

**Conclusion:** Despite access to functional handwashing facilities and high levels of knowledge of good handwashing practice, many children still do not wash their hands. The HiFive intervention led to statistically significant but relatively small improvements in handwashing rates. Future research on interventions that address HiFive’s implementation challenges, and perhaps combine social motivators with behavioral nudges, is warranted.

**Trial Registration:** The trial was pre-registered with the Registry for International Development Impact Evaluations, study ID 5a12613323ff9 (link)
Key Messages:

What is already known?

- Historical approaches to promoting handwashing have focused on accessibility to soap and water and public awareness campaigns about the health benefits of handwashing.
- A more recent strategy for promoting handwashing is to use motivators derived from social psychology such as social pressure, emotive reactions based on disgust, and the desire to have status within society and to feel attractive.
- In India, a targeted village-level campaign with messaging based on emotional behavioral drivers for handwashing including the desire to fit in with others and the desire to avoid contamination increased the prevalence of handwashing with soap. In Nepal, a village-level campaign to improve food hygiene by triggering motives of disgust and affiliation increased handwashing rates of mothers. But in Zambia, a similarly focused campaign had no effects, possibly because the message was diluted by information about other behaviors.

What are the new findings?

- Rates of handwashing in government primary schools in the Philippines were extremely low: despite relatively high levels of access to soap and handwashing stations, only 2.5 percent of students were observed washing their hands with soap after using the toilet, and only 14.8 percent of students were observed washing their hands with at least water after toilet use.
- A handwashing promotion intervention was designed around the social motivators of peer-affiliation and disgust and was delivered to children in government primary schools.
- The intervention led to a statistically significant but relatively small improvement in handwashing rates.

What do the new findings imply?

- Improving hygiene knowledge and hygiene access alone are insufficient in generating large-scale improvements in handwashing practice. This study reaffirms the importance of behavioral promotion strategies and warrants their further investigation.
- School behavior-based programming can play a role in increasing handwashing; however, more research is needed to understand whether and how interventions can effectively trigger social motivators to improve handwashing behavior among children.
I. Introduction

Evidence linking hand-hygiene to reductions in the burden of infectious disease is well-documented. Systematic reviews have found that handwashing with soap (HWWS) reduces diarrheal risk by 31 to 48 percent. While handwashing without soap can significantly reduce bacterial contamination, HWWS is substantially more effective; in one study, HWWS eliminated 71 percent more bacteria of faecal origin than handwashing with water alone. HWWS is also associated with large reductions in other intestinal infections, including parasitic infections as well as respiratory infections, and skin infections. Although less established, several studies point to positive spillovers of handwashing on school attendance and child development.

Despite the proven health benefits and relative low cost of handwashing, less than 20 percent of the world’s population wash their hands with soap after defecating. Thus far, hygiene interventions to motivate HWWS have had mixed results, ranging from no effect to over 60 percentage points increase in HWWS rates. No single approach has emerged as a consistent way to generate large scale, sustained improvements in handwashing rates.

Traditional handwashing interventions focus on educating the public on the importance of HWWS. In order to be effective, these programs must rely on the assumption that individuals make rational hand-hygiene decisions if presented with basic knowledge about health and hygiene. Other interventions address the supply-side, such as providing soap or building infrastructure to improve access to handwashing. While knowledge and access are necessary, even in environments where soap and water are available and education levels are high, handwashing rates remain far from universal.

More recent interventions pair improvements in access and knowledge with theory-based approaches to invoke behavior change. The Evolutionary-Ecological (Evo-Eco) theory of the influences and drivers of human behavior is one model that is often used as a framework for designing handwashing promotion programs. The Evo-Eco model proposes a list of fifteen motives, based on humans’ evolutionary needs for reproduction and survival that drive behavior change. Out of these fifteen, the emotional and social motives most easily exploited in handwashing promotion campaigns are ‘affiliation’ and ‘disgust’.

Affiliation is the tendency for humans to conform in order to reap the benefits of social living. The fear of social exclusion if an individual is seen to be acting in a way that is socially undesirable is a powerful driver of behavior. Affiliation includes both empirical expectation (“I want to wash my hands because everyone else washes their hands”) and normative expectation (“I want to wash my hands because I think that other people believe that I should wash my hands”). Disgust is the tendency to avoid something unpleasant or offensive. In the same way that fear is an adaptive mechanism for avoiding predators, disgust is thought to be a genetically hardwired emotion that functions as a parasitic avoidance strategy. Disgust can manifest as an individual-level emotion (“I want to wash my hands before I eat because if I do not it would be like I am eating feces”) or a group-level emotion (“I want to wash my hands otherwise I might smell, and others will distance themselves from me”).

Messaging campaigns that harness disgust and affiliation as social motivators of behavior change have had mixed success in improving hand-hygiene within the household. Biran et al. found that six-weeks after the implementation of a community-level multimedia campaign designed around the concepts of disgust and affiliation, the rate of observed HWWS in households in intervention villages in Andhra Pradesh was 19 percent compared with only 4 percent in control villages. In Nepal, Female Community Health Volunteers implemented a campaign that used the motives of disgust, affiliation, and nurture through songs, games, and other activities to motivate healthy food hygiene. Forty-five days after the intervention, the proportion of mothers who washed their hands with soap before feeding their child and the proportion of mothers who washed their child’s hands before eating were both approximately 65 percentage points (p.p.) higher than for mothers in households from randomly-assigned control.
clusters. Conversely, The Komboni Housewives intervention in Zambia, which among other activities, developed skits featuring a group of housewives gossiping about mothers who did not practice correct health behaviors, resulted in no significant improvement in rates of HWWS. The authors speculate that the null finding was a result of focusing on too many disparate behaviors, which they believe led to message dilution and overloading of the target population.

Findings from these previous studies suggest that using social and emotional motives from the Evo-Eco theory may be an effective strategy to induce behavior change, if the intervention is focused on either a single behavior or on a group of related behaviors. To date, the literature has focused on evaluating the impact of community-level campaigns where caregivers of children are often the target audience. It remains unclear whether interventions that use social motivators can lead to similar-sized improvements in HWWS when delivered in primary schools with children as the target audience. Considering the importance of instilling healthy hygiene behavior at an early age, the increased risk of infectious disease transmission in schools, and the linkages between infectious disease burden and school outcomes, an important question to answer is whether affiliation and disgust can work as hand-washing motivators for children in primary school.

In this study we report the results of a large-scale, school-based campaign that uses programming centered around disgust and affiliation to motivate handwashing behavior change. From July to August 2017, the Philippine Department of Education (DepEd), in collaboration with UNICEF and the International WaterCentre (IWC), implemented a six-week behavior change campaign, known as the HiFive for Hysan (Hygiene and Sanitation) program, in primary schools across two provinces in the Philippines. We exploit the phased-in random assignment of schools into the program to measure the impact of the campaign on rates of student handwashing.

II. Methods

Program Description

The HiFive intervention was developed following a qualitative research study by the International WaterCentre that explored hand-washing determinants and barriers in eight primary schools in the Philippines. The study found that students, especially in upper grades, were motivated by the desire to conform to peer norms rather than the norms and expectations of teachers and parents. Students also expressed strong visceral reactions to pictures and vignettes depicting poor hygiene practices of a student in different contexts. These results suggested that disgust and affiliation could be powerful motives in this context. While the majority of students had access to a functioning handwashing station with running water, soap was not always available. Often soap provided by the DepEd had run out, or teachers kept a supply at their desk and students were required to ask permission before using it. Student self-reported knowledge of the health benefits of hand hygiene was high in the study sample; however, when further questioned, students revealed a lack of understanding of fecal contamination and disease transmission.

These and other key findings from the formative research study informed the following set of design principles for a student handwashing intervention:

- Be based on Evo-Eco motives for behavior change, primarily disgust and peer-affiliation.
- Include messaging on germ transmission to strengthen the effect of emotional and social motives.
- Leverage student demand for HWWS as a way to improve soap availability and hand-washing access.
- Include regular fun and engaging activities suited to short term campaigns that can be easily integrated by teachers into existing academic subjects.
Based on these design principles, the IWC and UNICEF collaborated to develop the HiFive intervention. HiFive was a six-week school campaign where teachers used a set of HiFive tools (Table-1) to conduct hygiene and sanitation activities (Table-2). The expectation was that the behavioral messaging of HiFive activities would lead to increased motivation for HWWS, increased practice, and ultimately, increased demand for opportunities to hand-wash. Increased student demand would in turn lead to teachers addressing barriers to HWWS such as ensuring the stocking of soap, while lobbying principals to address more structural barriers to hand-washing (see Section A-1 in the supplementary appendix for the HiFive Theory of Change). The intervention itself did not directly supply soap or handwashing infrastructure to schools.

### Table-1: HiFive Tools

<table>
<thead>
<tr>
<th>HiFive Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storyboard</td>
<td>An interactive flip-chart story of two Filipino school children that builds messages of disgust and affiliation as motivators for encouraging children to hand-wash.</td>
</tr>
<tr>
<td>Poo-Tag</td>
<td>A game to teach students about fecal transmission. Students acting as contaminators try to spread their germs by “contaminating” (tagging) their fellow classmates while a group of students acting as soap “hand-washes” (un-tags) contaminated students.</td>
</tr>
<tr>
<td>iWash Song</td>
<td>A song reinforcing messages of the storyboard to be sung during daily group hand-washing and after conclusion of poo-tag</td>
</tr>
<tr>
<td>Murals</td>
<td>Scenes from the storyboard are painted as murals in schools to provide visual reminders of key sanitation messages.</td>
</tr>
<tr>
<td>Star-Chart</td>
<td>A chart that maps HiFive activities and other WASH steps that students pledge to complete in order to meet minimum hygiene and sanitation standards. The chart tracks classroom progress on WASH achievements and serves as a reminder for students about their role in championing hygiene and sanitation at their school.</td>
</tr>
</tbody>
</table>

### Table-2: HiFive Activities by Campaign Week

<table>
<thead>
<tr>
<th>Week</th>
<th>Activities</th>
</tr>
</thead>
</table>
| 1    | - Story-board is introduced in all classrooms  
      - Students are encouraged to call out or remind friends and family who do not wash their hands with soap after using the toilet or before eating |
| 2    | - Teachers reinforce massages on the benefits of hand-washing  
      - Poo-Tag Game and iWash Song are conducted with all students  
      - Murals are painted |
| 3    | - Pupils begin using a toilet worksheet, a supporting tool that encourages pupils on toilet cleanliness  
      - Teacher proposes a schedule for toilet cleaning based on the worksheet |
| 4    | - Pupils reenact or draw pictures of the Story-board  
      - Different classes come up with tunes for the iWash song  
      - Pupils play Poo-Tag during physical education class |
| 5    | - Pupils appraise their WASH success using the Star-Chart and identify next steps  
      - Pupils make the pledge to become HiFive champions by promising to wash their hands with soap  
      - Award presented for the best Story-board drawing or reenactment is given |
| 6    | - The campaign closes with a flag ceremony involving DepEd staff and municipal administrators |

### Study Design

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To test proof of concept, the DepEd conducted a two-year pilot of the HiFive program. Across the 2017-18 and 2018-19 school years, HiFive was introduced to a group of primary schools in the school districts of Camarines Norte, in Region V of the Philippines, and Puerto Princesa, located in the island of Palawan in Region IVB. Implementation of the first phase of the pilot took place during the start of the 2017-18 school year and lasted for six weeks from July to August.

We designed and implemented a clustered randomized controlled trial (RCT) to measure the effects of the HiFive intervention on our primary outcome: student HWWS after toilet use, as observed during classroom observations. We also measured the effects of the HiFive intervention on four secondary outcomes:

(i) student handwashing with at least water after toilet use, as observed during classroom observations,
(ii) student handwashing before eating, as reported in student surveys,
(iii) student handwashing motivations and beliefs, as reported in student surveys,
(iv) the availability of functional handwashing facilities with soap, as observed during facility observations.

To construct the evaluation sample of primary schools taking part in the HiFive pilot, we imposed a set of eligibility criteria based on basic water, sanitation, and hygiene (WASH) infrastructure requirements (Table 3). This ensured that schools participating in the evaluation had at least a minimum level of WASH infrastructure in place for the HiFive program to be effective. Administrative data collected by the DepEd was used to assess school eligibility. Out of 328 public primary schools in Camarines Norte and Puerto Princesa, 196 met the three inclusion criteria specified in Table 3.

Table 3: School Inclusion Criteria for HiFive Pilot Participation

<table>
<thead>
<tr>
<th>#</th>
<th>Category</th>
<th>Criterion</th>
<th>Schools Meeting Each Criterion (n=328)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Water</td>
<td>Water for cleaning available at least for certain days of the week</td>
<td>301</td>
</tr>
<tr>
<td>2</td>
<td>Sanitation</td>
<td>Overall student to toilet seat ratio is 100 or less</td>
<td>304</td>
</tr>
<tr>
<td>3</td>
<td>Hygiene</td>
<td>At least one functional group handwashing facility</td>
<td>215</td>
</tr>
</tbody>
</table>

Total schools meeting all criteria: 196 59.8%

Of the 196 schools meeting the eligibility criteria, half were randomly assigned to receive the HiFive program in the 2017-18 school-year (the “treatment group”), while the other half, the “control group”, were assigned to receive the intervention in the following school year. This evaluation tests the intent-to-treat impact of receiving the HiFive intervention in the 2017-18 school year.

Randomization was stratified by province and a school WASH index to ensure that schools with similar WASH characteristics within Camarines Norte and Puerto Princesa were allocated equally amongst treatment and control groups. This index included eleven indicators relating to school WASH infrastructure and WASH practices, such as the ratio of students to toilets and implementation of WASH in Schools programming. Each school was assigned a point value ranging from 0 (low baseline WASH infrastructure and practices) to 11 (high baseline WASH infrastructure and practices), resulting in 24 province-WASH strata.

We implemented and documented school randomization in Stata/IC version 14.0. Within each province-WASH stratum, schools were sorted in increasing order on a random number variable generated by the runiform() function, and the top 50% of schools in each stratum were assigned to treatment and the remainder to control. If a stratum had
an odd number of schools, then the last school in this randomized order was alternately assigned to treatment and control, resulting in an equal number of treatment and controls schools in the sample overall.

Following randomization, we checked for balance between experimental groups using pre-program school-level monitoring data collected by the DepEd (Table-4). As expected, given the stratification on an index of WASH characteristics, baseline WASH infrastructure and school hygiene practices did not differ significantly across treatment and control schools.

**Table-4: Balance Check, Comparison of Means Across Treatment and Control Schools**

<table>
<thead>
<tr>
<th>Strata variables:</th>
<th>Treatment School Mean</th>
<th>Control School Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>School located in Camarines Norte, as opposed to Puerto Princesa</td>
<td>66.3</td>
<td>66.3</td>
</tr>
<tr>
<td>WASH Index (out of 11 points)</td>
<td>6.54</td>
<td>6.61</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School-level variables:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td># of toilets</td>
<td>12.99</td>
<td>13.24</td>
</tr>
<tr>
<td># of non-functional toilets</td>
<td>0.13</td>
<td>0.13</td>
</tr>
<tr>
<td># of students</td>
<td>474.98</td>
<td>489.13</td>
</tr>
<tr>
<td>School has lunch canteen (yes/no)</td>
<td>0.85</td>
<td>0.81</td>
</tr>
<tr>
<td>Water always available (yes/no)</td>
<td>0.57</td>
<td>0.55</td>
</tr>
<tr>
<td>Has regular supply of soap (yes/no)</td>
<td>0.50</td>
<td>0.47</td>
</tr>
<tr>
<td>Students bring their own soap (yes/no)</td>
<td>0.21</td>
<td>0.29</td>
</tr>
<tr>
<td>HW facility with soap in playground (yes/no)</td>
<td>0.22</td>
<td>0.29</td>
</tr>
<tr>
<td>Toilets are cleaned daily (yes/no)</td>
<td>0.92</td>
<td>0.88</td>
</tr>
<tr>
<td># of teacher supervised group hand-washing events per week</td>
<td>3.33</td>
<td>3.00</td>
</tr>
<tr>
<td># of teacher supervised group tooth-brushing events per week</td>
<td>2.49</td>
<td>2.87</td>
</tr>
</tbody>
</table>

Notes: (i) The school-level variables listed in the balance check table do not include the individual variables included in the aggregate WASH index, which were balanced by design. (ii) Standard errors are heteroscedasticity-robust. (iii) The p-value from a joint test of orthogonality of all the balance check variables is 0.49.

**Sample Size**

We conducted power calculations to estimate the required sample size to detect a ten-percentage point improvement in HWWS, which we identified in collaboration with UNICEF as a relevant minimum detectable effect size for informing program recommendations. Assuming 80% power, a two-sided alpha of 0.05, an intra-class correlation of 0.3, and 196 clusters, we estimated that we would need to observe at least 20 handwashing opportunities per school, or 3,920 in total. We assumed that enumerators would need to spend approximately 2 hours of observation per classroom per school to achieve this sample. In actuality, this assumption was conservative, and enumerators were able to observe 5,296 handwashing opportunities (2,833 in treatment and 2,463 in control), exceeding our sample size target.

**Data Collection**

Baseline data were not collected since the HiFive program was implemented starting at the beginning of the school year and it was not possible to observe student handwashing prior to the start of school. Endline data were collected between November and December 2017, approximately three-months after the completion of the HiFive program. Sixty local enumerators with prior training in data collection, but who were not involved in program implementation, were recruited and trained on our data collection instruments to conduct the following activities:
Classroom observations of student handwashing behavior after toilet use

Student surveys of self-reported handwashing behavior before eating and after toilet use as well as student motivation and perception towards handwashing

Facility inspections of toilet and handwashing station availability and facility characteristics

Classroom Observations

All classrooms in grades one to six were eligible for observation unless the classroom did not have a functioning toilet visible from inside the classroom (2.6 percent of classrooms) or the classroom had a handwashing facility inside the toilet but did not have a handwashing facility outside of the toilet (8.5 percent of classrooms). Enumerators used SurveyCTO digital data collection software and a complete listing of eligible classrooms to randomly select one classroom in each grade for observation (excluding classrooms that did not have observable handwashing stations), for an average of 4.5 classrooms in each school. During each observation, enumerators spent two hours recording student’s handwashing behavior. While the teacher and students were aware of enumerators’ presence, enumerators explained that they were there to observe ‘normal classroom activities’ and made no mention of handwashing or sanitation. Enumerators chose a discrete spot in the back of the classroom from which to observe without drawing attention to themselves. Each time a student used the toilet, the enumerator noted whether the student washed his or her hands at a handwashing facility immediately after the student exited the toilet, and whether the student used soap. All students whose handwashing behavior was observed became part of the classroom observation sample. In total, we observed 5,296 handwashing opportunities (2,833 in treatment and 2,463 in control) from 840 classroom observations (438 in treatment and 402 in control) across 184 schools. 12 schools were not reachable on account of unexpected school closures due to holidays, school events, and severe weather; the final sample of 184 schools remained balanced on baseline characteristics.

Student Surveys

Since students ate lunch at different times and different locations, including at their homes, we were unable to observe whether children washed hands before they ate lunch. As a result, we relied on student surveys in grades four to six to measure student self-reported rates of handwashing before eating; younger students in grades one to three were not surveyed on account of being too young to understand survey questions and remain focused during the survey. In each school, two classroom sections per grade were randomly selected for surveying. Enumerators handed out consent forms to students in selected classrooms during their first school visit. Approximately one-week later, enumerators returned to the school, collected signed consent forms, and randomly sampled eight students per grade, stratified by gender, from selected classrooms using the list of students who returned consent forms.

In order to obtain the most credible possible estimates from student surveys, we attempted to triangulate handwashing before eating using three survey techniques. The first method was to directly ask students about whether they washed their hands with soap before eating lunch (direct-response). The second method was a script-recall question to test whether students mention HWWS when asked to recount the events that took place between the start of their lunch break and the time s/he started eating lunch. The third method was a list-randomization question as a way for students to report handwashing behavior without allowing the enumerator to identify individual survey responses. In list-randomization, surveyed students received a list of yes/no questions and were asked to respond with the total number of questions (not which ones) that they would respond ‘yes’ to. 30 percent of the students in our sample (across both treatment and control groups) were randomly selected to receive a four-item question list without the sensitive question asking about handwashing behavior. The other seventy percent received the same four-item list in addition to the sensitive question on handwashing behavior (for a total of five items). The list-randomization impact estimate is the double-difference of the average number of items between the treatment group receiving the five-item list and the treatment group receiving the four-item list, and the control group receiving the five-item list and the control group receiving the four-item list. The full list of list randomization questions is available in the survey instrument in the supplementary appendix (Section A-2).
We also asked students about whether they had washed their hands the last time after they used the toilet, in order to compare responses with direct observation. In the Discussion section we highlight potential limitations with self-reported handwashing in student surveys, particularly in contrast to direct observation, which we consider the more credible metric. In total, we administered 4,295 surveys (2,219 in treatment and 2,076 in control) to students from 192 schools.

Facility Inspections

Using a structured observation guide, enumerators conducted inspections of all unlocked student-accessible handwashing facilities within and outside classrooms, checking whether facilities had running water and soap available at the time of inspection. Enumerators observed 4,187 handwashing facilities (2,050 in treatment and 2,137 in control).

Analytical Model

The analytic model was defined prior to data collection and posted along with the evaluation pre-registration on the Registry for International Development Impact Evaluations (Study ID: RIDIE-STUDY-ID-5a12613323ff9). Impact estimates reported in the following section are from regression specifications, as described in our pre-analysis plan, that include school district, WASH index, and strata-level fixed effects, in addition to other control variables specific to the model to reduce variance in the outcome. Standard errors are clustered at the school-level, the level of treatment assignment. Sample weights equal to the inverse probability of a classroom section being selected for observation are included for outcomes from classroom observations. For outcomes from student surveys, we include sample weights equal to the inverse of the joint probability of a classroom section being selected for student interviews and a student being selected out of the number of returned signed consent forms. For each student level outcome reported we estimate the following weighted ordinary least squares regression model:

\[ Y_{ijk} = \beta_0 + \beta_1 T_k + \bar{\beta} W_k \cdot P_k + \bar{\beta} \bar{X}_{ijk} + \varepsilon_{ijk}, \]

where:

- \( Y_{ijk} \) denotes the outcome variable for student \( i \) within classroom \( j \) in school \( k \).
- \( T_k \) refers to the binary school-level treatment status.
- \( W_k \cdot P_k \) signifies strata fixed-effects; the 21 stratification dummy variables (with one stratum omitted) from the interaction of the eleven WASH index variables and a binary variable representing the province.
- \( \bar{X}_{ijk} \) represents a vector of student, classroom, and school level covariates including (i) a dummy variable for each of the six grades (with one grade omitted); (ii) the number of enrolled students per school, (iii) the number of students per class; (iv) fixed effects for the 12 municipalities of Camarines Norte and three districts of Puerto Princesa; and (v) a dummy variable for whether the student is female.
- \( \varepsilon_{ijk} \) is the student error term clustered at the school level.
- p-values from regressions are corrected to account for the family wise error rate using the Holm-Bonferroni method of multiple hypothesis corrections. While the pre-analysis plan specified a correction for multiple hypothesis, we deviated from the pre-defined process after further methods research. Specifically, to avoid over-correction of p-values, we separated out the primary outcome (HWWS, as specified in the pre-analysis plan) from secondary outcomes and subgroup analyses in the family-wise adjustments. Furthermore, outcome families with fewer than four outcomes were not corrected since the correction involved a relatively marginal adjustment that would not affect interpretation of results.

We estimated equivalent models for classroom and school-level outcomes except that outcomes include one observation per classroom or school and correspondingly the vector of covariates omitted student variables. In all models, point estimates are comparable without controls and with equal sample weighting. We have posted a
supplementary appendix that includes results from regressions with and without control variables, results with and without inverse probability weights, and additional subgroup analyses (Section A-3). We also include a completed CONSORT checklist for cluster randomized trials for this manuscript in the supplementary appendix (Section A-4).

**Ethical Approval**

Prior to observing classrooms, we received verbal consent from the school principal and teacher. For student surveys, we obtained signed consent from parents and verbal consent from respondents. The stated purpose of our research communicated during the consent process was to observe and learn about student health and sanitation behavior. Our evaluation was granted ethical clearance from a research ethics committee accredited by the Philippine Health Research Ethics Board – St. Cabrini Medical Center and the Asian Eye Institute - in addition to research clearance from the DepEd.

**Patient and Public Involvement**

Focus group discussions with students and school administrators informed the design of the HiFive program. The study’s subjects, including students, teachers, and school administrators, were not involved in the development of research questions, outcomes, study design, analysis, or interpretation of results. Findings were disseminated to DepEd administrators and educators who oversaw program implementation.

**III. Results**

**Impact of HiFive on Handwashing After Toilet Use**

The overall rate of observed student handwashing in our sample was strikingly low. In control group schools, students were observed washing their hands after using the toilet with at least water 14.8 percent of the time, and with soap only 2.5 percent of the time.

The HiFive program increased the frequency of handwashing after toilet use, however, the program failed to bring about large-scale hand-hygiene behavior change. The overall difference between treatment and control students in rates of observed individual handwashing after toilet use with water and soap was 3.7 p.p. (p < 0.01), or +148%, and with at least water was 5.6 p.p. (p = 0.03), or +38% (Table-5).

**Table-5: Observed Rates of Student Handwashing After Toilet Use**
Impact of HiFive on Handwashing Before Eating

Surveyed students dramatically over-reported their handwashing behavior in both treatment and control schools. The difference between self-reported and observed rates of HWWS after toilet use was 74.4 p.p. in treatment schools and 73.7 p.p. in control schools; the small difference in over-reporting between treatment and control schools was not statistically significant. It is likely that self-reported handwashing before eating suffers from similar rates of over-reporting.

Table-6 presents the results from three measures of handwashing before eating among students in grades four to six: direct response, script recall, and list-randomization. When asked directly about handwashing behavior before their most recent school lunch, 79.6 percent of students in HiFive schools reported washing their hands with soap compared to 75.3 percent of students in control schools (p-value of difference = 0.03). The script recall question may have been more successful in reducing self-reporting bias: in the control group, only 31.0 percent of students recounted washing their hands with soap when asked to describe the events preceding lunch. In HiFive schools, 6.4 p.p. (21%) more students recalled washing their hands with soap (p = 0.04).

The impact estimate from the list-randomization method was statistically indistinguishable from zero. The method appears to have failed to reduce social desirability bias: The reported rate of HWWS using list-randomization is similar to the level suggested through direct response. It is very possible that students may not have understood how their true response would be concealed with this type of question. Moreover, the large standard error and wide confidence interval of the list-randomization point estimate suggests that in addition to being under-powered, this method may have been too complex and not suitable for young students in our sample.
Impact of HiFive on the Availability of Handwashing Facilities

Access to a functional handwashing facility stationed nearby a toilet was high across all schools, especially relative to the rate of observed handwashing. 90.4 percent of toilets in control schools had a functional handwashing facility nearby, compared with 95.4 percent of toilets in treatment schools (p-value = 0.01).

However, handwashing facilities in HiFive schools were more likely to be stocked with soap. 38.9 percent of handwashing facilities near toilets in control schools had soap, compared with 49.7 percent of facilities in treatment schools (p < 0.01). At the classroom level, though the proportion of classrooms with a handwashing facility was similar across treatment groups, classrooms in treatment schools were 10.8 p.p. more likely to have a facility containing soap (68.3 percent in treatment school classrooms versus 57.5 percent in control, p-value of difference = 0.00).

While HiFive appears to have increased the incidence of soap stocked at handwashing stations, the absence of soap was not the only barrier to using soap: Among students who washed their hands only with water, soap was available 74.3 percent of the time, yet students opted not to use it.

Impact of HiFive on Student Handwashing Motivations and Beliefs

Students were asked to list the reasons why they wash their hands with soap (Figure-1). Enumerators were instructed not to read out options to students and to probe students by asking “any other reason” until the student said no. Enumerators coded student responses into a predetermined list, and if a reason did not fit under any of the options, enumerators selected an ‘other’ code and filled out a text response; these responses were later coded into existing categories or new categories during data analysis.

Motivations reported by students suggest that students were aware of the health benefits of handwashing; the most frequent reasons for handwashing were to prevent the spread of germs (65.9 percent) and to reduce the incidence of illness (61.8 percent). However, students rarely responded using visceral language repeated in HiFive program tools such as “gross”, “yuck”, or “eww”. Reasons related to social motivators were also rarely mentioned: Approximately one percent of students surveyed cited other students’ adverse reactions to unwashed hands as a motivator to HWWS (peer affiliation), and there was no difference between treatment and control groups (p-value = 0.91).
Figure-1
<insert here>

HiFive program tools sought to strengthen the motivating force of peer-affiliation by establishing classroom norms around handwashing. The goal was for students to perceive that their classmates wash their hands with water and soap and that students do not tolerate dirty, unwashed hands. We tested to see if the HiFive program entrenched these norms by asking students whether they believed that their peers wash their hands with soap at critical times (empirical expectation) and whether they believed that students should wash their hands with soap at critical times (normative belief). 25.6 percent of students in treatment schools reported that every student washes their hands with soap after using the toilet and before eating, compared to 22.4 percent of students in control schools, though the difference was not statistically significant (p-value = 0.16). Similarly, we do not find evidence that the HiFive program led to a notable difference in the proportion of students that strongly believe that other students should wash their hands with soap at critical times. Full regression tables including impact estimates on reported motivations for handwashing and beliefs about peer handwashing behavior are reported in the supplementary appendix (Section A-3).

IV. Discussion

Three months after the conclusion of HiFive, we find that the program led to a modest gain in the prevalence of handwashing after toilet use. Results are suggestive of similar sized increases in the rate of handwashing before eating. Despite the positive gains, handwashing rates remained extremely low. Student-reported motivations to handwash provide clues that HiFive did not successfully alter behavioral motivators explicitly targeted by the program. Reasons for handwashing related to peer-affiliation and the specific language of disgust used by the HiFive program were rarely mentioned and were not more frequently cited by students in HiFive schools than in control schools. Survey evidence indicates that students’ expectations and normative beliefs around peer handwashing did not change. It is therefore unlikely that HiFive entrenched critical social norms required for peer-affiliation to work as a social motivator.

The modest increase in HWWS observed in HiFive schools may be largely attributable to a greater opportunity for HWWS rather than an increased desire to HWWS. In addition to increasing the presence of handwashing stations nearby toilets, the HiFive program led to sizable increases in the stocking of soap at handwashing facilities and the proportion of classrooms with a handwashing facility containing soap. However, it is unlikely that providing universal access to stocked handwashing facilities would dramatically improve the frequency of student handwashing. In over 90 percent of classrooms, students had the opportunity to wash hands with water after using the toilet, yet fewer than 1 in 6 did so. In more than half of classrooms, students had the opportunity to HWWS, yet the rate of HWWS remained in the single digits. Similarly, knowledge gaps do not seem to be the primary constraint. Student surveys indicate high levels of student knowledge on the health benefits of handwashing. This confirms findings from other studies that have shown that knowledge and access by themselves do not translate to high levels of handwashing.

Limitations of the intervention design

It is unclear why the HiFive program was unsuccessful in changing student motivation for handwashing. One possibility is that a six-week campaign period may have been too short to lead to sustained behavior change, and students might require refresher sessions over the school year to reaffirm key HiFive messages. In other contexts, successful handwashing promotion interventions are sometimes implemented over a longer time period: a handwashing intervention in Pakistan that halved diarrheal incidence among children involved weekly household...
visits over the course of a year,\(^8\) while a handwashing intervention in Ethiopia that reduced parasitic reinfection by half involved weekly household visits over the course of six months.\(^7\) On the other hand, other handwashing interventions have been successful on an even shorter timeline and with fewer sessions than HiFive: the SuperAmma program in India, for instance, involved only four days of implementation over the course of a month and led to a 31 percentage point improvement in HWWS.\(^{11}\) Thus, while a longer HiFive intervention period might have further entrenched social norms, we do not regard the six-week implementation period to be the primary constraint to greater impact.

Another possibility is that the relevance of social motivators may have been inadequate given the context and student demographic. Despite formative research suggesting that disgust and affiliation were important motivational drivers among Filipino schoolchildren, we cannot rule out whether other social motivators or a combination of different approaches would have been more effective. For example, some researchers recommend an approach that targets multiple psychological determinants of handwashing at the same time, including motivators that trigger feelings of disgust and social pressure, as well as behavioral nudges that influence automatic or habitual responses.\(^{30}\)

We consider nudge-based interventions to be a particularly promising avenue for promoting handwashing in primary schools. Among the 303 students in our survey who admitted to not washing hands after using the bathroom, 54 percent said it was because they ‘forgot’, rather than for reasons related to lack of access to a functioning handwashing stations, being in a hurry, or a desire to not wash hands. Nudges could in theory trigger the automatic psychological responses that counter forgetfulness. In hospitals and universities, nudges in public restrooms such as eyes near handwashing stations and arrows pointing from toilet to sink have been found to increase rates of HWWS.\(^{31,32}\) A proof-of-concept study of a nudge-based intervention targeting handwashing in Bangladeshi schools found that HWWS rates increased only 14 percentage points when handwashing infrastructure was moved closer to toilet facilities, but 52 percentage points after a footpath from the toilet to the handwashing facility was painted on the ground.\(^{13}\)

The HiFive program was overhauled ahead of the second year of implementation to address some of the design challenges described above, including further integration of the program’s messaging into the classroom through detailed lesson plans and more extensive teacher training through a train-the-trainers model. However, handwashing rates among students after implementation of the revamped HiFive program remained below 8 percent. Given the limited impact of the HiFive program and the effectiveness of behavioral cues in other settings, we are working with UNICEF and DepEd to design, implement, and evaluate a nudge-based intervention in Filipino primary schools in the upcoming school year.

Limitations of the study and areas of further research

We acknowledge several limitations to our evaluation and suggest topics for further research.

First, since the HiFive program appears to have had a limited effect on students’ feelings of affiliation and disgust, we cannot disentangle problems in program delivery from problems with the underlying theory linking social motivators to handwashing behavior; either or both factors may have reduced the effectiveness of HiFive. At the same time, a revamped HiFive program with integrated detailed lesson plans and more extensive teacher training also failed to bring about large-scale behavior change, which makes us somewhat pessimistic about the effectiveness of triggering social motivators in isolation from other interventions. Future research should continue to look at the effect of social motivators, but particularly when complemented with other interventions such as behavioral nudges.

Second, the fact that a majority of students were aware of the importance of handwashing likely led students to over-report handwashing rates in the student survey: students were more than 70 percentage points more likely to say that
they washed their hands with soap after toilet use than were actually observed doing so, and it is likely that HWWS before eating was similarly over-reported. It is possible that students in treatment schools were more likely to over-report handwashing than students in control schools due to the social desirability effects triggered by HiFive messaging about peer affiliation. For this reason, treatment effects based on self-reported handwashing may be overestimated, and we regard these results as less credible than results based on direct observation. Script-recall appeared to reduce but not eliminate over-reporting, while the list randomization seemed to create confusion among student respondents.

Social desirability effects may have also led students to wash their hands more in the presence of enumerators than they would otherwise, inflating estimates of HWWS based on direct observation (so-called Hawthorne effects). In a prior handwashing study in hospitals, soap dispensers were used 2.5 times more frequently when auditors were present than when they were absent. While we cannot rule out Hawthorne effects in our study, these effects would have been modest given the extremely low rates of HWWS overall. We also took several steps to mitigate Hawthorne effects, including conducting direct observation before student surveys about handwashing, and giving enumerators a script to describe their presence in the classroom to teachers and students that mentioned observation of ‘normal classroom activities’ and did not reference handwashing or sanitation. Moreover, even if Hawthorne effects influence student behavior, they would have needed to be stronger in treatment schools than in control schools in order to bias estimates. While we consider this unlikely, future research could combine direct observation with other measures, such as measuring microbial contamination of hands or embedding sensors in soap dispensers.

Third, 38.7 percent of classrooms in the study had a handwashing station within the toilet facility that could not be observed by enumerators (in addition to a handwashing station outside of the toilet facility); the difference in the fraction of classrooms with a handwashing station within a toilet facility between treatment and control was not statistically significant. The presence of a handwashing station within a toilet facility could lead us to underestimate/overestimate the program effect if students in treatment schools use unobservable handwashing stations at higher/lower rate than students in control school. While we find no differential treatment effect on handwashing for students in classrooms that have a handwashing station within a toilet facility versus students in classrooms that do not, we cannot rule out the possibility of either upward or downward bias on our full-sample estimates.

Fourth, we collected data on student handwashing at a single point in time, three months after the conclusion of the HiFive intervention. We may have failed to capture larger immediate program effects that tapered off, or effects that materialized at a later date. Other studies of handwashing interventions collected outcome data at multiple points during and after the intervention, enabling a more thorough investigation of how treatment effects manifest over time. Further research on interventions like HiFive that seek to entrench social norms to improve handwashing behavior may provide valuable evidence on how the effectiveness of these interventions changes over time.

Finally, our study measured the effects of a handwashing intervention targeting social motivators in primary schools across two provinces in the Philippines. To be eligible for our study, schools required functioning handwashing stations and toilet facilities; 40 percent of schools in the region were not eligible due to a lack of critical handwashing infrastructure. In these schools and other regions, improving WASH infrastructure is a prerequisite to behavior-change interventions that target handwashing practices. At the same time, fewer than half of handwashing facilities in our study schools had soap. Further research is needed to evaluate the effectiveness of handwashing interventions that target social motivators in educational settings that start with more and less extensive handwashing infrastructure.
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**Data sharing statement:** The study protocol and deidentified data can be shared upon request to the corresponding author. The pre-analysis plan is available online at the Registry for International Development Impact Evaluations (RIDIE), study ID 5a12613323f9 (link).