Results of WASH UP! pilot impact assessment in Zambia

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Jenna Davis, James Winter, Gary Darmstadt

Stanford University

1) Executive summary

World Vision and its partner Sesame Workshop developed the WASH UP! program to promote improved water, sanitation and hygiene (WASH) behaviors among primary school children. The program includes World Vision investment in water supply and sanitation infrastructure at schools, along with training on maintenance. It also includes a multimedia program of up to 12 sessions that features a Sesame Muppet character named Raya, an empowered girl figure who promotes clean water, sanitation, and hygiene. The program targets 6- to 9-year-old children (grades 1 through 4) and is delivered by school teachers trained by Sesame Workshop staff (or by trainers that Sesame Workshop has capacitated).

World Vision and Sesame Workshop aspire to rigorous, cost-effective impact evaluation of the WASH UP! program. Such investments can not only help to strengthen the WASH UP! program, but are of tremendous value to the broader WASH sector. The fact that diarrheal disease disproportionately affects children, combined with claims that behavioral interventions compare favorably with more costly investments in infrastructure, has led many donors, governments, and implementing organizations to focus on school-based WASH behavioral programs. The impacts of such interventions have rarely been rigorously studied, however. There is little evidence regarding the types of programming that trigger behavior change and that help students sustain new behaviors over time, much less on the ways in which geographic and sociocultural context mediates the effectiveness of WASH-focused behavioral interventions. Some anecdotal evidence suggests that improving WASH infrastructure and behavior may be associated with increased educational opportunities for and empowerment of girls, although the pathways of impact are poorly understood. A research program built around WASH UP! has the potential to make significant contributions with respect to each of these knowledge gaps.

World Vision, Sesame Workshop and Stanford University formed a partnership around these research objectives in 2016 and agreed to pursue a pilot impact evaluation as a first step. Zambia was identified as the ideal site, given the strong performance of WASH UP! there in nearly 200 schools across the country starting in 2015. Twelve primary schools in Sinazongwe District were selected for the study, whose primary objectives were (1) to develop and test data-collection tools for future WASH UP! impact assessment research, and (2) to generate preliminary data on the WASH UP! program for future funding proposals. Emphasis was placed on 'learning to learn,' *e.g.*, piloting indicators for hard-to-measure concepts such as understanding of the fecal-oral route of disease transmission, children's self-efficacy, and child-to-parent information transmission.

Available resources and political considerations precluded the use of a managed experimental study design including a set of control schools from whom programming and

support would be withheld. Instead, the WASH UP! program (comprising WASH infrastructure enhancements and the 12-week curriculum, the 'intervention') was implemented in all 12 sample schools. It was understood that the lack of a control group would limit the ability to make causal claims about WASH UP!'s impacts, as it left open the possibility that observed outcomes could not be attributed entirely to the program. This potential for confounding was realized when cholera broke out in the capital city of Lusaka in late 2017, between midline and endline data collection. In response, the Ministry of Health initiated a vigorous public-health campaign whose messages overlapped those of the WASH UP! program to a considerable extent. Evidence suggests that, in our sample of schools, these events had major albeit relatively short-lived impacts on the salience of WASH issues, as well as on the behavior of school personnel, parents, and students. As such, it is not possible to evaluate the persistence of students' WASH UP!-related knowledge and behavioral gains beyond the midline study phase. This experience underscores the importance of ensuring a true control group in any follow-on research intended to generate causal claims about the impacts of the WASH UP! program.

For the Zambia pilot, study resources were focused on Grade 1 and Grade 4 students in order to capture the experience of the youngest and oldest children who typically go through the WASH UP! curriculum. Information was collected from these students, their teachers, and their parents/caregivers at three different timepoints. The baseline was conducted at the start of the school term in May/June 2017; the midline in September/October 2017, shortly after the WASH UP! program had been implemented; and endline in June/July of 2018. Complete panel data (for each of the 3 rounds) were collected through in-person interviews with a total of 558 students and their parents, as well as from the entire set of 24 Grade 1 and Grade 4 teachers at the 12 study schools. Data were collected in local language by 20 Zambian enumerators who had completed intensive training with the Stanford team. Other data-collection activities included water and sanitation infrastructure assessments and structured observation of student handwashing practices in each school; testing of drinking water sources for fecal contamination; and hand-rinse sampling of a subset of students and parents.

Overall, the study generated valuable results that are relevant to the ongoing improvement and implementation of WASH UP! as an intervention; to the design of follow-on research that can quantify the impacts of the program with a high degree of confidence; and to the wider community of researchers and implementers interested in using school-based programming to catalyze broader, household- and community-scale change.

First, the Zambia study found that students and teachers had overwhelmingly positive feedback about the curriculum. More than 90% of students who participated in WASH Up! said that the sessions were "fun" and "interesting," and all but one of the teachers

interviewed said they were planning to teach WASH UP! again in the subsequent school term. Evidence also suggests that students understood and internalized many of the key messages taught through WASH UP!. Recalling that the study was not powered for the objective to make confident causal claims, marked improvement in students' knowledge and WASH-related behaviors is observed, particularly for the younger Grade 1 students. For example, the share of Grade 1 respondents able to provide scientifically valid information about "germs" (*tuzunda* in Tonga language) rose by almost 60%, from 43% to 68%. Regarding a key WASH UP! message to use safe water sources, the share of Grade 1 students who reported that it was safe to drink water from unimproved sources like ponds and rivers was halved, from 40% to 19%.

This result is particularly impressive given the fact that teachers reported that they were able to deliver an average of just 6.3 of the 12 sessions during the intervention period. Teachers are not required to complete the entire WASH UP! curriculum within a school term; however, all indicated that this had been their intention. Competition from other before- and after-school clubs, sports practices, and similar events was the most commonly cited reason (by 58% of teachers) for not completing the WASH UP! curriculum within the 12-weeks term This finding suggests that it could be helpful to more intentionally 'modularize' the content such that it can be effectively administered across multiple school terms. Another challenge to student engagement in the popular WASH UP! sessions was congestion. Over the entire study period 70% of students said that they thought sessions were "too crowded," which is consistent with reports from 56% of teachers that they combined more than 2 grades into each WASH UP! session they conducted. Teachers estimated that an average of 69 students attended each session. Developing strategies that ensure all students are able to interact with the play-based materials provided in the WASH UP! kit could be important in the face of such large group sizes.

Another key insight from the Zambia study is that well-functioning WASH infrastructure is essential, but not sufficient on its own, to ensure improved WASH behaviors. Each of the 12 schools in the sample had an improved water source, typically a borehole with handpump. Each school also had latrines, although the median ratio of students to functioning latrines at baseline was 51:1, which is twice the government standard of 25:1. Across the 3 rounds of data collection, each school was observed to have between 1 and 2 functional handwashing stations (*i.e.*, with water and soap or ash available), for an average of roughly 300 students. At baseline—which coincided with the start of a new school year—all schools had water available at the handwashing station and 40% had both water and soap (or ash) available. For the remaining study phases, handwashing stations did not have water during 20% of observed handwashing opportunities, which limited students' ability to practice a key behavior advocated in the WASH UP!

curriculum. On the other hand, even when water and soap were available at handwashing stations, students only opted to use them for 83% of the 1,730 handwashing events observed at baseline; 54% at midline (779 events); and just 40% at endline (618 events). Taken together, these results underscore the interdependency of education, motivation, and providing an enabling environment for WASH UP! to deliver meaningful impact.

The Zambia study also generated important learning with respect to the design of future impact evaluation research. For example, teachers' variable implementation of the 12-week curriculum highlights the importance of documenting actual student participation (exposure) in the WASH UP! program within treatment schools. Efforts to capture this information in the Zambia pilot within sessions failed, which meant that analysis of dose-response effects relied on self-reported attendance data from students and their parents. Several feasible, technology-enhanced strategies are currently being discussed for possible implementation in the future.

In addition, resource constraints required that all interviewing for the Zambia study be conducted on school grounds. Future work will prioritize visiting students' households so as to minimize the burden on parent respondents and to provide objective (rather than self-reported) data on WASH conditions in the home environment. Such information would also allow a comparison of students' exposure to WASH-related pathogens in the school *versus* home context. In Zambia, for example, 100% of the Grade 1 and Grade 4 respondents had access to a functioning toilet at school, yet only 60% of their parents reported having a latrine at home. This type of analysis will be important for making sense of observed health impacts—or the lack thereof—in future WASH UP! evaluations.

A final area in which the Zambia study returned interesting results concerned engaging students as agents of change who encourage improved WASH behaviors among their peers, parents and other family members. WASH UP! curricular materials include simple homework assignments designed to catalyze student sharing of key messages with others. Evidence from the Zambia pilot suggests that (1) many teachers did instruct students to share WASH UP! content outside of school; (2) a substantial share of students reported hearing those instructions; (3) many of those students did approach a family member to share WASH UP!-related information; and (4) the vast majority of students who made such efforts felt that their family member(s) were welcoming of the information.

These results are encouraging; they also serve as a reminder of the many information transmission steps upon which the 'child as change agent' ambition depends. Given the limited evidence in the literature of successful efforts to promote healthy behaviors *via* student emissaries, within the Zambia study an experiment was implemented to test one strategy for enhancing transmission of WASH UP! messaging. Half the study schools were randomly selected to receive a 'takehome' object, which was simply a small printed color

handout with an image from the WASH UP! storybook. Teachers distributed the handout to students during a session and asked them to share it, along with information about the day's lesson, with their family members. Among parents who subsequently reported that their child came to them to share a WASH-related lesson from school, 17% had a child whose school received the boundary object and 11% had children who did not receive it. These results thus suggest that, whereas the overall share of parents reporting a WASH-related discussion with their children is quite small, a relatively low-cost intervention potentially boosted messaging transmission by 55%. Future research will build on these findings by testing alternative object types and by giving increased attention to measuring both their exposure and impact.

The Zambia pilot laid a solid foundation for the learning partnership between World Vision, Sesame Workshop, and Stanford. The considerable learning that emerged from this relatively modest effort allows future research to focus on filling remaining knowledge gaps and testing curricular and infrastructural strategies that could amplify the impact and sustainability of WASH UP! programming. The partners' commitment to generating and sharing rigorous evidence from the collaboration also represents a major contribution to the broader WASH sector. Such evidence can help shift other organizations toward cost-effective for triggering and sustaining WASH behaviors in schools, with the ultimate goal of improving health and well-being for students, teachers, and families worldwide.

1) Background and objectives

Despite substantial reductions in child mortality from diarrhea over the past 25 years, an estimated 2,000 children—almost all of whom live in low- and middle-income countries—continue to die from diarrheal disease every day. Diarrheal disease is caused by environmental exposure to pathogens that are transmitted principally through fecal-oral pathways. The World Health Organization estimates that 4% of the global burden of disease could be prevented by improving water supply, sanitation, and/or hygiene. Among these interventions, hygiene—which includes behaviors such as handwashing and management of stored water—has often been cited as the most cost-effective strategy for reducing the diarrheal disease burden.

World Vision and its partner Sesame Workshop developed the WASH UP! program to promote improved hygiene behaviors among primary school children. The program includes World Vision investment in water supply and sanitation infrastructure at schools, along with training on maintenance. It also includes a multimedia program with up to 12 sessions that was created by Sesame Workshop. The curriculum is centered on a Muppet character named Raya, an empowered girl figure who promotes clean water, sanitation, and hygiene. The program targets children in the 6- to 9-year-old range (grades 1 through 4), and is taught by primary school teachers who have been trained by Sesame Workshop (or by trainers that Sesame Workshop has capacitated). The program was piloted in Zambia in 2015, reaching more than 2,500 children in 25 schools in rural communities. The program was subsequently scaled up and has now been implemented in nearly 200 schools across the country.

To date, the WASH UP! initiative has made use of formative research to develop curricular materials, as well as some non-systematic data collection of evidence regarding student, teacher, and parent uptake of the program's key messages. World Vision and Sesame Workshop aspire to rigorous, cost-effective impact evaluation of the program. The fact that diarrheal disease disproportionately affects children, combined with claims that behavioral interventions can compare favorably with more costly investments in infrastructure, has led many donors, governments, and implementing organizations to focus on school-based WaSH behavioral programs. Few of these interventions, however, have been studied rigorously. Moreover, no peer-reviewed research was identified that investigates the ways in which geographic and sociocultural contexts mediate the effectiveness of WaSH-focused behavioral interventions. Finally, limited evidence suggests that improved WaSH behaviors may be associated with increased educational opportunities, especially for girls, and contribute to girls' empowerment, although the

pathways of impact are poorly understood.[1] A research program built around WASH UP! has the potential to make significant contributions with respect to each of these knowledge gaps.

As a first step in launching such a research collaboration, World Vision, Sesame Workshop and Stanford University agreed on the need for a pilot impact evaluation study. Given the strong performance of WASH UP! in Zambia, it was viewed as an ideal setting for this pilot. Sinazongwe district was chosen as the field site, with 12 primary schools selected for the study. The primary objectives of the investigation were:

(1) *To develop and test data-collection tools for future WASH UP! impact assessment research*

The WASH UP! program has the potential to improve child well-being across several domains, including educational performance, child health and development, and girls' empowerment. Program architects also hope that children who complete the WASH UP! program will act as agents of change for improving WASH-related behaviors within their families and communities. It is no simple feat to identify valid and reliable indicators of such diverse outcomes and impacts for the program. The Zambia study provides an opportunity to test different strategies for quantifying a number of important but hard-to-measure constructs (e.g., children's self-efficacy, child-to-parent information transmission, fecal contamination of the environment, girls' agency). The insights gleaned in this work will inform the selection of cost-effective tools and indicators for future, full-scale WASH UP! impact evaluations.

(2) *To generate preliminary data on the WASH UP! program for future funding proposals*

Donor organizations who would be able to provide the level of support needed for a WASH UP! program country rollout typically require a well-articulated theory of change, along with a compelling proof of concept, before they are willing to make a substantial investment. The Zambia study will help generate preliminary data regarding the outcomes and impacts of the WASH UP! program. It will also demonstrate our commitment to a theory-driven intervention that is informed by careful testing and refining of valid and reliable data-collection instruments.

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[1] It is important to emphasize that influencing gender norms is not an explicit objective of the WASH UP! curriculum. World Vision, Sesame Workshop and Stanford were all interested in assessing potential for spillover effects in this domain, however, so our pilot study included a module designed to test for possible effects.

2) Research questions and study design

The primary research questions guiding this study were:

(1) What is the impact of exposure to the WASH UP! program on students' knowledge, attitudes, and perceptions regarding WASH behaviors and health; as well as their WASH-related behaviors, health outcomes, and school attendance?

(2) What is the impact of delivering the WASH UP! program on teachers' knowledge, attitudes, and perceptions regarding WASH behaviors and health; as well as their WASH-related behaviors and health outcomes?

(3) To what extent are key messages from the WASH UP! program transmitted by students to their parents/parents (hereafter, 'parent')?

(4) What is the impact on perceptions and attitudes related to girls' intellectual abilities, agency and societal value of primary exposure (students and teachers) and secondary exposure (parents) to the WASH UP! program?

The Stanford team proposed a managed experimental research design for the study, as it is considered the gold standard for making causal claims about the effects of an intervention such as the WASH UP! program. A managed experimental design requires data collection both before and after program implementation, carried out in a sample of both treatment (WASH UP!) and control schools.

Through discussion with World Vision colleagues, it was decided to forego a true control arm in favor of a policy or 'business-as-usual' control with respect to school WASH infrastructure maintenance. During planning meetings leading up to the pilot study, Stanford documented some variability in the status of WASH infrastructure at schools in the study area. This issue was discussed with World Vision staff; in particular, it was noted that any evaluation of WASH UP! that includes behavioral outcomes will require an enabling environment with functioning infrastructure, such that students can demonstrate the WASH behaviors emphasized in the program.

As a result, it was decided that a more relevant comparison for the Zambia pilot would be between an 'effectiveness' group of schools who received the WASH UP! program and who managed their campus WASH infrastructure as per their usual practices, *versus* an 'efficacy' group who also received the WASH UP! program but who had additional support (directly from World Vision or from a third party contracted by World Vision) in ensuring that their WASH infrastructure was fully functional. This would allow us to add a fifth research question to the study: What are the costs and benefits associated with ensuring functionality of school WASH infrastructure through external support, compared with the efforts that school administrators, staff, parents, and students take to maintain their own infrastructure?

Unfortunately, this plan had to be abandoned during the teacher training phase of WASH UP! implementation in Sinazongwe. World Vision-Zambia colleagues concluded that it was infeasible during this time period to ensure high levels of external support for WASH infrastructure maintenance in the 6 schools chosen for that arm. As a result, the study design ultimately took the form of a quasi-experiment, with data collection in 12 schools before and after implementation of the WASH UP! program, but without a control group. The key limitation of this design for making sound causal claims is that it leaves open the possibility that observed outcomes may not be fully attributable to the WASH UP! program.

This potential for confounding was realized when cholera broke out in the capital city of Lusaka in late 2017, between midline and endline data collection. In response, the Ministry of Health initiated a vigorous public-health campaign whose messages overlapped those of the WASH UP! program to a considerable extent. Evidence suggests that, in our sample of schools, these events had major albeit relatively short-lived impacts on the salience of WASH issues, as well as on the behavior of school personnel, parents, and students. As such, it is not possible to evaluate the persistence of students' WASH UP!-related knowledge and behavioral gains beyond the midline study phase. This is why we exclude endline data from many statistical tests of significance presented in the report.

3) Key outcomes

The outcomes of interest in the study were generated through an effort by the Stanford team to develop a conceptual causal model of the WASH UP! program. This objective was realized through review of background materials on the program and semi-structured interviewing of both World Vision and Sesame Workshop colleagues (see Annex 1 for a copy of the conceptual model).

Based on this work, the outcomes for the pilot study were developed to assess the extent to which key ideas communicated in the WASH UP! program were understood and, where applicable, incorporated into WASH behaviors by students, teachers, and parents. Additional outcomes not directly related to learning objectives of WASH UP! were added that assess the extent to which exposure to the program influences gender perceptions in each group. Specific constructs related to primary outcomes include:

- Student retention of key curricular messages
- Changes in student WASH behaviors related to WASH UP! key messages
- Extent and content of information shared by students with parents/caregivers (hereafter 'parents')
- Parent retention of key messages
- Teacher retention of key messages

Constructs related to secondary outcomes include:

- Teacher understanding of relevant cause-effect relationships in WASH and health
- Changes in teachers' perceptions of girls' intellectual abilities/societal value
- Changes in students' perceptions of girls' intellectual abilities/societal value
- Changes in parents' perceptions of girls' intellectual abilities/societal value
- Changes in girls' self-efficacy
- Fecal contamination of students' and teachers' hands (a proxy for handwashing behavior)

Given the short time duration of the study, we attempted to evaluate only two short-term impact:

- 7-day period prevalence of self-reported diarrheal illness among students, teachers, and students' parents
- Rates of school absenteeism

Without a control arm it was not possible to draw causal inference about the program's impact on either of these impacts. In both cases, our efforts were focused on testing measurement approaches for collecting reliable data.

Our experience with measuring health-related impacts is summarized in Section 13, but our efforts in measuring absenteeism failed. School attendance records at the study schools were available and generally thorough. By contrast, it was difficult to determine which students attended WASH UP! sessions, which were often held before or after school. We met with school personnel to brainstorm low-cost ways of recording attendance at WASH UP! sessions, but ultimately none of these was deemed feasible. This is an area that will need additional work if hypotheses regarding the program's impact on absenteeism are to be tested in future research.

4) Sample frame and participant recruitment

The 12 government-operated primary schools recruited into the study were all located in Sinazongwe District of Zambia's Southern Province (Figure 1). All were located within a World Vision Area Develop Program (ADP) and had a functioning piped water supply and latrines, although the WASH infrastructure was not necessary in compliance with Ministry of Education standards (e.g., minimum student-to-toilet ratios).

The WASH UP! program targets students in the 1st to 4th grades. We decided to focus our resources in the study on students who were in Grade 1 or Grade 4 at baseline, so as to evaluate outcomes for some of the youngest and oldest children who go through the WASH UP! curriculum. The study also included data collection from these students'

teachers and parents. We attempted to obtain information from the same set of participants in each round of data collection, i.e., we sought to create a panel dataset, not just a series of cross-sectional data with different participants in each time period. In theory, either approach would allow us to draw conclusions about how the values for indicators of interest for the entire sample of students (or teachers or parents) have changed, *in aggregate*, from one data-collection period to the next. A panel dataset, however, allows us to evaluate the effect that temporally varying characteristics of an *individual* have on outcomes of interest. It is thus more informative but also more resource intensive, as we had to structure the sampling and consent procedure to track and repeatedly contact individual study participants. We also had to over-sample at baseline relative to our minimum desired sample size in anticipation of some sample attrition over time.

Figure 1: Location of study area, Zambia

At baseline, within each grade we attempted to recruit 30 students for participation at each school, stratified into two equal-sized groups of males and females.[2] A student was

[2] Our sample frame was developed with the intent to pursue a cluster randomized trial of intensive WASH infrastructure maintenance against a backdrop of full-sample WASH UP! program implementation (the 'efficacy-effectiveness' study described above). We were highly constrained by practical considerations such as limited financial resources. Power calculations were focused on observed handwashing among the student sample because it is a critical outcome for the program and could be usefully compared across the two infrastructure maintenance cohorts even in the absence of a true control arm. We used published

eligible for inclusion if (1) his/her parent had provided informed consent for their own and their child's participation in the study during an informational meeting run by World Vision staff prior to the launch of data-collection activities, (2) his/her parent submitted a signed permission slip indicating assent for the student's participation, (3) s/he was present on the first day that the data-collection team visited his/her school, and (4) s/he personally agreed to participate in the study activities (i.e., no student was required to participate even if his/her parent had assented on his/her behalf). If more than 30 students met these criteria for a given school and grade, participants were selected using a combination of random and quota sampling; specifically, students were randomly chosen and added to the male or female subsample until the number in each group reached 15. In cases where a parent had children in both grades, one of the students was randomly selected to be the study participant and the 'focus child' for interviews with the parent.

During midline and endline data collection, personalized invitations were sent home with the same children who participated in the baseline activities, encouraging their parents to return for all three rounds of data collection. Broadcasts over a local radio station were also used to raise awareness about the study and encourage participation. No compensation was provided to parents for their participation; students received stickers during each of the three meetings they had with enumerators during the study period.

5) Field procedures

We employed a repeated measures design that would allow assessment not only of outcomes immediately after the WASH UP! program concluded, but also of the sustainability of those outcomes several months after the intervention. We completed three rounds of data collection: A baseline in May/June 2017, midline in September/October 2017, and endline in June/July of 2018 (see Annex 2 for more details on the study timetable). Timing for each round of data collection had to be carefully coordinated with the academic calendar. The baseline round was undertaken at the start of the school term, just before teachers launched the WASH UP! program. Scheduling for subsequent rounds was undertaken in consultation with World Vision and school personnel. For instance, school administrators and teachers were understandably reluctant

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literature to identify expected baseline rates of handwashing, a meaningful minimum effect size that would be relevant for planning and program design, and estimated intraclass coefficient values. Ultimately the maximum number of possible clusters (schools) was limited by the number of schools located within the World Vision ADP in which WASH UP! had not already been introduced. We thus computed scenarios for involving different combinations of the five grades whose students participate in WASH UP! (kindergarten through 4th). Ultimately we settled on 12 school-level clusters, with two grade-level clusters (Grade 1 and Grade 4) and approximately 30 students in each grade. Going forward we will need to address the difficulty of identifying whether a randomly selected student in schoolyard has participated in WASH UP! or not, along with several other sampling-related challenges that emerged in this study.

to have data collection activities take place during periods in which students were preparing for and taking national standardized exams.

5.1 Enumerator training and instrument development

Enumerators were recruited through a combination of newspaper advertisements, word of mouth recommendations, and the existing World Vision network of data entry interns and enumerators. They were interviewed by Jenna Davis, James Winter, and two senior World Vision staff. Additional interviews were conducted by World Vision Zambia prior to training. Twenty enumerators were invited to participate in a 2-week training, after which 18 were selected to continue on to data collection.

Training consisted of intensive review of informed consent procedures, interview practice, questionnaire review, water sampling and hand sampling procedures, and preemptive solutions to common challenges in the field. Training occurred over the course of 2 weeks and included 1 day of pilot interviews at a nearby school that was not included in the study sample frame.

A teacher who worked at a school that was not included in the study sample frame and who was fluent in both English and Tonga translated the student and parent questionnaires (the teacher survey was conducted in English). Enumerators refined the translations during the training period, providing valuable suggestions regarding language choice that was more suitable to the region, education levels, and age of our participants. Particular care was taken with translating words that were shared between the WASH UP! materials and the survey.

5.2 Data collection

Data collection required approximately 4 weeks of full-time work for the full enumeration team during each of the three rounds of data collection.[3] The following activities were undertaken:

- Structured, one-on-one, in-person interviews of students and parents in Tonga language
- Structured, one-on-one, in-person interviews of teachers in English
- Drinking water source sampling
- School-level assessments of water and sanitation infrastructure
- Structured observation of student handwashing practices

[3] The team spent between 19 and 22 days completing data collection for the 12 sample schools, depending on study phase.

- Hand-rinse sampling of students and parents (endline only)

All data collection was undertaken on school grounds. We conducted parent interviews at school because it was deemed cost prohibitive to visit the parents of our student participants in expansive, rural communities. This strategy allowed for significantly higher sample size than was initially targeted. However, we acknowledge the likely selection bias implicit in parents' self-selecting to participate in the study. We believe that the strong presence of World Vision in the district as a supporter of school children (and provider of various types of material support to the community) motivated some parents to travel to school to participate.

At each school one or two enumerators carried out an infrastructure assessment to document the water, sanitation, and handwashing infrastructure at each school. The presence of consumables such as soap was also recorded. In addition, structured observation of student handwashing behavior occurred over the course of 1 or 2 days at each school during each data-collection period. A local enumerator would sit 50-100m away from the toilets in a discrete location. In instances where there were two latrine sites (e.g., boys and girls toilets were separated by about 200m in one school), two enumerators would work separately on the same task. Each enumerator would record the number of children washing their hands with water, soap, as well as the number of children who left the latrine without washing their hands. Collected data were used to compute the proportion of times that a child used soap and water to wash hands when both were available, *i.e.*, how often children who had the ability to wash with soap and water opted to do so.

Enumerators recorded interview data on Samsung Galaxy tablets running SurveyCTO. Stanford University project staff reviewed the survey data within two days of collection, discussing and correcting any errors with members of the field team. During endline data collection, hand-rinse samples were collected using a technique developed by Jenna Davis' research group. The technique involves the subject inserting one hand into a clear plastic bag filled with sterile water and agitating it, with help from the enumerator. After 30 seconds, the subject removes the first hand and inserts the second, repeating the process. Through this process, particles that are adhered to the subject's skin are released into the water, which is then filtered and analyzed for evidence of fecal contamination. This technique had been used successfully with school-aged children for studies conducted in Tanzania and Kenya, and was well received in those contexts. In Zambia, the samples were processed in a field lab we constructed at the team's lodge. Results were recorded on data sheets, digitized, and sent to Stanford for review.

6) Results: Study sample composition

The number of interviews conducted per school at baseline ranged between 16 and 94. Interviews were only conducted with children whose parents had provided written consent for their participation. The number of student interviews was thus constrained by both parent cooperation and total student population in the target grades 1 and 4 (Table 1; additional information provided in Annex 3).

A total of 761 students in grades 1 and 4 were interviewed at baseline. An approximately even split in the gender of students interviewed in grade 1 was achieved, and a slightly higher proportion of female students in grade 4 (Table 2). The average age of students at baseline was 8 and 11 in grade 1 and 4, respectively. At endline, 558 pupils were interviewed, representing a recapture rate over the entire study period of 73%. A higher share of Grade 1 students was lost to follow-up as compared to Grade 4 (29% *versus* 24%), whereas the percentage of male and female students was identical (27%).

Table 1: Number of student respondents enrolled, interviewed at baseline, by grade and school (N = 761)

	Grade 1			Grade 4		
	Sampled	**Enrolled**	**% of enrolled G1 students interviewed**	**Sampled**	**Enrolled**	**% of enrolled G4 students interviewed**
Chimonselo	32	68	47%	36	54	67%
Kanchindu	34	74	46%	21	47	45%
Makonkoto	28	87	32%	36	103	35%
Mweezya	14	36	39%	21	36	58%
Ngoma	26	42	62%	30	51	59%
Nkandabbwe	38	66	58%	41	81	51%
Siakabamba	42	66	64%	34	42	81%
Siatwiinda	33	79	42%	29	99	29%
Sikaneka	46	69	67%	20	65	31%
Sinakasikili	10	62	16%	6	67	9%
Sinazeze	49	93	53%	41	111	37%
Syamuyala	40	66	61%	54	66	82%
Total	**392**	**808**	**49%**	**369**	**822**	**45%**

Table 2: Number of student respondents interviewed, by grade, gender, and data-collection period

	Grade 1	Grade 4	Male	Female
Baseline (N=761)	392	369	364	397
Midline (N=584)	283	301	281	303
Endline (N=557)	278	279	267	290

Our final baseline sample included 392 parents of children in Grade 1 and 338 parents of children in Grade 4 (Table 3). The typical parent respondent was a 38-year-old married female with 3 children. Because many married respondents reported being in polygamous relationships, each was asked to provide information to enumerators only about the household with whom s/he shared meals and sleeping quarters on a regular basis.

Table 3: Demographic information for parent respondents, baseline phase (N = 730)

Mean age	% Female	% Married	% Monogamous	Mean HH size	Mean years in the community
37.9	78.0%	85%	27%	6.5	17.3

We included all 24 of first- and fourth-grade teachers in the study sample (Table 4). Just over 60% were female, and they had an average of 5.9 years' experience at their current school. One in five served as the school's sanitation, hygiene and nutrition (SHN) coordinator, responsible for extracurricular programming on these topics as well as managing tasks such as maintaining the school garden.

Table 4: Demographic information for teacher respondents, baseline phase (N = 24)

Mean age	% female	Years at current school	SHN* coordinator	% living on school grounds	Number of grades taught
36.6	63%	5.9	21%	60%	1.6

*Sanitation, hygiene & nutrition coordinator

7) Results: School WASH infrastructure and services

All schools in the study sample had functioning improved water sources, typically a borehole with handpump. As shown in Figure 2, at baseline the median ratio of students to functioning latrines was 51:1, twice the government standard of 25:1. The commissioning of new latrines at two schools during the study period reduced the median ratio to 33:1 by endline, although a quarter still had ratio values of 80:1 or higher.

Table 5 summarizes the number and status of handwashing facilities that were observed at sample schools during each round of data collection. We were unable to identify a government student-to-handwashing facility ratio standard.

Table 5: Characteristics of handwashing infrastructure at sample schools, by study phase (N = 12)

	Mean number of handwashing stations	Mean student-to- station ratio[2]	Mean number of stations with water	Mean number of stations with soap
Baseline	2.4 (range: 0-5)	177 (median=163)	1.9 (range: 0 - 4)	1.1 (range: 0 - 4)
Midline	1.7 (range: 0-3)	159 (median=172)	1.0 (range: 0 - 3)	0.1 (range: 0 - 1)
Endline	2.1 (range: 0-7)	238 (median=236)	1.5 (range: 0 - 3)	0.3 (range: 0 - 2)

[1] All ratio calculations based on school enrollment at baseline.

[2] All schools had morning and afternoon school sessions serving different groups of students. Student-to-handwashing station ratios were calculated by dividing school enrollment by number of latrines, then dividing by two.

7.1 Water supply services

Across all data-collection periods, between 76% and 86% of student respondents reported that, when they need water for drinking at school, they walk to their school's source (a borehole or tap) and use a shared cup or bottle to collect and drink water (Table 6). Only 10% of students said that the school provides buckets or containers in their classrooms, and just 3% said they bring water in a container from home.

Table 6: Percentage of student respondents who reported obtaining drinking water at school using indicated method, by data-collection period

	Baseline (N= 760)	Midline (N= 583)	Endline (N= 553)
Shared cup/bottle kept at source	42%	35%	35%
Uses hands to drink directly from source	35%	34%	41%
Brings own cup/bottle to the source	19%	25%	20%
Drinks directly from source (no cup or hands)	2%	2%	1%
Other	2%	4%	2%

7.2 Handwashing facilities

Teachers were asked about institutional responsibilities for ensuring availability of water and soap at student handwashing stations at their schools (Table 7). The Sanitation/ Hygiene/Nutrition (SHN) coordinator was most frequently cited as the person tasked with keeping supplies at the handwashing station. Teachers were included more frequently in later study phases as compared to the baseline. With regard to soap provision only, 13% of respondents reported that "nobody" was responsible at baseline; this percentage fell to 5% and 6% at midline and endline, respectively.

Table 7: Percentage of Grade 1 & 4 teachers citing indicated party as responsible for ensuring supplies available at student handwashing stations
(Unprompted except 'Anyone else?' Multiple answers encouraged)

	Question: "Who is responsible for ensuring that there is water and soap available at the students' handwashing station(s)?"							
	Water				**Soap**			
	SHN*	**Teachers**	**Students**	**Custodial staff**	**SHN***	**Teachers**	**Students**	**Custodial staff**
Baseline (N=23)	87%	65%	39%	13%	74%	39%	13%	9%
Midline (N=22)	77%	77%	45%	0%	82%	73%	23%	5%
Endline (N=32)	69%	91%	28%	0%	66%	56%	25%	0%

[1]SHN refers to the Sanitation/Hygiene/Nutrition coordinator for the school (typically a teacher)

8) Results: Delivery of and participation in WASH UP! programming

We originally conceived of treatment in this study to be defined as being a student in a class that implemented all 12 of the WASH UP! program sessions between baseline and midline of the study period. Teachers were not strictly informed that completing all 12 (or any number) of sessions was required; however, it was our understanding that this was the goal embraced by school personnel during the Sesame Workshop-led teacher training. As such, we anticipated that a typical WASH UP! student would be exposed to approximately 12 sessions, with some variation resulting from student absenteeism. As shown in Table 8, however, teachers in our sample reported that they completed, on average, roughly half of the curriculum during the intervention period.

Table 8: Teacher responses regarding frequency, timing, and attendance at WASH UP! sessions in school term prior to interview

	Average # of sessions conducted	**Average # of students per session**	**% who taught WASH UP! during regular class time**	**% who taught WASH UP! before or after school**
Midline (N=24)	6.3	67.0	80%	20%
Endline (N=26)	4.4	41.8	66%	34%

Student responses suggest even lower levels of exposure to the WASH UP! program—an average of 2.2 sessions *versus* the 6.3 cited by teachers (Table 9). The discrepancies between teacher and student accounts could be the result of student absenteeism on days

when WASH UP! was offered, as well as teachers' conducting WASH UP! lessons as part of the standard school day lesson (and thus not being perceived as programming by students). It could also, in part, be the result of teachers' over-reporting of WASH UP! activities so as to avoid reporting what they feared would be disappointing information to the World Vision-affiliated study team.

Table 9: Student reported rates of participation in WASH UP! sessions during school term prior to interview

	Percentage of students reporting having attended any WASH UP! sessions in prior term		Among students who reported attending WASH UP!, average number of sessions reported attending*	
Midline	Grade 1: 48% N=281	Grade 4: 66% N=297	Grade 1: 2.2	Grade 4: 2.1
Endline	Grade 1: 41% N=275	Grade 4: 64% N=277	Grade 1: 2.0	Grade 4: 2.0

**In Zambia, WASH UP! was designed as a 12-session, 12-week curriculum.*

When asked if there were any particular reasons that more WASH UP! sessions had not been conducted during the school term, 58% of teacher respondents said that scheduling around other activities, such as after-school sports clubs, meetings and workshop, was difficult (Table 10). Interestingly, all but one of the teachers interviewed said they were planning to teach WASH UP! in the subsequent school term, and that they would resume the curriculum from where they left off. This finding has implications for the evaluation of long-term uptake of WASH UP! messaging in future research of the program.

Table 10: Responses to open-ended question regarding reasons for non-completion of entire WASH UP! curriculum in prior school term (*Grade 1 and 4 teachers*)

	Question: "Thinking about the last term in which you taught WASH Up, is there any particular reason that you were not able to offer all 12 of the program sessions?"					
	Too many other activities	Not enough time	Did not have materials	National exam prepara-tions	School adminis-tration not supportive	Students weren't interested
Midline (N=24)	54%	38%	21%	8%	0%	0%
Endline (N=26)	69%	19%	0%	4%	4%	0%

The WASH UP! program includes a variety of materials to help teachers communicate key messages to students in engaging ways. Teachers were asked at midline and endline about the frequency with which they had used each of the materials to teach WASH UP! The endline data are presented in Table 11 below.

Responses to this question are hard to interpret, both because of the variation in the number of sessions offered across teachers and because the curriculum encourages the use of different types of materials for different sessions. With those caveats, we see that roughly half of teachers reported using the facilitator's guide, story mat, and story book at least four times during WASH UP! sessions. These materials require no additional accessories or inputs to be usable. Use of the slides and ladders game was more variable. Teachers cited limiting factors such as the need to make their own dice and the infeasibility of using the single game board with the large groups of students they taught. Almost half of teachers said they never used the WASH UP! video. During baseline a delay in projector delivery drove this result. In later phases, however, 11 of 12 schools had projectors but reported infrequent use as a result of unreliable electricity and other constraints.

Table 11: Frequency of reported teacher use of specified WASH UP! curricular materials in term prior to interview, endline (*Grade 1 and 4 teachers; N=26. Material types prompted and response categories probed as needed.*)

	Question: "In the past term, how often did you use each of the following materials to teach the WASH UP! program?"						
	Facilita-tor's guide	**Story mat**	**Slides & ladders game**	**Story book**	**Calendar**	**Training manual**	**Pro-jector / video**
I used it FOUR TIMES OR MORE	58%	54%	15%	46%	35%	19%	4%
I used it TWO OR THREE TIMES	15%	19%	27%	19%	8%	23%	42%
I used it ONCE in teaching WASH UP!	12%	27%	23%	27%	19%	12%	0%
I NEVER used it to teach WASH UP!	4%	0%	31%	8%	38%	42%	46%
Don't know / Can't remember	12%	0%	4%	0%	0%	4%	8%

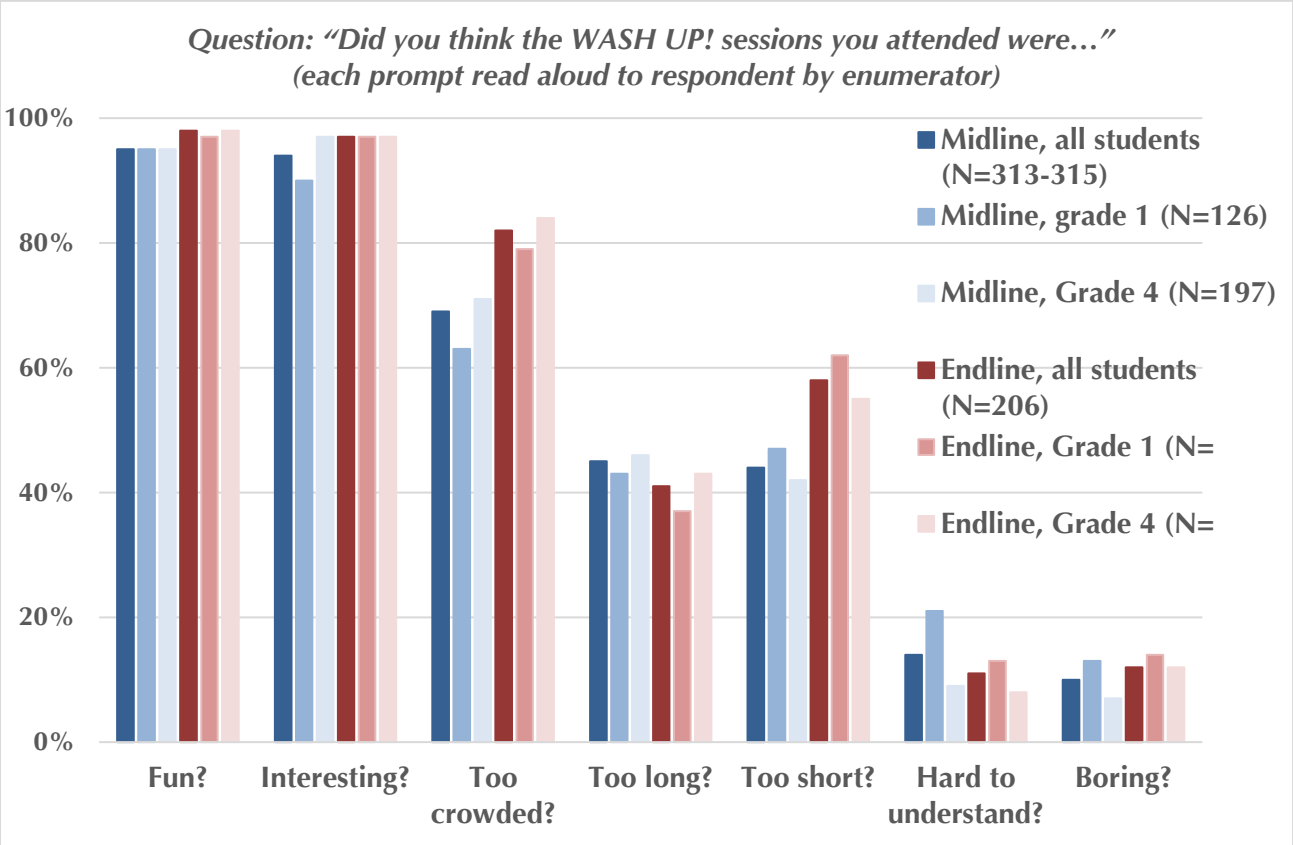
The responses in Table 11 do not reflect the fact that teachers conducted different numbers of WASH UP! sessions in the term prior to interview. The structure of the response categories does not allow for easy weighting. When the analysis is restricted to teachers who reported completing more than four WASH UP! sessions (N=15), the results suggest that the Facilitator's Guide and Story Mat were used most frequently. The Slides & Ladders game was utilized less frequently. Teachers cited limiting factors such as the need

to make their own dice and the infeasibility of using the single game board with the large groups of students they taught.

8.1 Teacher and student feedback on WASH UP!

The vast majority of students who said they participated in WASH UP! reported that the sessions were fun and interesting (Figure 3). Roughly one in nine students said they thought the program content was difficult to understand, and a similar proportion felt the program was boring. Opinions were divided regarding the length of WASH UP! sessions among both Grade 1 and Grade 4 students.

Figure 3: Percentage of Grade 1 and 4 students agreeing with indicated descriptor of WASH UP! sessions, by study phase. (*Order of descriptors was randomized. Response categories were probed as needed.*)



*Midline N values range between 313 and 315 as a result of 'Don't know' responses.

Over both study periods, 70% of students said that they thought WASH UP! sessions were "too crowded," which is consistent with reports from 56% of teachers that they combined more than 2 grades into each WASH UP! session they conducted. More than 70% of teachers who delivered WASH UP! to grades 1 or 2 reported having combined sessions.

Teachers also estimated that an average of 69 students (standard deviation=48) attended each program session.

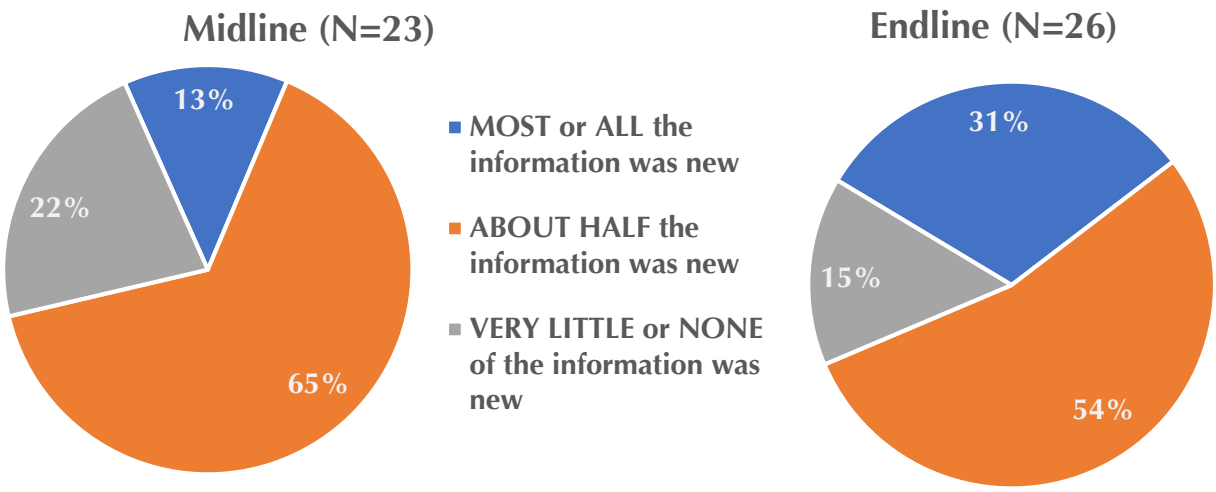
At midline—following the first term in which the program was offered—all but one of the 26 teachers interviewed reported planning to teach WASH UP! again in the following term. In response to an open-ended question about what features (if any) they particularly liked about the program, three quarters said they felt the program content is "important" (Table 12). At endline this share increased to 96%, perhaps influenced by the cholera epidemic in Zambia that occurred between midline and endline phases of the study.

Table 12: Frequency of reported feature of WASH UP! that Grade 1 and 4 teachers particularly liked, by study phase
(Unprompted except 'Anything else?' Multiple answers encouraged.)

	Question: "Can you tell me anything you particularly liked about the WASH Up curriculum?"					
	Program content is important	**Materials made teaching easy**	**Materials can be used to teach other subjects**	**Students were engaged**	**Enjoyable to teach**	**Characters made teaching easy**
Midline (N=23)	78%	48%	43%	35%	30%	17%
Endline (N=26)	96%	42%	23%	50%	15%	27%

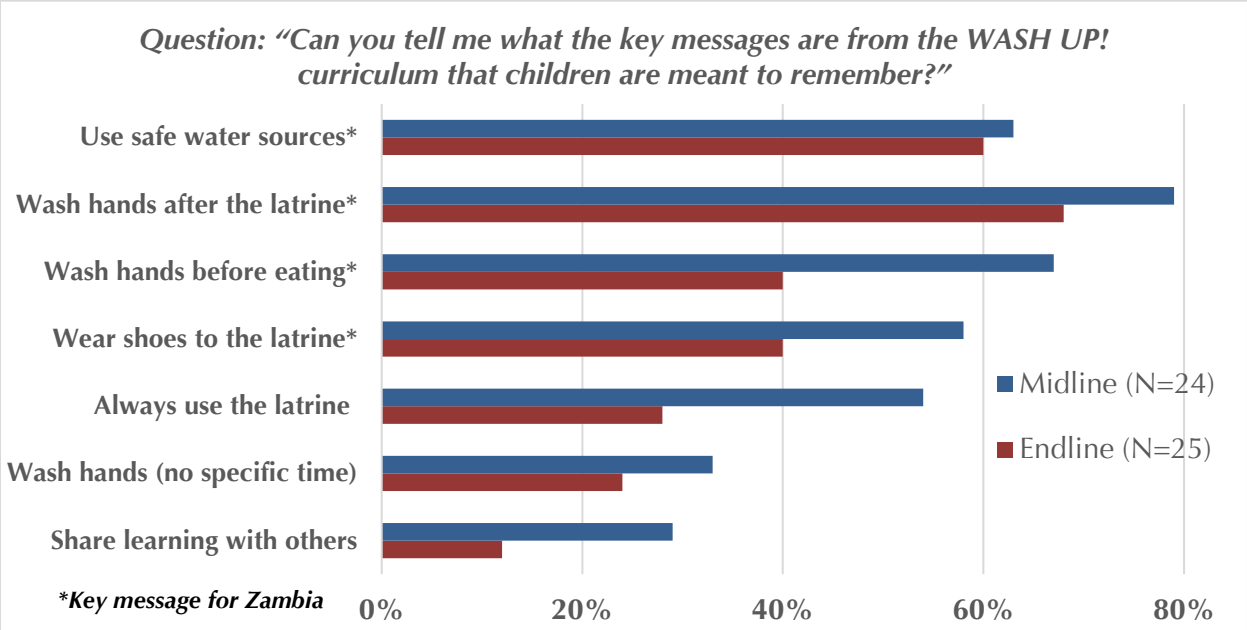
We also asked teachers whether the content of the WASH UP! curriculum was new for students in their grade, or if it was largely a review of information they had been taught before that was presented in a more engaging manner (Figure 4). Overall, a majority of teachers reported that roughly half of the WASH UP! information was familiar and half was new. The pattern of responses was very similar between Grade 1 and Grade 4 teachers (data not shown).

Figure 4: Percentage of *Grade 1 and 4* teachers reporting indicated share of new content in WASH UP! curriculum, midline and endline. *(Options were prompted by enumerator and response categories were probed as needed.*)



Finally, enumerators asked teachers to name the key messages that they had taught to students through the WASH UP! program during the term prior to interview. The program is designed to allow emphasis on different key messages that are appropriate to a given context. In Zambia, the four key messages for WASH UP! were: (1) only drink water from safe sources, (2) always wear sandals to the latrine (3) always wash hands after using the toilet, and (4) always wash hands before eating. At midline, between 58% and 79% of teachers who taught WASH UP! in the previous term identified each key message without prompting (Figure 5). These percentages were lower in endline, ranging between 40% and 68%. Note that the remaining messages cited by teachers are also part of the WASH UP! curriculum, but not selected during the planning and teacher training workshops to be primary themes that would be emphasized by teachers.

Figure 5: Percentage of Grade 1 and 4 teachers citing indicated WASH UP! key message without prompting, by study phase
(Unprompted except 'Any other message?' Multiple answers encouraged.)



9) Results: Changes in WASH knowledge and behavior of students & teachers

The conceptual model linking the WASH UP! program to long-term health and well-being impacts for children hypothesizes a causal pathway that includes increased knowledge of fecal-oral transmission of pathogens and the adoption of behaviors to interrupt that transmission. Recalling that the study was not designed or powered with the objective to make confident causal claims, the following sections summarize evidence of changes in students' knowledge and WASH-related behaviors between baseline and the introduction of the WASH UP! program at the sample schools.

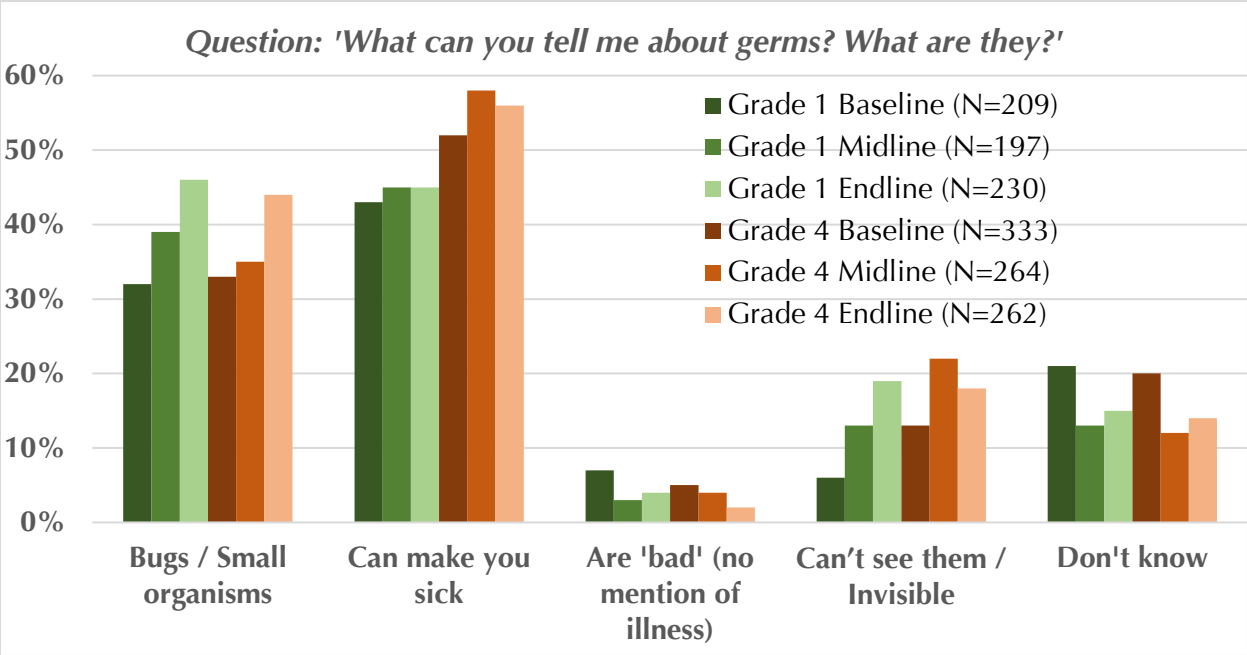
Table 13: Percentage of students reporting familiarity with the concept of germs, by grade and study phase

	Question: "Now I'd like to ask you about germs. Have you ever heard the word 'germs' before?"		
	Baseline (N)	**Midline (N)**	**Endline (N)**
Grade 1	54% (390)	76% (280)	85% (251)
Grade 4	90% (369)	88% (300)	94% (264)
Total	*71% (761)*	*82% (580)*	*90% (554)*

WASH-related knowledge questions for student respondents focused on the key messages in the WASH UP! curriculum. For example, during each round of data collection students were asked if they had ever heard the word "germs" before (*tuzunda* in Tonga). The largest gain in this knowledge indicator was seen in Grade 1 children (Table 13). At baseline, roughly half of Grade 1 respondents said they had heard of germs; by endline, this value had risen to 85%.

Students who reported knowing what germs are were asked a second, open-ended follow-up question probing their understanding: "What can you tell me about germs? What are they?" (Figure 6) Over all grades and study periods, eighty percent of these respondents provided scientifically valid information about what germs are, where one might come into contact with them, and/or what the effects of contact with germs might be). Trends over the study period suggest a steadily increasing share of students stating that germs are small organisms not visible to the naked eye and that can cause illness.

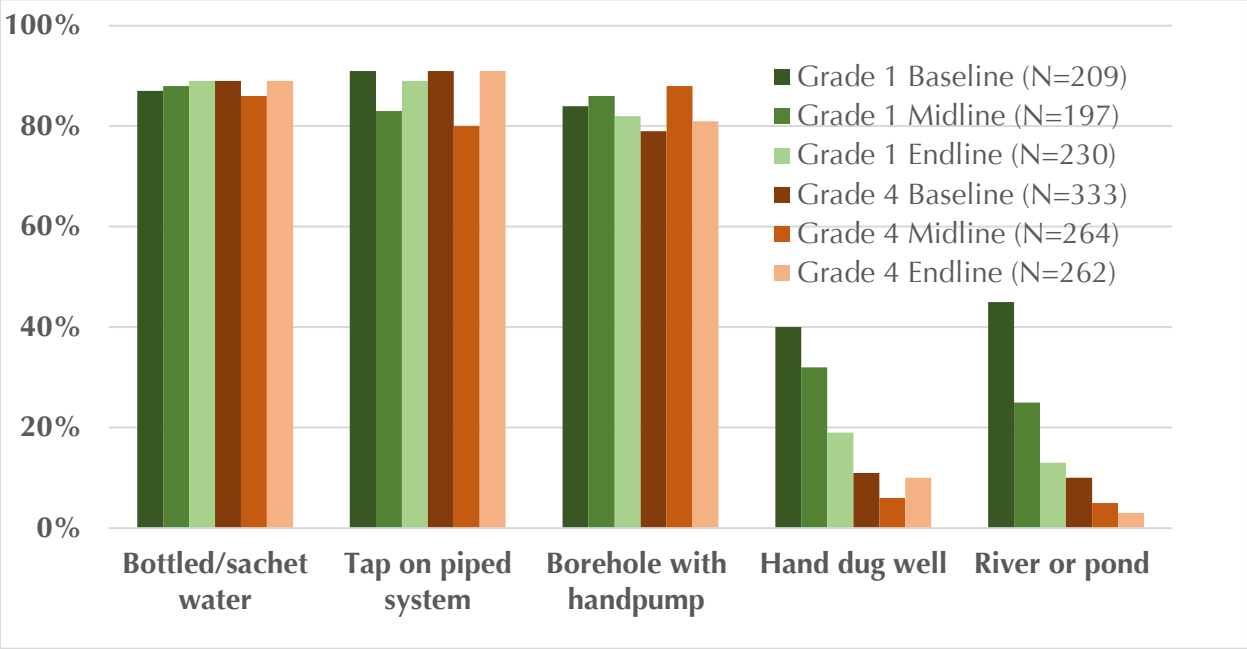
Figure 6: Percentage of students reporting indicated feature about germs (among those saying they knew what germs are), by grade and study phase.
(Unprompted except 'Anything else?' Multiple answers encouraged.)



Students were also shown a series of photos of common water sources and asked whether, in general, the water that would be obtained from each source was safe to drink directly, without treatment (Figure 7). Across all study phases 79% or more of children said that bottled water, as well as water provided by taps on a piped system or by a borehole, would be safe to drink. At baseline roughly 40% of Grade 1 children said that drinking

water from a hand-dug well or surface water source was safe. By endline, this percentage had fallen by more than half, and the gap between Grade 1 and Grade 4 student knowledge had closed considerably.

Figure 7: Percentage of student respondents who identified indicated source of water as safe for drinking without treatment, by grade and study phase



If a student respondent said s/he thought a particular source was "unsafe" s/he was asked a follow-up question about what specifically was in the water that made it unsafe for drinking (Table 14). Among the 547 children in both grades who answered this question with regard to surface water, at baseline 41% specifically mentioned sewage/fecal contamination and 34% mentioned "germs." At endline, these percentages had increased to 57% and 49%, respectively. Baseline-to-midline gains (~20%) were equivalent for Grade 1 and Grade 4 students with respect to the sewage answer option. Over the same period, the share of Grade 1 students citing "germs" increased by 147%, compared to 9% among Grade 4 students (who had a much higher starting point at baseline).

Table 14: Percentage of students identifying indicated reason that surface water is unsafe for drinking without treatment, for full sample and by grade and study phase
(Unprompted except 'Anything else?' Multiple answers encouraged.)

Grade 1	Baseline (N=216)	Midline (N=208)	Endline (N=241)
Dirt	50%	54%	55%
Feces/Sewage	23%	28%	46%
Germs	19%	47%	49%
Urine	0%	16%	22%
Bathers	17%	36%	24%
Dead bodies	1%	1%	9%

Grade 4	Baseline (N=331)	Midline (N=270)	Endline (N=272)
Dirt	57%	51%	53%
Feces/Sewage	52%	63%	66%
Germs	46%	50%	49%
Urine	1%	48%	51%
Bathers	6%	36%	35%
Dead bodies	2%	4%	10%

It is interesting to note the large increase in the share of students reporting that urine in surface water makes it unsafe for drinking. Virtually no students gave this answer during baseline, compared with about one fifth of Grade 1 and half of grade 4 students in both midline and endline. From a public health perspective, water contaminated with urine does not pose a major risk of pathogen exposure (as does water contaminated with even a

small amount of feces).[4] The WASH UP! materials do not call out urine as a key health risk. It may be that the program's emphasis on correct and consistent latrine use overall ('whenever you need to pee or poop') may have resulted in students' associating urine and feces exposure with an equivalent risk of diarrheal disease.

9.1 Exposure analysis

The results presented in the previous section represent an intent-to-treat analysis that does not take into account whether individual students participated in WASH UP! sessions. At midline and endline, 57% and 52% of students, respectively, reported attending at least one session of WASH UP! during the previous term (see Section 8). In this section we present a subset of repeat analyses that do incorporate the extent of exposure to WASH UP! programming. A few important caveats are in warranted, however. First, as noted in Section 8 is reason to believe that (particularly Grade 1) students may not have been aware every time their teacher was delivering WASH UP! content. Second, there is limited variation in the number of sessions that students reported attending. For this reason many analyses dichotomize the notion of 'exposure,' dividing students into groups that reported attending some *versus* no WASH UP! sessions.

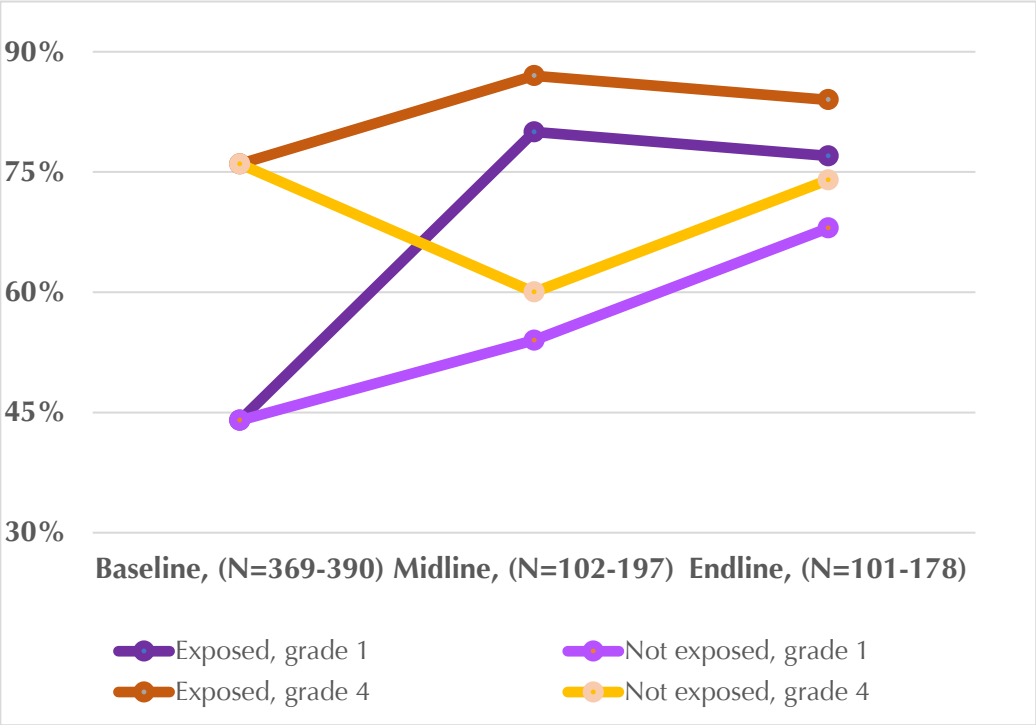
Most importantly, because the study did not allow for a true control group our sample does not include students who we can confidently say had no exposure to the program. Students who reported that they did not attend WASH UP! sessions are classmates of those who did; they could be influenced by their peers' sharing of information from the program and/or modeling of improved WASH behaviors. Students who did not attend WASH UP! sessions also had teachers who are WASH UP! instructors, some of whom reported offering program-related reminders outside of formal sessions. WASH UP! imagery was also displayed in classrooms and at latrine blocks in some schools. In short, we believe that only a small share of students in the study sample were completely unaware of and unaffected by the implementation of WASH UP! in their schools.

With these important caveats, our findings suggest that students who reported attending at least one WASH UP! session did exhibit higher rates of knowledge gain regarding some key messages from the curriculum as compared to students who said they did not participate in the program. For example, between baseline and midline the share of

[4] This is not to say that consuming water contaminated with urine carries no health risk at all. In general, however, contact with feces would pose a much greater risk of exposure to diarrheal pathogens, which is the focus of the public-health messaging in WASH UP!.

exposed students who were able to provide specific, scientifically supported information about germs increased to a greater extent than with unexposed students.[5]

Figure 8: Percentage of students reporting scientifically supported information about germs* (among those saying they knew what germs are), by reported program exposure, grade and study phase.



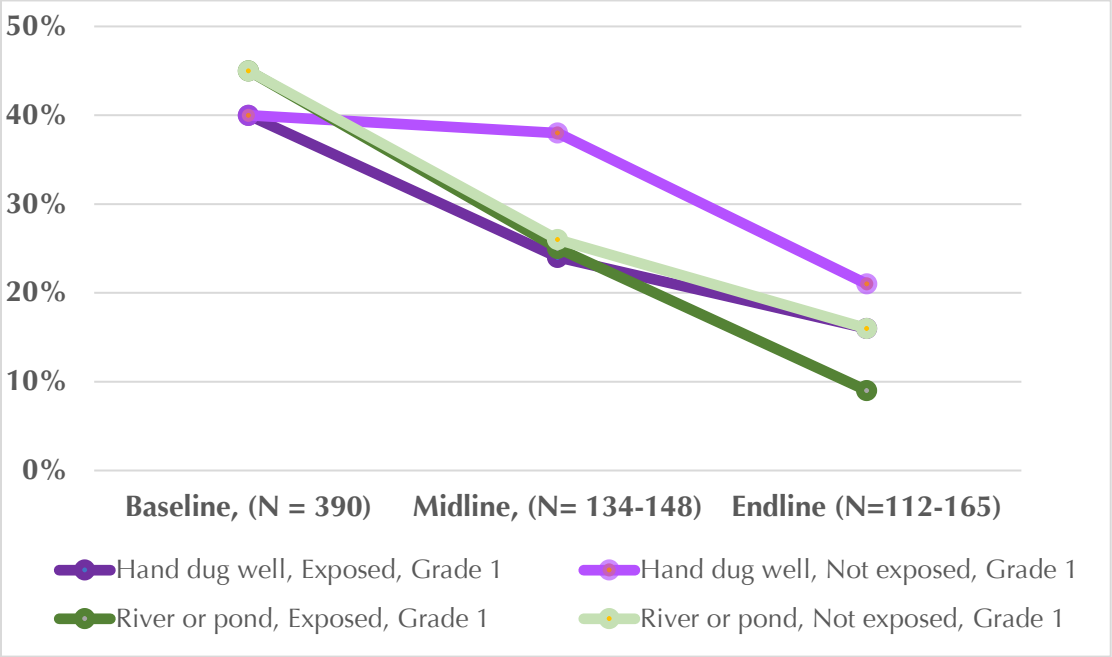
*Information could include the sources, health effects, and/or characteristics of germs (e.g., not visible to the human eye).

The share of Grade 1 students who identified surface water sources (rivers and ponds) as safe for drinking without treatment fell by about 20 percentage points (45% to 25%) between baseline and midline; trends are nearly identical for exposed and unexposed students. By contrast, knowledge that water from hand-dug wells is unsafe for drinking without treatment fell from 40% to 25% for exposed students during this period, whereas

[5] By endline the knowledge of students in each paired comparison had begun to converge. We are unable to disentangle WASH UP!-related influence (e.g., students attending more sessions in the term following the intervention) from that of Ministry of Health promotion related to the cholera epidemic.

essentially no change is observed for unexposed students.[6] Although any conclusions are necessarily speculative for the reasons detailed above, we note that effective messaging around dug wells is more nuanced (e.g., some types of wells *are* safe sources) whereas messaging about the danger of surface sources is quite common both within and outside the school environment. The results for the two knowledge items are thus consistent with the notion that students exposed to WASH UP! exhibited differential gains in understanding of water source health risks over the intervention period.

Figure 9: Percentage of Grade 1 students who identified indicated source of water as safe for drinking without treatment, by reported program exposure and study phase



9.2 Urination and defecation behaviors

During the baseline round of data collection, when asked where they most recently urinated and defecated while at school (in two separate questions), 98% of students reported using the school latrine. Just 1% admitted that they used the bush. These values changed to 94% and 6% at endline. We do not view these results as an indication of increased open defecation; rather, we made improvements to the way in which we asked

[6] See previous footnote, however, regarding the trend toward convergence of knowledge about dug wells by endline. Both WASH UP! and the Ministry of Health messaging targeted this exposure pathway as a key illness prevention message.

these questions in an effort to make students more comfortable with sharing sensitive information. Rather than immediately asking students what choices they made, we first asked a respondent how often his/her peers urinated or defecated in locations other than the school latrine (Table 15). Roughly 40% of student respondents reported that fellow students urinate outside the latrine "sometimes" or "often" and 38% reported said that fellow students defecate outside the latrine "sometimes" or "often."

Table 15: Percentage of Grade 1 & 4 students reporting indicated frequency with which peers urinate or defecate outside the latrine at school, by data-collection period

	Question: "Some children we have talked to told us that, when they need to [urinate / defecate], sometimes they go in the latrine at school, and sometimes they go outside. Here at your school, how often do children go outside when they need to [urinate / defecate]?"					
	Urination			**Defecation**		
	Often	**Some-times**	**Rarely**	**Often**	**Some-times**	**Rarely**
Midline (N=581)	4%	36%	59%	2%	29%	69%
Endline (N=556)	5%	33%	61%	1%	25%	73%

These data align fairly well with information collected from teachers, who indicated that students urinating (in particular) and defecating outside the latrine at school is not uncommon (Table 16). At endline, 45% of teachers reported that students urinated outside the latrine "sometimes" or "often." Twenty-eight percent reported that students defecate outside the latrine "sometimes" or "often."

Table 16: Percentage of Grade 1 & 4 teachers reporting indicated frequency of student urination/defecation outside the latrine at school, by data-collection period

	Question: "In many schools, there are instances in which students do not use latrine or toilets and instead URINATE / DEFECATE somewhere outside. To the best of your knowledge, how often do students AT YOUR SCHOOL urinate / defecate outside instead of using the latrine or toilet? Would you say they URINATE / DEFECATE outside…"					
	Urinate			**Defecate**		
	Always or often	**Some-times**	**Rarely / never**	**Always or often**	**Some-times**	**Rarely / never**
Baseline (N=29)	17%	52%	31%	7%	31%	62%
Midline (N=24)	4%	33%	63%	4%	17%	79%
Endline (N=33)	9%	36%	55%	3%	25%	72%

9.3 Hand hygiene behavior

We obtained self-reported information about hand hygiene practices from surveys with students, as well as perceptions of handwashing feasibility from surveys with teachers. We complemented these data with direct observation of handwashing behaviors during the days that our team visited each school in the sample. In general teachers generally sanguine regarding both the enabling environment for handwashing at schools and the likelihood that a student would wash his/her hands following toilet use without prompting (Table 17).

Table 17: Percentage of Grade 1 & 4 teachers who said they agree 'somewhat' or 'completely' with indicated statement, by data-collection period
(Answer categories probed as needed.)

	"STUDENTS at my school can EASILY wash their hands whenever they want to."	**"After using the toilet, STUDENTS in my level usually wash hands WITHOUT having to be reminded by an adult."**
Baseline (N=28)	86%	71%
Midline (N=24)	79%	96%
Endline (N=33)	79%	85%

We carried out structured observation of handwashing infrastructure and student hand hygiene behaviors at each school (Table 18). Each student visit to the school latrine was considered a handwashing 'opportunity' and the handwashing station located closest to

that latrine was the target of the observation. All schools had at least water available for the handwashing station at baseline, and 40% had both water and soap or ash available.[7] For the remaining study phases, handwashing stations without water were documented roughly once out of every five handwashing opportunities, which limited students' chances to practice good personal hygiene.

Table 18: Percentage of handwashing opportunities during which indicated supplies were observed to be available for student use at primary handwashing station, by data-collection period (*All 12 sample schools combined*)

	Baseline	Midline	Endline
No water available	0%	21%	18%
No cleanser (soap / ash) available	65%	68%	82%
Both water and cleanser available	40%	32%	18%
Total person-days of observation	20	19	22

Note: Column totals exceed 100% because some sample schools used both soap and ash.

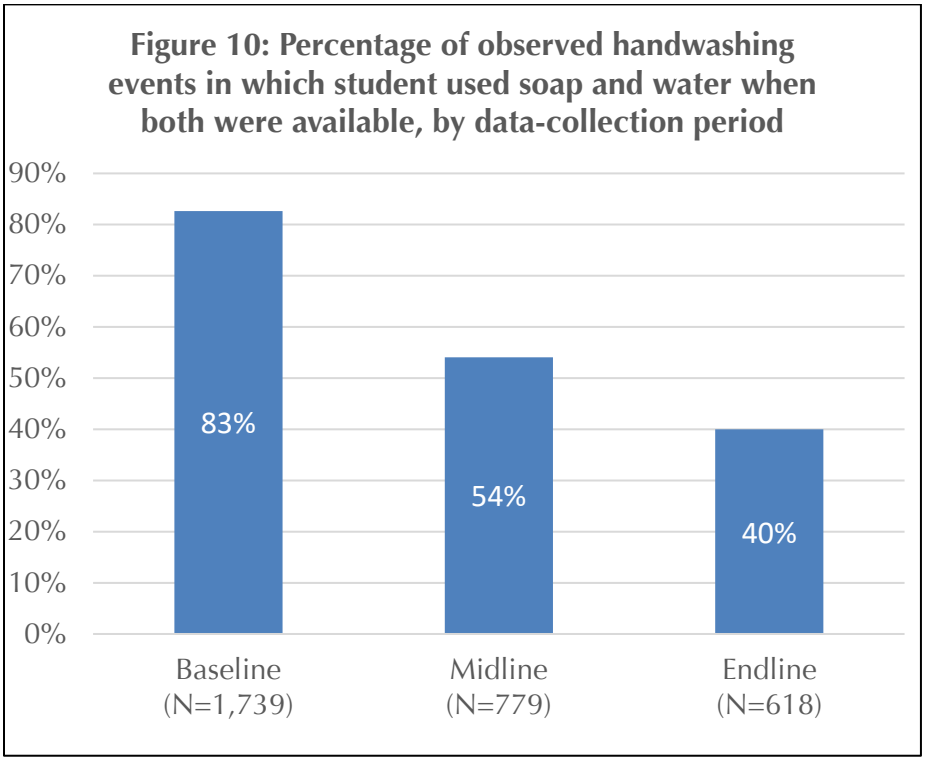
The observational data contrast somewhat with information obtained through surveys of Grade 1 & 4 teachers (Table 19). For example, at baseline only 43% of teachers said that water was always available at handwashing stations. This percentage more than doubled between baseline and midline, whereas the inverse trend was documented during observation.

[7] The WASH UP! program does not encourage use of ash for handwashing; however, it is widely perceived as a substitute for soap among the administrators and teachers in our sample schools.

Table 19: Percentage of teachers providing indicated response to the question "To the best of your knowledge, how often is water and soap actually available at the students' handwashing station?," by data-collection period

	Water available				Soap available			
	Always / almost always	Often	Some-times	Rarely / Never	Always / almost always	Often	Some-times	Rarely / Never
Baseline (N=23)	43%	22%	30%	4%	0%	13%	39%	48%
Midline (N=22)	95%	0%	5%	0%	23%	14%	45%	18%
Endline (N=32)	81%	9%	6%	3%	31%	16%	34%	19%

Even when water and soap were available at handwashing stations, students did not always use them (Figure 10). Rates were highest at baseline (83% of observed handwashing events) and declined to less than half (40%) by endline.



9.4 WASH-related knowledge and self-reported behaviors among teachers

We obtained data from Grade 1 and 4 teachers regarding their WASH-related knowledge, including topics that are addressed in the WASH UP! curriculum and broader issues. For example, we asked each teacher in the sample whether s/he thought that diarrhea could be the result of a variety of potential causes that were read out in random order by the enumerator (Table 20). Virtually all respondents agreed that contaminated food and water could cause diarrhea; between 89% and 100% also identified contact with feces as a cause, depending on study phase. A substantial share of teachers also said they believed that diarrhea could be triggered by causes for which less scientific evidence exists, including changes in the weather and bad/evil spirits.

Table 20: Percentage of Grade 1 & 4 teachers stating that indicated factor is a cause of diarrhea, by study phase
(List of causes randomized and prompted.)

	Question: "Next I'd like to ask you about diarrhea—frequent soft or watery stools. As far as you know, which of these can give a person diarrhea? Can it be caused by…"						
	Eating contaminated food?	**Drinking contaminated water?**	**Contact with feces?**	**Teething?**	**Changes in weather?**	**Malaria?**	**Bad spirits?**
Baseline (N=28)	100%	96%	89%	61%	43%	43%	11%
Midline (N=24)	100%	100%	100%	68%	65%	27%	4%
Endline (N=33)	97%	100%	97%	58%	48%	47%	20%

When asked about the reasons that they wash their hands in an open-ended question, more than 82% of Grade 1 and 4 teachers gave responses related to removing germs or protecting their health at baseline. This percentage rose each study phase, reaching 94% at endline (Table 21). A large share of teachers also identified the two critical times for handwashing that are emphasized within the WASH UP! curriculum: after using the toilet and before eating (Table 22). About one third mentioned handwashing before preparing food; none mentioned washing hands after cleaning a child's bottom. These are two additional "critical times" for handwashing as per the literature, but they are not key messages of the WASH UP! curriculum. It is also important to note that baseline data collection with teachers occurred two weeks into the school term, following the WASH UP! teacher training with Sesame Workshop colleagues. For some teachers who did not

attend this training, the baseline interview was further postponed; some had to be interviewed after they had taught their first session of WASH UP!.

Table 21: Percentage of Grade 1 & 4 teachers naming indicated motivation for washing hands, by study phase
(Unprompted except 'Any other reason?' Multiple answers encouraged.)

	Question: "When you wash your hands, what are the main REASONS that do you do it?"			
	Kill germs/ be healthy	**Remove dirt/soil/ food**	**Appear clean / decent**	**It is simply a habit**
Baseline (N=28)	82%	82%	36%	4%
Midline (N=24)	88%	63%	38%	0%
Endline (N=33)	94%	61%	30%	6%

Table 22: Percentage of Grade 1 & 4 teachers naming indicated time for handwashing, by study phase ***(Unprompted except 'Any other time?' Multiple answers encouraged.)***

	Question: "Can you tell me AT WHAT TIMES you think it is most important to wash your hands?"				
	After using the TOILET	**Before EATING**	**Before PREPARING FOOD**	**After playing/ working OUTSIDE**	**When hands look DIRTY**
Baseline (N=28)	93%	93%	29%	14%	24%
Midline (N=24)	100%	100%	29%	25%	25%
Endline (N=33)	97%	88%	39%	42%	7%

Teachers were also asked about the extent to which they agreed or disagreed with a series of statements that included some key messages from the WASH UP! curriculum (Table 23). Across all data-collect periods, virtually all teachers agreed that individuals should wear shoes when using a latrine and that handwashing prevents diarrhea. The share who agreed that washing hands just with water is equally effective as washing with water and soap fell from 21% at baseline to 4% at midline ($p<0.01$). The majority of teachers did not seem to be aware that handwashing can be effective in preventing some types of respiratory illness, an idea that is well supported by epidemiological literature but not included in the WASH UP! curriculum.

Table 23: Percentage of Grade 1 & 4 teachers who said they agree 'somewhat' or 'completely' with indicated statement, by data-collection period
(Statement order randomized and answer categories probed as needed.)

	It is IMPORTANT for students to wear SHOES or SANDALS when they visit the latrine.	Washing hands will PREVENT our teachers and students from getting DIARRHEA.	It is IMPORTANT for students to share what they learn in school with their PARENTS at home.	Washing hands will PREVENT our teachers and students from getting RESPIRATORY ILLNESS.	Washing hands with WATER ALONE makes them just as clean as washing with water AND SOAP.	Washing hands will PREVENT our teachers and students from getting MALARIA.
Baseline (N=28)	100%	100%	93%	36%	21%	11%
Midline (N=24)	100%	100%	100%	29%	4%	8%
Endline (N=33)	100%	97%	100%	39%	3%	12%

10) Results: Children as change agents

The WASH UP! program is designed not only to educate and motivate primary school students toward improved WASH behaviors, but to encourage those students to drive behavioral change among their parents and other family members as well. We sought to assess the extent to which students did transmit messages home through survey questions posed to both students and their parents. For example, at baseline one quarter of students said that they recalled a teacher asking them to share a specific lesson at home with their family members at some point during the prior school term (Table 24). This rate is considerably lower than that reported by parents (60%), although the question posed to parents was more general: Did the student share information from a school lesson on his/her own initiative (*i.e.*, without being asked by the parent)?

Table 24: Percentage of students reporting being instructed by teachers to share a lesson or information with their family members, by data-collection period

	Baseline (N)	Midline (N)	Endline (N)
Grade 1	16% (392)	41%* (283)	45% (278)
Grade 4	32%# (369)	58%*# (302)	64%# (279)
All students	24% (761)	50%* (585)	54% (557)

*Value is significantly different from baseline period percentage for same grade cohort ($p<0.01$).

Value is significantly different from Grade 1 cohort percentage for same period ($p<0.01$).

Across both grades, the percentage of students who said they received such instruction was significantly higher at midline following the WASH UP! intervention (both $p<0.01$). In each time period a greater share of grade 4 students said they were instructed to share information with their families as compared to grade 1 students (both $p<0.01$), which could reflect differences in actual teacher practice by grade, in students' ability to recall such instructions, or both. Similar results are observed when the analysis is restricted to students who reported being asked to share a school lesson related to water, sanitation, or hygiene (Table 25).

Table 25: Percentage of students reporting being instructed by teachers to share a WASH-related lesson or information with their family members, by data-collection period

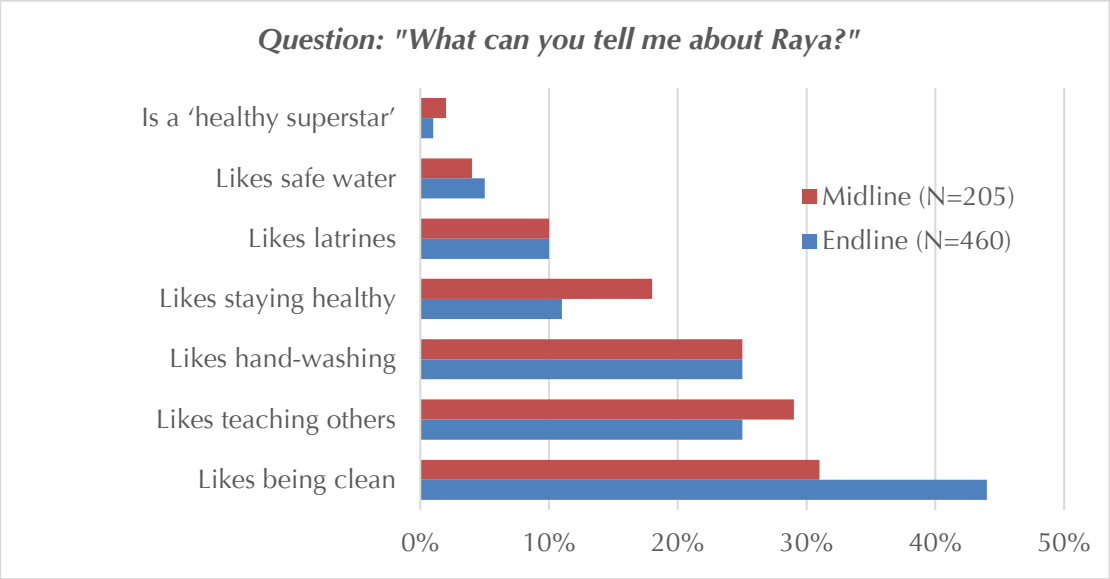
	Baseline (N)	Midline (N)	Endline (N)
Grade 1	3% (392)	11%* (283)	10% (278)
Grade 4	15%# (369)	35%**# (302)	34%# (279)
All students	8% (761)	22%** (585)	22% (557)

Value is significantly different from baseline percentage for same grade cohort (*$p<0.05$, **$p<0.01$).

Value is significantly different from Grade 1 cohort percentage for same period ($p<0.01$).

In addition to being encouraged by teachers to share WASH UP! learning at home, children appear to have picked up on Raya's modeling of children as teachers. When asked what they remembered most about Raya, the fact that she likes teaching others was cited as often as her focus on washing hands (Figure 11).

Figure 11: Percentage of students citing indicated feature of Raya (among those who said they recognized her image) (*Unprompted, except 'Anything else?' Multiple responses permitted*)



Parents were also asked about whether their child specifically came to them to share a lesson from school during the prior school term (Table 26). The full-sample value (60%) is considerably higher than that reported by students, although the question posed to parents was more general: Did the student share information from a school lesson on his/her own initiative (*i.e.*, without being asked by the parent)? It was not feasible to add the nuance of whether the child's sharing was the result of teacher instruction.

Overall, a slight increase in the percentage of parents reporting their children sharing school lessons is observed between baseline and midline. The increase is statistically significant only for the sub-sample of parents with a female focus child (grades 1 and 4 combined).

Table 26: Percentage of parent respondents who reported that their child shared something s/he learned during the prior school term, by gender of respondent, gender of child, grade of child, and study period

	Baseline	Midline	Endline
Parent is male	59% (159)	65% (142)	65% (98)
Parent is female	62% (556)	64% (476)	74% (409)
Focus child is male	61% (348)	57% (304)	74% (242)
Focus child is female	62% (367)	71% (321)*	71% (265)
Focus child is in Grade 1	59% (383)	65% (327)	70% (280)
Focus child is in Grade 4	64% (332)	63% (291)	75% (227)
Total	62% (715)	64% (619)	72% (507)

*Notes: Sample sizes in parentheses. *Value is significantly different than percentage of indicated student sub-group at baseline, p<0.05.*

Findings from the pilot study suggest that the likelihood of a student reporting that s/he carried WASH-related information to family members from school is higher for those who were recalled being exposed to WASH UP! programming. Compared to students who said they had not participated in WASH UP!, those who reported attending at least one session were more 2.6 to 3 times more likely to report having been told to share program-related information with family members (Table 27).

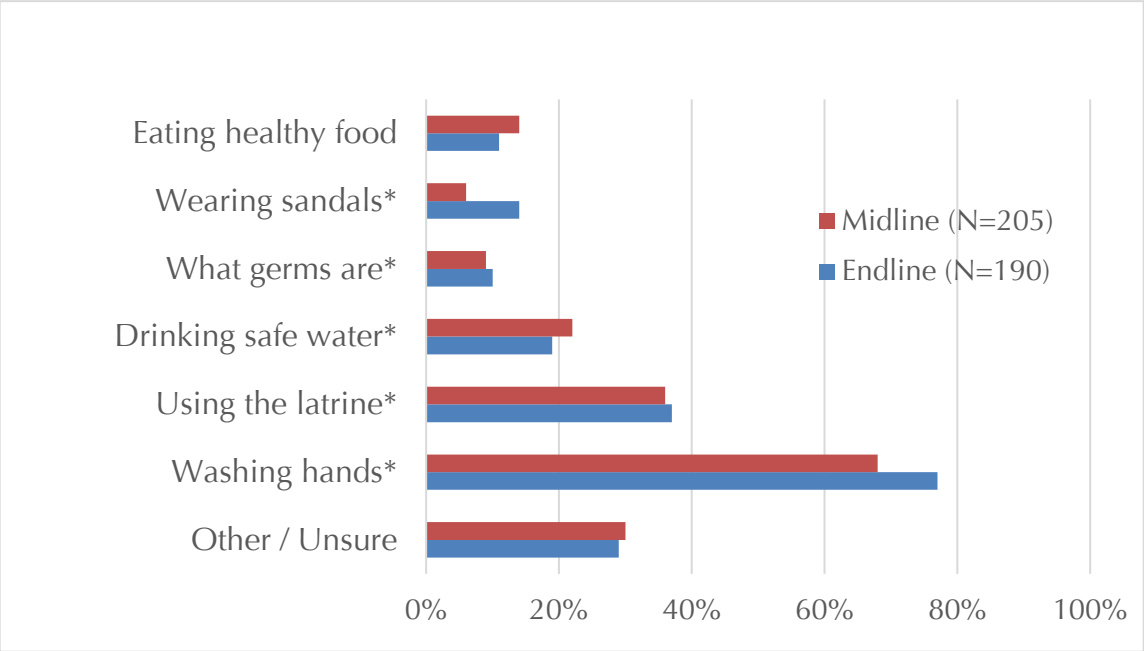
Table 27: Percentage of students reporting being instructed by teachers to share a WASH-related lesson or information with their family members, by reported program exposure, grade and data-collection period *(Sample size in parentheses)*

	Baseline (N=267-372)	Midline (N=104-197)	Endline (N=101-178)
Exposed to WASH UP!, Grade 1	3%	15%**	18%
Not exposed to WASH UP!, Grade 1	3%	7%	5%
Exposed to WASH UP!, Grade 4	15%	41%**	40%
Not exposed to WASH UP!, Grade 4	15%	25%	23%

**Value is significantly different from baseline percentage for same grade cohort, p<0.01.

When asked what specific topics children shared with their families, parents most frequently mentioned handwashing (Figure 12). This was followed by using the latrine (36%) and only using safe water (22%). Students increased the frequency with which they reported discussing handwashing at endline, possibly the combined result of WASH UP! and the Ministry of Health cholera education campaigns.

Figure 12: Percentage of Grade 1 & 4 parents reporting sharing of school lesson on indicated WASH topic by child (*Among those reporting their child sharing WASH-related learning; unprompted; multiple responses permitted*)



* Key messages from the WASH UP! storybook

When asked which family members they shared WASH information with, at midline students reported speaking primarily with their mothers (73%), and 48% said they spoke with fathers (multiple answers were permitted). These percentages increased to 82% and 55%, respectively at endline.

At midline, roughly half of students who said they shared lessons from school with their families felt that their relatives listened but already knew the information; another 44% of students said they thought the information they shared was new to their family members. Just 2% said that their family was not willing to listen to the information they shared. These data are consistent with 91% of parents reporting that they speak with their children about what they learned in school "every day" or "2-4 times per week," and suggest a

sociocultural context that is conducive to the programmatic objective of children acting as change agents.

11) Results: Parent WASH behaviors, household enabling environment

Despite evidence of some successful transmission of information related to WASH UP! themes from students to family members, there is no evidence to suggest significant change in many of the knowledge, attitude, or self-reported behavioral outcomes for parents between baseline and midline. As one example, self-reported rates of water treatment, for example, were essentially unchanged over the course of the study (Table 28).

Table 28: Percentage of Grade 1 & 4 parents reporting treatment of drinking water, by study phase (*Sample size in parentheses)*

	Percent reporting treating household drinking water "always" or "often"
Baseline	17% (720)
Midline	17% (639)
Endline	19% (509)

Similarly, when asked about the reasons that they wash their hands in an open-ended question, 4 out of 5 Grade 1 and 4 parents gave responses related to removing dirt, soil or food (Table 29). Fewer than half mentioned killing or removing germs or protecting their health in any data-collection period; the percentage actually decreased from 43% to 36% following the WASH UP! intervention period.

Improvements in some self-reported behaviors and infrastructure access were documented over the course of the study, but significant results were largely concentrated during the midline-to-endline period when the Ministry of Health cholera prevention campaigns were launched. For example, the mean number of self-reported handwashing events during the day prior to interview increased from 4.3 at baseline to 4.6 and 5.2, respectively, at midline and endline. The share of parents saying that a dedicated handwashing station exists in their home increased between baseline and midline, but a similar pattern is not observed in student responses (Table 30).

Table 29: Percentage of Grade 1 & 4 parents reporting indicated motivation for handwashing, by study phase *(Among parents reporting handwashing; unprompted; multiple responses permitted. Sample size in parentheses)*

	Question: "When you wash your hands, what are the main reasons you wash them?"			
	Remove dirt / soil / food	**Kill germs / Be healthy**	**Appear clean / decent**	**Other / Don't know**
Baseline	82% (732)	43% (732)	32% (732)	9% (732)
Midline	81% (651)	36% (651)**	38% (651)*	9% (651)
Endline	81% (512)	47% (512)	41% (512)	9% (512)

Value is significantly different from baseline percentage (*p<0.05, **p<0.01).

Table 30: Percentage of Grade 1 & 4 parents and students reporting having access to indicated facility at home, by study phase *(Sample size in parentheses)*

	A designated handwashing station for use after urinating/defecating		*A private latrine (own or a neighbor's)*	
	Parent responses	**Student responses**	**Parent responses**	**Student responses**
Baseline	47% (530)	62% (759)	60% (528)	70% (759)
Midline	55%** (638)	63% (581)	60% (630)	71% (579)
Endline	59% (508)`	71%‡‡ (556)	66%‡ (507)	80%‡‡ (555)

**Value is significantly different from baseline percentage, p<0.01.

Value is significantly different from midline percentage, ‡‡p<0.01, ‡0.01<p<0.05.

Whereas all children in our sample have access to a latrine at school, at baseline only 70% reported that their household has a latrine at home (Table 30). This is higher than the

60% of parents who reported having access to a private latrine (their own or a neighbor's) ($p<0.01$).[8] The significant increase in reported household latrine access between midline and endline is consistent with the Ministry of Health's encouragement to build sanitation facilities as a key strategy to fight cholera during the outbreak.

12) Boundary object experiment

We carried out an experimental investigation within the study to test a strategy for enhancing transmission of WASH UP! messages from students to their family members. A subset of schools was selected to receive a 'boundary object,' which was simply a small printed color handout with an image reproduced from the curriculum storybook.[9] Teachers were asked to distribute the handout to students during a WASH UP! session when they asked students to share information about the lesson with family members.

Our findings suggest a pattern of enhanced outcomes for the boundary object cohort, although none is statistically significant (Tables 31 and 32). For example, between baseline and midline the share of parents reporting that their focus child discussed a WASH-related topic with them increased by 10 points (7% to 17%) in schools that received the boundary object, compared to an increase of 5 percentage points in the other schools (6% to 11%). Data on motivations for handwashing and the presence of a dedicated handwashing station at home similarly indicate larger program effect sizes for households whose students were members of the boundary object cohort.

Table 31: Percentage of parents reporting their key motivation to wash hands is 'to kill germs' and/or 'to be healthy,' by boundary object cohort and data-collection period

	Baseline	Midline	Endline	Midline-Baseline change
Boundary object	35% (N=253)	40% (N=224)	52% (N=184)	+5%
No boundary object	45% (N=478)	34% (N=425)	44% (N=327)	-11%

[8] The differences between parent *versus* student responses are not substantially changed if this analysis is restricted to the matched parent and student pairs for whom we obtained data in all three rounds of the study.

[9] The term 'boundary object' is well established in sociology and refers to a physical object with multiple uses or forms of significance in different communities or contexts. Ours is arguably not an entirely appropriate use of the term because we sought to connect the school and home environments through the shared experience and use of an object.

Table 32: Percentage of parents reporting having a dedicated place to wash hands at home, by boundary object cohort and data-collection period

	Baseline	Midline	Endline	Midline-Baseline change
Boundary object	41% (N=249)	64% (N=222)	64% (N=183)	+23%
No boundary object	52% (N=287)	51% (N=416)	57% (N=325)	-1%

As noted above, a difference-in-difference multivariate regression analysis would be needed to account for the dissimilarities in baseline values between the cohorts, as well as potential interaction effects between cohort and potentially contextual variables for which we do not have data (e.g., household income). For the purpose of this study, we are gratified to have successfully executed production and distribution of the boundary object, and the results are sufficiently promising to warrant further development of this idea in future WASH UP! research.

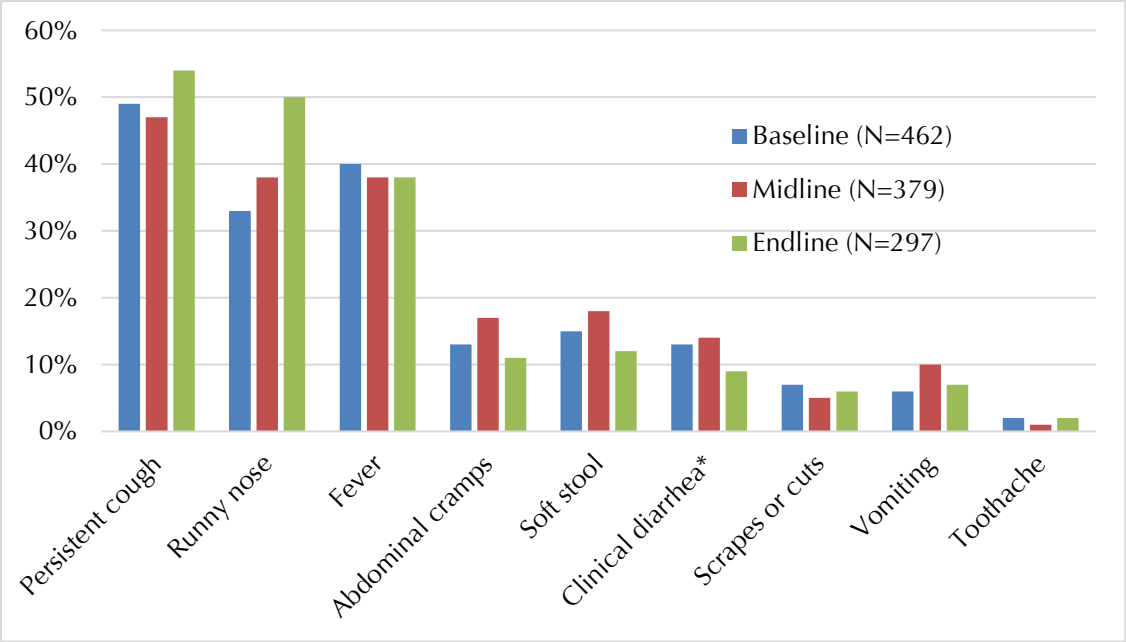
13) Results: Changes in health

The pilot study was not powered to detect impacts of WASH UP! on the health of students or their family members; nevertheless, we did develop and pilot modules to collect symptom data about each group. For example, parents were asked about health symptoms during the prior week of the youngest child in the household who was not exclusively breastfeeding. Data presented in Figure 13 are restricted to children under the age of 5.

One in seven parents (13%-14%) reported a child whose symptoms met the WHO criteria for clinical diarrhea during both the baseline and midline data-collection rounds. These results are in line with published research showing rates of 12.7% (for two-week period prevalence) in 2015.[10] No significant difference in prevalence rates across study period for any of the reported symptoms was observed.

[10] S. Bosomprah *et al.* (2016). Findings from a comprehensive diarrhoea prevention and treatment programme in Lusaka, Zambia. *BMC Public Health.* doi 10.1186/s12889-016-3089-7

Figure 13: Percentage of parents reporting indicated symptom for youngest under-5 child not exclusively breastfeeding, in week before interview (*prompted responses)*



*The World Health Organisation defines a case of diarrhea as having 3 or more loose or watery bowel movements within a 24-hour period.

14) Results: Changes in gender norms and attitudes

It is important to emphasize that influencing gender norms is not an explicit objective of the WASH UP! curriculum. World Vision, Sesame Workshop and Stanford were interested in assessing the potential for spillover effects in this domain, given the prominence of Raya as an empowered girl character throughout the WASH UP! curriculum. The pilot study thus included a module designed to measure gender-related attitudes and perceptions of students, teachers, and parents. Results must be interpreted cautiously given the exploratory nature of the investigation.

14.1 Gender-related perceptions of parents

Parent respondents were asked a series of statements and asked whether they agreed or disagreed, "completely" or "somewhat," with each one. The responses are shown in Table 33, grouped by gender of the respondent. A significantly higher share of female caretakers agreed with several statements asserting girls' superior skills relative to boys (e.g., in reading, mathematics, and leadership). For both female and male respondents, the percentage of 'agree' responses for these prompts increased with each data-collection round. Only comparisons between baseline and endline values were found to be statistically significant, however.

Table 33: Percentage of parents agreeing 'somewhat' or 'completely' with indicated statement read by enumerator, by gender and study phase

Female respondents	**Baseline (N=560)**	**Midline (N=480)**	**Endline (N=409)**
In general, boys are more intelligent than girls of the same age.	64%	67%	66%
Girls can do just as well as boys in school.	87%	85%	88%
In general, girls are better at being leaders than boys.	76%*	76%*	79%*
Girls tend to be better at reading than boys of the same age.	72%*	73%	80%‡
In our society, education is less valuable to girls than it is to boys.	44%	43%	48%
Girls tend to be better at mathematics than boys of the same age.	60%**	66%**	73%**,‡‡
Girls are better behaved than boys in school.	53%	55%	63%‡‡
I trust the information my children tell me they learned in school.	94%	97%	98%
It is important that my daughter complete secondary education.	98%	99%	100%
In matters of the home, it is the father who knows best what to do.	78%	80%	84%

Male respondents	**Baseline (N=158)**	**Midline (N=140)**	**Endline (N=99)**
In general, boys are more intelligent than girls of the same age.	69%	62%	68%
Girls can do just as well as boys in school.	82%	90%	94%
In general, girls are better at being leaders than boys.	66%	64%	69%
Girls tend to be better at reading than boys of the same age.	61%	66%	76%‡
In our society, education is less valuable to girls than it is to boys.	42%	33%	44%
Girls tend to be better at mathematics than boys of the same age.	42%	46%	57%‡
Girls are better behaved than boys in school.	56%	61%	64%
I trust the information my children tell me they learned in school.	94%	96%	97%
It is important that my daughter complete secondary education.	100%	98%	98%
In matters of the home, it is the father who knows best what to do.	82%	80%	82%

Value is significantly different for female *versus* male respondents within same data-collection period, $^{**}p<0.01$, $^{*}0.01<p<0.05$.

Value is significantly different for endline *versus* baseline within same respondent sub-sample, $^{‡‡}p<0.01$, $^{‡}0.01<p<0.05$.

14.2 Gender-related perceptions of teachers

Teachers were asked a similar series of questions about the extent to which they agreed with a set of gender-related prompts. The percentage who said they agreed 'completely' or 'somewhat' with each statement is presented in Table 34 below. Response patterns were quite similar across male and female teachers.

Table 34: Percentage of teachers agreeing 'somewhat' or 'completely' with indicated statement, by gender and study phase ***(Prompted responses; N in parentheses)***

	FEMALE HEAD TEACHERS are naturally better HEAD TEACHERS than male head teachers.	In our society, EDUCATION is LESS VALUABLE to girls than it is to boys.	Usually, GIRLS have HIGHER INTELLECTUAL CAPACITY than boys of the same age.	MALE TEACHERS are naturally more EFFECTIVE than female teachers in the classroom.	In general, BOYS are usually more INTELLIGENT than girls of the same age.
Baseline (N=26-28)	30%	82%	54%	25%	39%
Midline (N=23-24)	46%	50%*	63%	29%	22%
Endline (N=32-33)	25%	48%	33%‡	21%	21%

With the exception of a 32 percentage point drop in the share of teachers who agreed that education is less valuable to girls than boys in Zambian society (p=0.03), no statistically significant changes were observed between baseline and midline. Another 30-point drop was observed between midline and endline, this regarding the share of teachers agreeing that girls have 'higher intellectual capacity' than male peers. In contrast to the parent findings, no strong pattern emerges from these data. This is perhaps to be expected given the much smaller number of respondents.

14.3 Gender-related perceptions of students

Student respondents were also asked a series of questions designed to elicit perceptions around gender norms and stereotypes. The exercise was modeled after a recently

published study on this topic in US students.[11] First, a student respondent was shown drawings of equal numbers of male and female children, all taken from the WASH Up materials (but not accompanied by any dialogue).

Next, the student was asked a series of questions in order to ensure that his/her definition of the concepts "nice" and "smart" were consistent with those of the research team. Specifically, s/he was asked to listen to three test stories and then identify traits commonly associated with "nice" and "smart" children, such as sharing and answering questions correctly in class. Then the respondent was shown a pair of pictures (one of a boy and the other of a girl) and asked to indicate which of the two children s/he thought the story was about. No additional information was given to signal the "correct" answer to the question. Eight questions were asked in total, four asking the respondent to identify a "nice" child, and four asking them to identify a "smart" child.

Students' responses are summarized in the figures below. Specifically, the values indicate the percentage of children who identified their OWN gender when asked to identify the child who was either smart or nice. A value of 60%, for example, indicates that 60% students in the indicated category (e.g., grade 1 boy students) selected a boy when asked to indicate which child possessed the quality in question (nice or smart).

For each of the student sub-groups, no significant difference is observed either in responses to the 'smart' *versus* 'nice' scenario prompts or across study period. The share of girls in Grade 4 who selected girl images when asked to identify the 'smart' child increased by ten percentage points over the course of the study; however, an equivalent decline is observed for Grade 1 girl students. It is interesting to note that, overall, rates of own-gender selection are higher for girls *versus* boys in each grade/study phase comparison, for both the 'smart' and the 'nice' scenarios.

[11] L. Bian *et al.* 2017. Gender stereotypes about intellectual ability emerge early and influence children's interest. *Science.* doi 10.1126/science.aah6524

Figure 14a: Percentage of students selecting image of child matching own gender when asked to indicate 'smart' child, by grade, gender, and study period

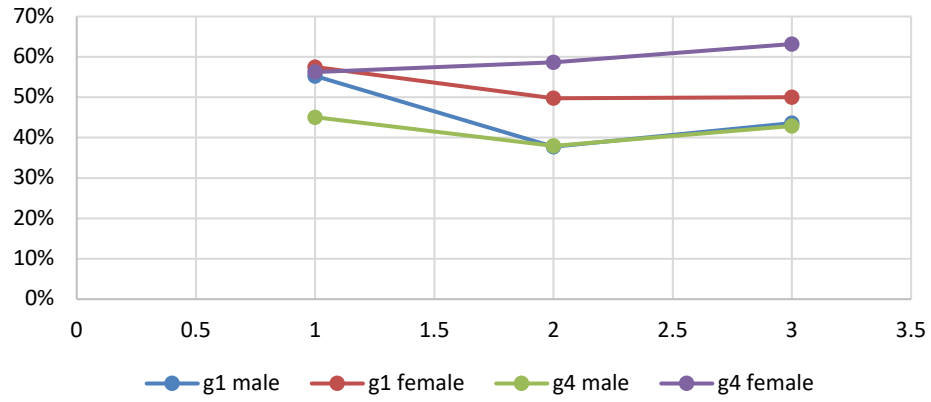
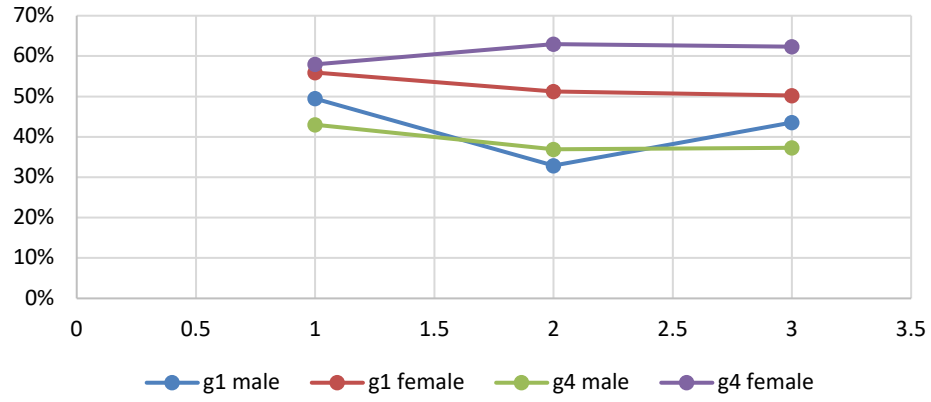


Figure 14b: Percentage of students selecting image of child matching own gender when asked to indicate 'nice' child, by grade, gender, and study period



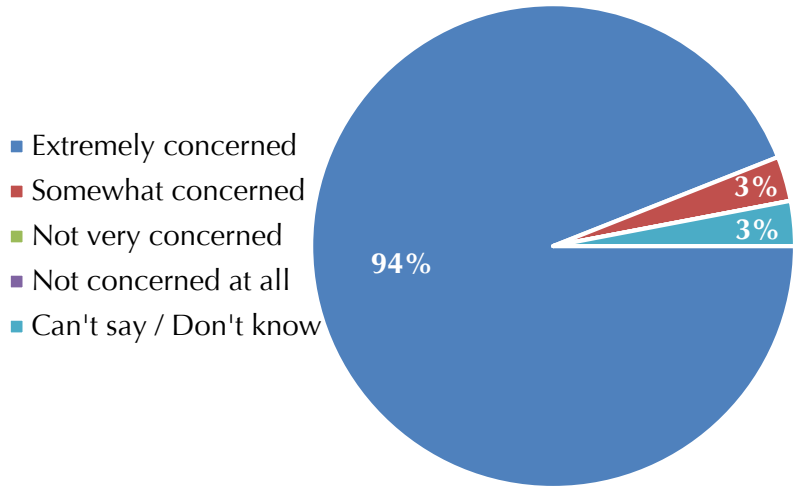
We also attempted to measure self-efficacy for student participants in the study by asking them a series of questions about their confidence in their abilities to undertake a variety of tasks. The undertakings included preparing a meal, get good marks in school, and teaching a peer something s/he doesn't know. We were interested in comparing aggregated self-efficacy scores for boys and (particularly) for girls before and after exposure to WASH UP!. This effort was unsuccessful, however, because the vast majority of students reported being 'very' sure or confident of him/herself with respect to each challenge described by the enumerator. Whereas this finding certainly provides encouraging evidence regarding students' self image, it created a lack of variation in the dataset that made it impossible for us to evaluate change over time.

15) Potential for study confounding by cholera outbreak

Recognizing that the primary objective of this study was to develop, pilot and refine data-collection tools that could be used in subsequent full-scale research, our ability to draw sound causal inference about the outcomes and impacts of the WASH UP! program study participants was compromised by the lack of a control group of schools. The outbreak of cholera in Zambia's capital between the midline and endline rounds of data collection led to a government sponsored public-health campaign whose messages overlapped those of the WASH UP! program to a considerable extent. Evidence suggests that, in our sample of schools, these events had major albeit relatively short-lived impacts on the salience of WASH issues.

Figure 15: Percentage of teachers reporting indicated level of concern about cholera outbreak *(N=32; endline)*

Question: "I'd like to talk with you about the CHOLERA OUTBREAK that began in Lusaka starting late last year. When the outbreak occurred, HOW CONCERNED would you say that staff, students, and parents at this school were about it?"



For example, teacher respondents reported a very high level at all 12 schools in our study sample when the outbreak emerged (Figure 15). Several teachers related anecdotes describing considerable disruption in day-to-day operations. Moreover, the Ministry of Health enlisted schools in its effort to raise awareness about the outbreak and cholera prevention strategies. Almost 80% of teachers reported that, in response to the outbreak, representatives from the Ministry of Health, Ministry of Education, and/or the District

Education Board Secretaries asked them for assistance with cholera-related messaging at their school. Not surprisingly, the content of that messaging was quite similar to WASH UP! program key messages (Table 35). Moreover, 88% of teacher respondents said that they explicitly instructed students to share this Ministry-provided information with family members at home. At the same time, the majority of teachers reported that the Ministry provided no written materials for distribution to students and families; the messaging was conveyed orally by Ministry representatives to school staff. A small number were given posters or letters to display on campus grounds.

Table 35: Percentage of teachers reporting sharing indicated information with students during the cholera outbreak between midline and endline *(N=32)*

Can prevent cholera by washing hands	Can prevent cholera by using the latrine	Cholera is a disease /makes you sick/can kill you	Cholera is caused by germs/bacteria	Cholera causes diarrhea / vomiting	Cholera is caused by feces
88%	45%	39%	33%	21%	3%

These developments make it essentially impossible to evaluate the persistence of students' WASH UP!-related knowledge and behavioral gains beyond the midline study phase. They underscore how critical it is to ensure a true control group in any follow-on research intended to generate causal claims about the impacts of the WASH UP! program.

16) Summary and conclusions

The pilot study in Zambia was highly successful in terms of allowing World Vision and Sesame Workshop to establish a strong and constructive collaboration with Stanford. The learning agenda that the organizations co-created has the potential both to enhance the impact and cost-effectiveness of the WASH UP! program, as well as to generate rigorous and actionable evidence that can guide investment and practice in the water sector more broadly.

The amount of learning that was achieved in the study was considerable—particularly considering the modest (relative to other, equally ambitious impact evaluations) financial cost. At the same time, the decision to forgo a true control group ultimately undermined the value of the third round of data collection. Similarly, in aborting the infrastructure efficacy/ineffectiveness comparison an opportunity was missed to explore the magnitude and types of investment that are needed to ensure a well-functioning enabling environment at schools where WASH UP! is implemented. Focusing on this issue seems particularly important given the structured observation results, wherein the likelihood that

students used soap and water for handwashing fell over time. This finding suggests that neither education nor infrastructure hello are sufficient two trigger consistent hand hygiene practices. We speculate that indeed, the two work in tandem; unless infrastructure is consistently operational over some minimum period of time, students' good handwashing habits cannot take hold.

Those limitations aside, a number of encouraging results emerged from the Zambia study regarding the effectiveness of the WASH UP! curriculum. Students and teachers uniformly enjoy the program, and evidence points to considerable "stickiness" of several key messages despite a lower-than-expected proportion of the sessions being completed. It also seems that the charge embedded within the WASH UP! program to carry health behavior messages to family members and peers was heard and acted upon by teachers and at least some students. Given the widespread interest in such 'child as change agent' models both within and outside the WASH sector, we are excited about the possibility of developing this theme further in the future.

The Zambia study also generated important lessons for the design of future research. For example, we found it much harder than expected to characterize exposure to WASH UP! at the individual student level. Additional effort is needed on this front if we are to continue with a repeated measures design; otherwise, the full benefits of collecting panel data cannot be realized. We also saw the importance of using direct observation, rather than just self-report, to generate data related to key WASH behaviors. Going forward we should prioritize strategies that can produce reliable information in a more continuous manner (*i.e.*, between visits of the field team), given some evidence in Zambia of strategic bias and 'coaching' of children during interview periods.

If World Vision and Sesame Workshop continue to be interested in tracking the impact of WASH UP! on knowledge, attitude, and behaviors of students' family members, similar efforts are needed to identify routine, cost-effective data-collection strategies from households. Household data are also important for evaluating health outcomes, because a child's home environment may have quite different exposure risks and degree of enabling environment relative to the school setting. In-person visits are thus clearly preferable in terms of being able to collect direct observation data (e.g., the type and quality of water, sanitation and hygiene infrastructure at home). We may also be able to utilize short SMS-based surveys to obtain some less nuanced data on a more frequent basis (e.g., whether a parent received a boundary object from his/her child).

As has been made clear throughout this report, the primary goal of the study was "learning to learn," i.e., developing and testing data-collection approaches for future WASH UP! impact research. We also sought to generate some preliminary data that could be used for future funding proposals. Both objectives were met. Study findings must be interpreted

cautiously, however, and with reference to the particular caveats associated with each type of result. Study limitations include the above-referenced absence of managed experimental features and implementation-related challenges for WASH UP!, as well as the non-random selection of schools and classrooms and reliance on self-reported data for several important constructs. We have endeavored throughout the report to avoid the use of statistical tests where the underlying data do not satisfy required assumptions, and we encourage readers to view individual findings as illustrative rather than representative or quantitatively meaningful.

A final important value of the Zambia pilot is setting the foundation for a collaboration that will continue to generate and share rigorous evidence from WASH UP! implementation with the broader sector. We appreciate World Vision's and Sesame Workshop's commitment to probing more and less successful dimensions of the WASH UP! program, developing and testing potential enhancements and solutions in partnership with Stanford, and disseminating the results widely. Such efforts are critical for increasing the adoption of successful approaches and, ultimately, amplifying the impact of school-based WASH interventions.

17) Annex 1: Conceptual causal model for WASH UP! (May 2016)

This conceptual causal model was generated through a series of semi-structured interviews of World Vision and Sesame Workshop staff by members of the Stanford research team. It was subsequently used to ground the development of research questions and hypotheses, and then as a framework for creating data-collection instruments that would allow us to collect valid and relevant data to answer those research questions.

Input/Treatment

(1) 12-week curriculum
   a. Weekly sessions
   b. Participants aged 6-9 years (grades 1-4)
   c. After school health/ nutrition/WASH club with lead teacher
   d. 7th/8th grade "helpers"

(2) Raya character

(3) Activity based learning
   a. Storybook
   b. Games
   c. Floormat & activities
   d. Videos
   e. Homework assignments

(4) Training
   a. Teachers
      i. Initial 3-day training
      ii. Training manual

(5) Buy-in process
   a. Ministries
   b. Community leaders

(6) Teacher support
   - WASH UP! facilitator guide
   - World Vision WASH UP! coordinator and ADP WASH staff

Outputs

- # schools provided curriculum
- # teachers trained
- # students completing the program
- # others engaged (CHW, parents, etc.)
- *Others?*

1A. WASH-related outcomes

Child-focused WASH outcomes

- Student can identify "good" WASH behavior as defined by WASH UP! program, AND student is motivated to practice "good" WASH behavior correctly and consistently (e.g., because of cause/effect understanding, desire for affiliation, etc.) → Student practices good WASH behaviors regularly
    - Key assumptions: Student's environment is conducive to practicing "good" WASH behavior correctly and consistently (e.g., water and soap are available, toilet is available and functioning)
- Student is empowered/encouraged to share WASH knowledge → Student shares WASH knowledge with peers at school → Student-informed peer can identify "good" WASH behavior as defined by WASH UP! program→ Student-informed peer is motivated to practice "good" WASH behavior correctly and consistently (e.g., because of cause/effect understanding, desire for affiliation, etc.) → Student-informed peer practices good WASH behaviors regularly
    - Key assumptions: Student communicates messages consistent with WASH UP! program (i.e., message distortion is minimal)

Teacher-focused WASH outcomes

- Teacher can identify "good" WASH behavior as defined by WASH UP! program AND teacher is motivated to practice "good" WASH behavior correctly and consistently (e.g., because of cause/effect understanding, desire to model for students, etc.) → Teacher practices good WASH behaviors regularly
    - Key assumptions: School environment is conducive to practicing "good" WASH behavior correctly and consistently (e.g., water and soap are available, toilet is available and functioning)

Household- and community-level WASH outcomes

- Student is empowered/encouraged to share WASH knowledge → Student shares WASH knowledge with caretakers and siblings at home → Student-informed family members can identify "good" WASH behavior as defined by WASH UP! program→ Student-informed family members are motivated to practice "good" WASH behavior correctly and consistently → Student-informed family members practice good WASH behaviors regularly, AND parents invest in improved WASH services for household
    - Key assumptions: Student communicates messages consistent with WASH UP! program (i.e., message distortion is minimal); Student's promotional behavior within his/her family is permissible with respect to cultural norms

- Factors that could influence causal pathway include: Gender (of student, siblings, 'target' parent(s)); age (student versus siblings/caretakers); baseline household WASH situation (e.g., existence of reliable water supply, toilet); poverty (ability of parents to invest in WASH-related improvements)

- Student can identify "good" WASH behavior as defined by WASH UP! program, AND student is motivated to practice "good" WASH behavior correctly and consistently (e.g., because of cause/effect understanding, desire for affiliation, etc.) → Student practices good WASH behaviors regularly → Students develop habits associated with good WASH behaviors that are cemented as long-term practices

1B. WASH-related impacts

Short- to medium-term

- Students and teachers practice "good" WASH behaviors regularly → Level of fecal contamination in schools and homes of participating teachers and students is reduced, AND Level of fecal contamination on hands of participating teachers and students is reduced → Exposure to fecal pathogens by students and teachers is reduced → Incidence/prevalence of diarrheal illness among participating teachers and students is reduced → Incidence/prevalence of diarrheal illness among family and community members with whom participating teachers and students interact regularly is reduced → Rates of child mortality from diarrheal illness in participating communities is reduced
    - Key assumptions: A substantial share of diarrheal pathogen exposure can be prevented by adoption of "good" WASH behavior as defined by WASH UP! program
- Expenditure on health care, AND frequency of missed school/work, attributable to diarrheal illness among households with participating students and teachers is reduced

Longer term

- Reduced exposure to fecal pathogens→ Rate of child malnutrition and stunting in participating communities is reduced → Rate of child cognitive impairment associated with fecal pathogen exposure in participating communities is reduced → Boys' and girls' educational attainment in participating communities increased → Employment opportunities expanded → Income increases → Wealth increases → Well-being improves
    - Key assumptions: Most/all of extant malnutrition/stunting can be prevented by reducing exposure to fecal pathogens; returns to education (e.g., expanded employment opportunities) exist
- Students develop habits associated with good WASH behaviors that are cemented as long-term practices → Strong community norms regarding sanitation practices established and enforced

2A. Education-related outcomes

Direct child-focused educational outcomes

- Students find WASH UP! curriculum engaging and fun → Students are motivated to attend school on WASH UP! days → Absenteeism among participating students is reduced
    - Key assumption: Students who desire to attend school are not precluded from doing so by forces beyond their control
- Students find WASH UP! curriculum engaging and fun → Students gain additional practice with reading and writing → Reading comprehension, reading aloud, and writing performance among participating students improves
    - Key assumption: Students have adequate time and supervision with WASH UP! materials to allow skills development

Indirect child-focused educational outcomes

- Incidence/prevalence of diarrheal illness among family and community members with whom participating teachers and students interact regularly is reduced → The demand for older (particularly girl) siblings to care for ill younger siblings is reduced → School absenteeism among older (particularly girl)
    - Key assumption: Older (particularly girl) siblings miss school in order to take care of younger children with diarrheal and/or respiratory illness

Other educational outcomes

- Teachers find WASH UP! curriculum engaging and teaching tools/strategies useful for non-WASH subjects → Teachers derive greater satisfaction from their jobs → Rate of teacher retention in participating schools increases

2B. Education-related impacts

Medium- to long-term

- Absenteeism is reduced AND Reading/writing performance improves among participating students → Boys' and girls' educational attainment increased→ Employment opportunities expanded → Income increases → Wealth increases → Well-being improves
    - Key assumptions: Students who desire to attend school are not precluded from doing so by forces beyond their control; returns to education (e.g., expanded employment opportunities) exist

- Rate of teacher retention in participating schools increases → Quality of teaching improves → Boys' and girls' educational attainment increased → Employment opportunities expanded → Income increases → Wealth increases → Well-being improves
    - Key assumptions: Teacher retention is positively associated with educational outcomes; returns to education (e.g., expanded employment opportunities) exist

3A. Gender-related outcomes

- Engagement with the character of Raya enhances girl students' perceptions of their own intellectual ability, self worth, and societal value (i.e., increased agency)→ Girl students feel capable of and entitled to a high-quality education → Girl students invest time and effort in their schoolwork, AND girl students gain confidence in asking questions/making demands of their teachers
- Engagement with the character of Raya enhances boy students' perceptions of girl students' intellectual ability and societal value→ Girl students are seen as intellectual equals by boy students → Boy students have greater respect for girls → Young men have greater respect for young women → Gender-related biases in extra-curricular settings (e.g., civic life, economic sphere) decreases
- Engagement with the character of Raya enhances teachers' perceptions of girls' intellectual ability and societal value→ Gender-related bias in teaching practices is reduced
- Curriculum requires collaboration between students and parents → Girl students present WASH UP! materials to, and/or cooperate on assignments with, parents → Parents' perception of girl students' intellectual ability increases → Parents' commitment to girls' education increases

3B. Gender-related impacts

- Girl students invest time and effort in their schoolwork, AND girl students gain confidence in asking questions/making demands of their teachers → Boy-girl educational attainment gap is reduced → Girls' opportunities for self-actualization are expanded → Girls'/women's engagement in civic life increases → Women attain greater power and status in their communities → Rates of gender-based violence decrease
- Gender-related biases in extra-curricular settings decreases → Women are increasingly seen as equals in social and political sphere → Girls' /women's engagement in civic life increases → Women attain greater power and status in their communities → Rates of gender-based violence decrease AND opportunities for self-determination among women expand
- Gender-related bias in teaching practices is reduced → Boy-girl educational attainment gap is reduced → Girls' opportunities for self-actualization are expanded →

Girls'/women's engagement in civic life increases → Women attain greater power and status in their communities → Rates of gender-based violence decrease AND opportunities for self-determination among women expand

- Parents' commitment to girls' education increases → Boy-girl educational attainment gap is reduced → Girls' opportunities for self-actualization are expanded → Girls'/women's engagement in civic life increases→ Women attain greater power and status in their communities → Rates of gender-based violence decrease AND opportunities for self-determination among women expand

4. Research questions and hypotheses of potential interest

Causal mechanisms

- How are the behaviors promoted by WASH UP! actually internalized by children experiencing the program? For example, are they viewed as part of a cause-effect relationship (e.g., dirty hands = illness)? As practices of 'good,' 'decent,' 'popular,' etc. children (motivated by affiliation desires)? As rituals? What are the implications of these different possible cognitive frames for children's motivation and ability to (1) practice the behaviors correctly and consistently over time, and (2) make decisions about non-targeted behaviors that still have a connection to WASH? (JD)

Health

- To the extent that the WASH UP! intervention reduces exposure to fecal pathogens among teachers and students, what is the relative contribution of different exposure pathways (*e.g.*, drinking water, hands, surfaces) to this benefit? (JD)
- How does baseline nutritional status mediate the cause-effect relationship between reduced exposure to fecal pathogens and child health outcomes? (JD)

Education

- How can the effectiveness of the WASH UP! curriculum delivery by teachers best be measured? (This seems important, as teaching effectiveness is likely to mediate the cause-effect relationship of exposure to the program and outcomes of interest.) (JD)
- Is there any way to unpack the WASH UP! curriculum elements in order to assess which among them are particularly effective in (1) teaching new concepts, (2) cementing familiar concepts, and (3) increasing student self-efficacy vis-à-vis good WASH behaviors? (JD)
- Under what conditions do children effectively transmit health-related messages learned at school to 'non-exposed' peers (and siblings, and parents) in a way that results in the target individual internalizing and retaining those messages? ('Conditions' likely include but are not limited to age and gender of messenger/target 'non-exposed' individual; message form and content; relevant sociocultural norms; extent to which the school system is viewed as a source of credible information) (JD)

- Related hypothesis: Messages that are transmitted using a 'boundary object' (loosely, a physical object that communicates specific ideas, information, or concepts, yet whose interpretation can vary across individuals) will be more effectively taken up by targets than messages conveyed without the use of boundary objects.

Gender

- Are particular elements of the WASH UP! curriculum particularly effective in (1) teaching new concepts, (2) cementing familiar concepts, and (3) increasing student self-efficacy vis-à-vis good WASH behaviors for boys *versus* girls? (JD)

Economic development

- What is the relevant timeframe over which to assess the impact of decreased burden of diarrheal disease on economic development (assuming the causal pathways articulated in the prior sections)? (JD)

18) Annex 2: Project timeline

October 2016	Human subjects protocol to Stanford Institutional Review Board and relevant Zambian institution(s)
October- November 2016	Data-collection instruments drafted (SU), reviewed by WV/SW, finalized, and translated into local language. Surveys coded onto tablets (SU). Plans for study discussed with WV-Zambia country staff. Plans for hiring enumerators established with WV country staff. Preliminary interviews with enumerator candidates conducted (WV-Zambia and SU). Pilot interviews with children, parents, and teachers conducted (SU).
May 2017	Enumerators contracted (WV-Zambia). Enumerator training, including additional pilot testing of baseline instruments (SU with WV-Zambia support). WASH UP! teacher training conducted (SW with WV-Zambia support). Baseline data collected (SU with WV-Zambia support).
May-July 2017	Roll out of WASH UP! program in sample schools (School staff).
September 2017	Enumerators contracted (WV-Zambia). Refresher training for enumerators conducted (SU). Midline data collected (SU with WV-Zambia support).
October 2017 -April 2018	Periodic follow-up visits to schools for WASH infrastructure spot checks
June-July 2018	Enumerators contracted (WV-Zambia). Refresher training for enumerators conducted (SU). Endline data collected (SU with WV-Zambia support).

19) Annex 3: Supplementary information on sample frame

Table 3A: Number of student respondents interviewed, by grade, gender, school and data-collection period

	Baseline					Midline					Endline				
	Total	Grade 1	Grade 4	Male	Female	Total	Grade 1	Grade 4	Male	Female	Total	Grade 1	Grade 4	Male	Female
Chimonselo	68	32	36	34	34	46	18	28	23	23	41	15	26	19	22
Kanchindu	55	34	21	24	31	38	23	15	17	21	41	28	13	17	24
Makonkoto	64	28	36	24	40	36	14	22	11	25	42	19	23	17	25
Mweezya	35	14	21	12	23	34	13	21	11	23	26	11	15	9	17
Ngoma	56	26	30	29	27	51	23	28	24	27	48	23	25	23	25
Nkandabbwe	79	38	41	35	44	65	30	35	30	35	66	30	36	34	32
Siatwiinda	76	42	34	42	34	46	21	25	25	21	58	31	27	30	28
Sikalamba	62	33	29	30	32	57	33	24	33	24	39	24	15	15	24
Sikaneka	66	46	20	33	33	50	34	16	29	21	7	4	3	6	1
Sinakasikili	16	10	6	10	6	12	7	5	6	6	69	39	30	36	33
Sinazeze	90	49	41	47	43	74	39	35	41	33	68	25	43	32	36
Syamuyala	94	40	54	44	50	75	28	47	31	44	505	249	256	238	267
Total	761	392	369	364	397	584	283	301	281	303	1010	498	512	476	534