Handwashing with Ananse

Evaluating the Effectiveness of A Game-Based Handwashing Curriculum to Generate Learning and Behavior Change

PREPARED BY

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Acronyms

mCAPI	Mobile Computer Assisted Personal Interviewing
CBO	Community-based Organization
DHS	Demographic and Health Survey
DID	Difference-in-differences
HWWS	Handwashing with water and soap
ICH	Institute for Community Health
IRB	Institutional Review Board
ITS	Interrupted Time Series
OR	Odds Ratio
WASH	Water, sanitation, and hygiene

Acknowledgements

Handwashing with Ananse was co-designed by the Engagement Lab at Emerson College, UNICEF Ghana, Ghanaian Red Cross Society, Ghanaian Educational Service, Right to Play Ghana, and the Red Cross Red Crescent Climate Centre. Primary school children in Ghana helped design the curriculum by playing several iterations of the curriculum's games and stories and providing feedback throughout the design process.

The evaluation of Handwashing with Ananse involved several stakeholders, including the Engagement Lab, Institute for Community Health (ICH), TNS Ghana, and Right to Play Ghana. The Engagement Lab acted as the main evaluating agency. ICH designed evaluation instruments and provided data analysis and training of field workers, while TNS Ghana implemented data collection in the field. The Red Cross/Red Crescent Climate Centre also assisted in the qualitative analysis of focus group discussions. Right to Play Ghana provided trained facilitators to implement Handwashing with Ananse within intervention schools. UNICEF Ghana provided funding for the evaluation and gave overall guidance on the evaluation's design and implementation.

We thank all students, teachers, and school administrators who helped design Handwashing with Ananse and who participated in the study to evaluate its outcomes.

Executive Summary

Handwashing with Ananse is a modular, four-week game-based curriculum for 7-11 year old children that teaches children why, how, and when to wash their hands with water and soap. The curriculum is organized by an overarching narrative, wherein students compete to outsmart Ananse the Spider. Throughout the four-week lesson plan, students are exposed to traditional Ghanaian storytelling, song, dance, and games to orient them to the subject. In the traditional fable of Ananse the Spider, Ananse steals all of the wisdom in the world and hides it in a pot, which then breaks and the wisdom goes back into the world. In Handwashing with Ananse, children are told that not all of the wisdom escapes and that Ananse hid the handwashing knowledge in his pockets. The curriculum challenges children to do activities that allow them to "break" Ananse's pockets and let the wisdom back into the world.

Evaluation

The purpose of this evaluation was to identify whether Handwashing with Ananse is effective in generating learning and behavior change. The study included 20 schools from two districts in Central region of Ghana and one district in Eastern region of Ghana. The curriculum was facilitated in 10 intervention schools between 9 and 30 March 2017, and 10 additional schools, which did not receive the curriculum, were used as a comparison group. Schools were randomly assigned to groups. Lack of handwashing infrastructure was a criteria for inclusion in the study. All 20 schools were equipped with two Tippy Tap stations with two Tippy Taps each prior to baseline. Outcomes were evaluated at baseline, two weeks post-intervention (posttest 1), and 15 weeks post-intervention (posttest 2). Measurements included surveys delivered orally to children, structured observations of Tippy Taps, structured observations of the curriculum being implemented, focus group discussions immediately following intervention in the treatment group, and sensors and cameras mounted to Tippy Taps to count handwashing events.

Handwashing with Ananse has shown to be an effective intervention in several important ways: changes in knowledge, attitudes, and behavior led to a significant decrease in self-reported illness of 8.2% more than the comparison group at posttest 2. The significant decrease in reported illness in the intervention group, as opposed to the comparison group that received only handwashing infrastructure, is the most promising finding. It can be explained by looking at several key positive indicators.

Knowledge

The study demonstrates a significant increase in knowledge of how to HWWS. As demonstrated in previous HWWS studies, knowledge of HWWS tends to be quite high, making it difficult to show significant changes. And while Handwashing with Ananse did not seem to have an impact on knowledge around When and Why to handwash, it did demonstrate impact on knowledge of How to handwash. This is likely due to the interactive and playful nature of the curriculum, where details of how to handwash were embedded into song and games. The nuance of how to handwash can easily get lost in more traditional approaches.

Children compete to outsmart Ananse the Spider, who has hidden all the handwashing knowledge in his pockets.

Attitudes

Ananse motivated significant peer-to-peer learning, with significantly more children in the intervention group talking to peers and family about handwashing at both posttests [DID: 8.6% at posttest 1 (p=0.034) and 9.7% at posttest 2 (p=0.015)]. Children were eager to share what they learned and to communicate their positive attitudes about handwashing with peers. Children in all focus groups mentioned positive emotions toward the songs, dances, and games from Handwashing with Ananse, which likely served as another subconscious motivator for behavior change. Children were most likely to share what they learned with siblings and friends outside of school, either because they wanted to prevent sickness, or because they wanted to enjoy playing the activities with others. They most often mentioned sharing the "water and soap" song with others. Again, this is a direct result of the nature of the intervention, where being immersed in the narrative of Ananse over several weeks motivated the children to share their experience. They were eager to bring people into the narrative they were experiencing and share with them their victories of defeating the mischievous spider. Observations of gameplay and focus groups showed that children who participated in Handwashing with Ananse continued to learn from each other in informal settings, sharing information about handwashing during and after lessons, both in and out of school. The survey did not show a significant increase in children reporting they wash their hands at school at the same times each day. However, video and Tippy Tap observations, which show an increase in handwashing behavior, suggest participants began to establish handwashing routines in school by handwashing during break times.

Behavior

Children in the intervention group practiced HWWS significantly more than those in the comparison group, and also improved observed handwashing quality over the comparison group. The intervention group reported HWWS before eating, before cooking, and after toilet use 5.1% more of the time than children in the comparison group at posttest 1 (p=0.000) and 3.9% more of the time at posttest 2 (p=0.000). Tippy Tap observations also showed a comparative increase in HWWS before eating and after toilet use in the intervention group. Videos show a significant level shift (p=0.002) in HWWS in the intervention group two months after the start of the intervention. The video data provides important texture to traditional measures, shedding light on the challenges of providing consistent infrastructure and ensuring access over time. At posttest 1, 83% of intervention schools and 33% of comparison schools showed an improvement in HWWS quality, and at posttest 2, 50% of intervention schools and 38% of comparison schools showed an improvement in HWWS quality.

Handwashing with Ananse motivated behavior change, but certain factors in the study likely contributed to behavior change as well. The study provided access to soap and water in a school environment supportive of handwashing behavior. Without a positive enabling environment, behavior change is not possible. Provision of Tippy Taps also likely served as a reminder to wash hands. While the study did include a washout period to account for any large increase in handwashing from the novelty of Tippy Taps, the presence of Tippy Taps likely continued to encourage handwashing. Adequate soap and water access, and visual cues and reminders to handwash with soap, are all key to behavior change. The evaluation documented in this report attempts several new methodological approaches, including video cameras and motion sensors mounted on Tippy Tap handwashing structures. While this method is experimental and therefore imperfect in its implementation, it sets this study apart from other HWWS evaluations. The hard measure of handwashing behavior provides additional evidence of the intervention's impact.

Long-Term Impact

The study did not show a significant comparative increase in soap access at home for children who participated in Handwashing with Ananse. For children who participated in Handwashing with Ananse, there was a decrease in self-reported illness of 8.2% more than the comparison group at 15 weeks post-intervention. This, in combination with the significant increase in handwashing behavior, suggests a positive additive effect of implementing Handwashing with Ananse in schools with existing handwashing infrastructure.

Recommendations

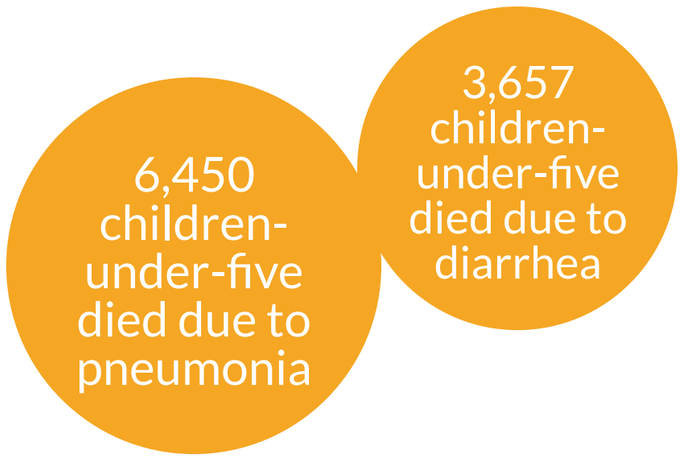
Handwashing with Ananse should be considered for wider implementation, but certain factors should be considered before scaling up. Handwashing with Ananse cannot be effective if children do not have regular access to soap and water, both in and out of school. The curriculum should be implemented in schools with existing infrastructure, or should be accompanied by the installation of Tippy Taps. Finding a way for the curriculum to reach adults outside of school should also be considered, to provide a supportive environment for behavior change at home. The curriculum, while easy to follow along in storybooks, also requires trained facilitators, and should be scaled with clear and simple instructions for facilitators. While this study focused on in-school implementation, scale-up should also consider facilitation by community-based organizations (CBOs).

Context

Diarrheal diseases and acute respiratory infections such as pneumonia are the two leading causes of death in children ages one month to five years worldwide, resulting in about six million deaths in children-under-five each year. In 2015 alone, approximately 10,000 children-under-five died from diarrhea and pneumonia in Ghana [1]. Handwashing with soap and water (HWWS) is a low-cost, highly effective method for preventing illness and death from diarrheal and respiratory diseases. HWWS can reduce the risk of respiratory infections by 6 to 44% and reduce the risk of diarrhea by about 30% [2,3]. However, according to the 2014 National Demographic and Health Survey (DHS), only 39% of households in Ghana had water and soap (46% urban households, 29% rural households) [4].

Handwashing with Ananse seeks to increase awareness and practice of HWWS by providing children an interactive and playful way to learn about handwashing, share what they learn with peers and family, and increase their practice of HWWS.

In 2015 in Ghana, approximately 54,000 of 3.7 million children-under-five died



Evaluation Purpose: Is Handwashing with Ananse Suitable for Scale-up?

UNICEF Ghana, the Ghanaian Red Cross Society, and the Ghanaian Educational Service are interested in whether the curriculum, or specific components or it, is suitable for scale-up in primary schools across Ghana. A quasi-experimental, mixed-methods study sought to determine whether Handwashing with Ananse has a direct, measurable impact on the knowledge, attitudes, and handwashing behavior of participating children at 2 weeks post-intervention and 15 weeks post-intervention. The evaluation included 20 schools from two districts in Central Ghana and one district in Eastern Ghana from October 2016 through July 2017. Right to Play Ghana implemented the curriculum in 10 intervention schools between 9 and 30 March 2017.

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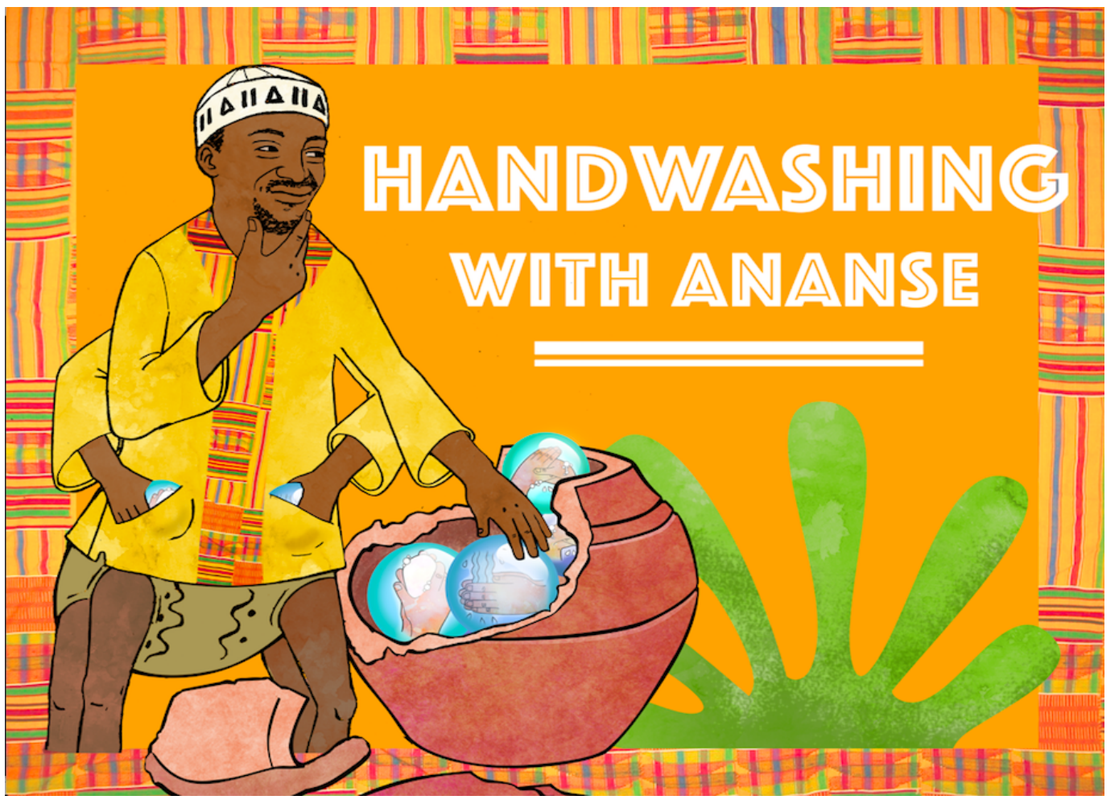
3. Ejemot-Nwadiaro, Regina I, Ehiri, John E, Arikpo, Dachi, Meremikwu, Martin M, Critchley, Julia A. Hand washing promotion for preventing diarrhoea. Cochrane Database Syst Rev [Internet]. 2015 Sep [cited 2017 Oct 31];9(CD004265). Available from: http://onlinelibrary.wiley.com.ezproxy.bu.edu/doi/10.1002/14651858.CD004265.pub3/full

4. Ghana Statistical Service, Ghana Health Service, ICF International. Ghana Demographic and Health Survey 2014. Rockville, Maryland, USA: GSS, GHS, ICF; 2015 Oct.

The Intervention

In the traditional fable of Ananse the Spider, Ananse steals all of the wisdom in the world and hides it in a pot, which then breaks and the wisdom goes back into the world. In Handwashing with Ananse, a four-week game-based curriculum designed for 7-11-year-old children in Ghana, children are told that not all of the wisdom escapes and that Ananse hid the handwashing knowledge in his pockets. The curriculum challenges children to do activities that allow them to "break" Ananse's pockets and let the wisdom back into the world.



Materials Required:

- Printed storybook
- Sticks and stones
- Clean water
- Bar of soap
- Pail or bowl for dirty water
- Cup or container to pour water

Resources

- 1-2 facilitators to lead 20-30 children at a time
- 2-hour session per week for 4 weeks

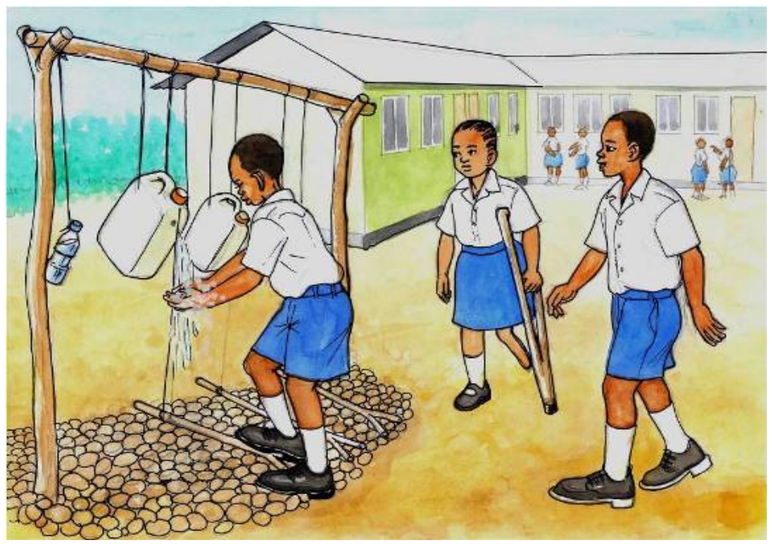
In each weekly two-hour session, children hear a story about Ananse, then play a game based on the story. Facilitators encourage children to sing and dance along with the story. When each lesson concludes, the facilitator asks children to complete playful challenges which will break Ananse's pockets before the next week, such as handwashing at correct times or teaching others a song from the curriculum.

Chapter 1: WHY to Handwash with Soap

Chapter 2: HOW to Handwash with Soap

Chapter 3: WHEN to Handwash with Soap

Goal: Create a playful context for children to learn about handwashing for the duration of the curriculum.



Handwashing Infrastructure: Tippy Taps

All 20 schools in the study were supplied with two Tippy Tap stations constructed from metal, jerrycans, and string. One was placed outside near an eating area, and the other outside near the school's toilet. Each station supported two jerrycans and two bars of soap. Volunteers refilled water and soap throughout each school day. Tippy Taps were installed months prior to data collection to allow any immediate increase in handwashing due to the presence of new handwashing stations to subside.

Objectives

This evaluation's purpose was to determine whether Handwashing with Ananse has a direct measurable impact on the handwashing behavior of 7-11 year old children in Ghana, and therefore to ascertain whether the intervention, or a specific component of it, is particularly suitable for scale-up. The objectives included:

Objective #1

Participation in the curriculum increases knowledge and retention of the importance of HWWS among participating children.

- 1.1 Do participants have a better understanding of the critical times to HWWS and the correct method to HWWS?
- 1.2 Do participants have a greater understanding of the importance of basic healthy behaviors?
- 1.3 Are participants able to speak about the health risks of not HWWS?
- 1.4 When asked to recall content, are participants more likely to communicate content through personal narratives of gameplay?
- 1.5 Do participants make associations between game actions and moral dilemmas that they have faced in their personal lives?

Objective #2

Participation in the curriculum increases the frequency and propensity for participants to tell their peers about HWWS (peer education).

- 2.1 Do participants learn from each other in informal contexts about the health benefits of HWWS?
- 2.2 Do participants begin to establish routines in school that normalize HWWS behaviors?
- 2.3 Do participants talk to their peers about HWWS at a greater rate than non-participants?
- 2.4 Do participants talk to their families about HWWS at a greater rate than non-participants?

Objective #3

Participation in the curriculum increases the adoption of good HWWS practices.

- 3.1 Do participants HWWS at critical times at school more often than non-participants?
- 3.2 Do participants use proper HWWS technique more often than non-participants?

Objective #4

Participation in the curriculum decreases diarrheal and respiratory illness among participating children and increases their access to soap for handwashing.

- 4.1 Are participants less likely to experience symptoms of diarrheal and respiratory infections?
- 4.2 Are participants more likely to have access to soap post-intervention?

Evaluation Methodology

Researchers evaluated the curriculum with children ages 7 to 11 years in 20 primary schools (10 urban, 10 rural schools) from two districts in Central Ghana and one district in Eastern Ghana. Schools were randomly selected from a group of schools that met the following criteria:

- Student population is no more than 250 students
- School does not have handwashing facilities (i.e. functioning clean water source and availability of soap and availability handwashing facility such as veronica bucket, basin, or tap)
- No other handwashing programs were implemented in the school within the last two years

Data Collection Methods and Tools

Outcomes were measured with surveys administered orally to children, structured observations of Tippy Taps, measurements of weekly soap use at schools, video observations of Tippy Taps, and focus groups with children in the intervention group. Curriculum observations and Tippy Tap observations also measured fidelity to the intervention's implementation. Data collection tools are described in further detail below.

Curriculum Observations

- Data collector visits alternating classrooms to observe lessons and games in action and rates faithfulness with which each lesson was implemented
- Records student engagement, enjoyment, and confusion

Weekly Soap Measurement

- Weekly soap use (grams) measured by trained volunteers
- Daily soap use by child calculated as the average daily number of grams of soap used at the school throughout the month, divided by the baseline enrollment of children at the school

Survey with Children

- Students randomly selected from each age group
- 20 questions on handwashing knowledge, attitudes, and behavior
- Responses limited to yes/no, true/false, or scale of <5 options; introduced in specific order to mitigate social desirability bias
- Data collector administers survey verbally one-on-one with each student
- Students answer verbally and the data collector directly enters their response into a tablet pre-loaded with the survey using mobile Computer Assisted Personal Interviewing (mCAPI) software

Structured Observation of Tippy Taps

- Data collector sits in view of 1 Tippy Tap for 4-5 hours, twice, about one week apart, at each school
- Records students' adherence to correct handwashing technique, handwashing frequency before eating and after toilet use, Tippy Tap condition

Video Observation of Tippy Taps

- Motion-activated video camera placed at 90-degree angle above 1 Tippy Tap per school
- Field of view captures hands, arms, soap, and jerrycans
- Captures 30-second, 640x480 resolution videos on SD card until motion ends
- Records handwashing attempts

Focus Groups in Intervention Schools

- Two one-hour focus groups per intervention school; (Classes 1-3 and Classes 4-5).
- Conducted in local language by 1 facilitator and 1 notetaker
- Captures children's perceptions of the curriculum, understanding of key lessons, and sharing of content with friends and family

Data Analysis

Detecting an increase in both knowledge and favorable attitudes from 85% to 90% in the intervention group required a survey sample of 1,000 students at each time period, assuming the following conditions:

- Baseline knowledge and favorable attitudes: 85%
- Expected increase in knowledge and attitudes: 85%-90% (OR=1.59) in the intervention group, and no increase in the comparison group
- Type I error: 0.05, two-sided comparison
- Power: 80%
- Intraclass correlation (ICC): 0.04
- Intervention:comparison odds ratio (OR): 1 in the pre-period and 1.59 in the post-period

For measuring handwashing behavior, we used a simulation-based method to estimate power and sample size for time series studies, focusing on autoregressive (AR) error models. Detecting an increase in observed handwashing at key events with an effect size of 1.0 required a minimum of 100 observations of HWWS over 12 time points across all 20 schools both pre- and post-intervention. This assumed the following conditions:

- Effect size = (expected level change) + (monthly trend change)/ standard deviation
- Effect size based on similar intervention that increased HWWS from 1% (SD=1%) to 19% (SD=21%) in the intervention group, and 2% (SD=1%) to 4% (SD=2%) in the comparison group (effect size Cohen's d=1.01)
- 20% of the change will come from a change in level
- 80% of change will come from a change in trend
- Autocorrelation: 0.6
- 80% power to detect an effect size of 1.0

Survey data was analyzed in SAS and STATA. Focus group data was coded and analyzed by two researchers using Dedoose, a mixed methods analysis tool. Structured observations were analyzed in MS Excel. Videos were analyzed using an interrupted time series (ITS) approach, estimating an ordinary least squares (OLS) regression model of handwashing by hour and school, to identify the change in level and trends of handwashing due to the intervention. Handwashing was defined as the number of handwashing attempts per hour. In order to standardize this by size of school, we divided handwashing events by the number of students in each school. Also, to standardize the contribution of data from each school to the treatment vs. comparison group analysis, we developed poststratification probability weights that allowed each school to contribute an equal number of hours to the analysis in the pre- and post-periods. We compared handwashing rates and differences in trend and level shifts between the treatment and comparison schools. Soap measurements were also analyzed using an ITS model.

Study Sample

Stratified random samples were conducted at each time period as opposed to following students over time given anticipated difficulties with follow-up. The survey sample was randomly selected from classes KG2 through five, and is equally distributed by age, gender, urban/rural location, and intervention/comparison group. The sample included 1,217 children at baseline; 1,211 children at posttest 1; and 1,220 children at posttest 2. There were no statistically significant differences in sample demographics between intervention and comparison groups at baseline, and no significant differences in demographics between baseline and each of the two posttests.

Video Analysis

The cameras recorded 54,839 30-second videos over the study period across all schools. Video data was cleaned and sorted so that only videos of attempted handwashing events were analyzed. Trained observers scrubbed through videos in fast-forward mode, but when a video's content was unclear, observers watched it in real time. If the subject clearly used soap and/or water for handwashing, the video was kept in the dataset. The pre-period includes 767 hours of video recorded from 6 February to 9 March and the post-period includes 1055 hours of video recorded from 10 May to 19 June. Removing videos that were not of attempted handwashing reduced the dataset to 23,159 videos.

Limitations

1. Occasional lack of soap or water mainly due to reasons outside of schools' control

Some children self-reported in the survey that they did not always have access to soap at school. However, they may have misunderstood the meaning of having soap access "at all times," such as not having soap during class hours. There was no statistically significant difference in self-reported soap access at school between intervention and comparison groups. Tippy Tap observers reported there was always enough water and soap at all three time points in comparison schools, except for one observation at posttest 1 of a comparison school that reported there was sometimes soap. Animals sometimes tampered with the Tippy Taps; for example, a few videos show goats eating the soap. During heavy rain, the area around Tippy Taps became very muddy and may have affected use. However, this likely did not greatly affect use.

2. Queues and line abandonment may indicate two Taps not enough

Observations in all schools showed more students over time waiting "Most/All" or "Some" of the time in line to use Taps and some abandonment of Taps due to queues. Some observers suggested children had to wait in line because there were not enough handwashing stations for children to HWWS. Some children jumped the queue to wash their hands from behind the Tippy Tap. This typically only happened during busy school break periods and times when children gathered to eat.

3. Student confusion around wording of survey questions

It is possible that children found some survey questions confusing or misleading. Survey questions included the word "always" for questions on when one had to HWWS to try to avoid confusion around times it is necessary to HWWS versus times to HWWS just because hands appear dirty. It appears that children likely didn't understand this nuance. This confusion was also likely present for the question on having access to soap "all the time" at school.

4. Camera set-up and malfunction effect on video counts

If on certain days the camera was placed incorrectly on the Tippy Tap (e.g., backwards, rotated, etc.), the camera's field of view may have limited HWWS counts. Video observations may have underestimated HWWS counts if people who were handwashing were out of frame, or may have overestimated HWWS counts if the same children were present for multiple videos and/or re-washed with soap multiple times within a couple of minutes. This did not happen often enough to severely affect results. A few of the cameras also malfunctioned on certain days, particularly at follow-up, and produced discolored, zoomed-in footage that could not be used for HWWS counts. While these cameras are meant to record outside for prolonged periods, in general, camera breakdown was more common at follow-up and in a few schools, camera and battery breakdown resulted in not all schools have the minimum 12 days of data required for the ITS design.

5. Limitations of Interrupted Time Series (ITS) Design

ITS designs require a minimum number of observations pre- and post-period. Because of variations in the ability of cameras at each school to record quality video data, two schools were eliminated from the ITS analysis because we did not have sufficient data. Seasonality could also bias results from the ITS design, such as if rainy season affected use of Tippy Taps in schools, but we expect this effect to be distributed fairly equally across schools. Finally, it is also important to note that the ITS design does not provide individual level outcomes. In other words, while we can describe changes in handwashing at the school population level, we cannot infer whether children are more likely to handwash after the program on an individual basis (i.e., ecological fallacy).

Findings

Curriculum Implemented with High Fidelity

Handwashing with Ananse lessons and games were implemented with very high fidelity. Observers rated facilitator enthusiasm, children's engagement, and children's enjoyment as very high for all lessons and games. Observers also rated children's confusion as very low. In all focus groups, children mentioned positive emotions towards the curriculum.

"The game was a lot of fun such that i can still feel the joy"

Objective #1

Participation in the curriculum increases knowledge and retention of the importance of HWWS among participating children.

WHY to Handwash

At baseline, over 94% of the sample correctly answered that germs make people sick. There was no significant change over time. Knowledge that germs are too small to see with the naked eye also did not significantly change in the intervention group compared to the comparison group. While knowledge that there is a distinction between germs and dirt increased between baseline and each posttest, differences between the groups are not statistically significant.

The intervention significantly increased knowledge that sometimes it is important to wash hands even if hands do not look dirty [DID: 4.8% at posttest 1 (p=0.106) and 8.3% at posttest 2 (p=0.005)]. The intervention also increased knowledge that one can keep others healthy by HWWS before cooking [DID: 0.5% at posttest 1 (p=0.808) and 4.1% at posttest 2 (p=0.030)]. While the intervention did increase children's awareness that one cannot make hands clean using only water, from 72% to 80%, it was not a significant increase compared to the control group [DID: -3.2% at posttest 1 (p=0.379) and -3.4% at posttest 2 (p=0.333)].

HOW to Handwash

The intervention significantly increased knowledge of how to HWWS, particularly that the first step is to add clean water [DID: 18.3% at posttest 1 (p=0.000) and 7.4% at posttest 2 (p=0.047)]; and the second step is to add soap [DID: 7.6% at posttest 2 (p=0.018)]. Knowledge of the third step (wash palms, fingers, and thumbs) increased from 65% to 75% at posttest 1 and 94% at posttest 2 in the intervention group. Knowledge of the third step also increased in the control group, with more of an increase than the intervention group at posttest 2 [DID: -7.6% (p=0.027)]. This is likely because knowledge of the third step was not comparable between the two groups at baseline. At baseline, the intervention group was significantly more likely to correctly answer the third step of HWWS (65% vs. 54%, p<0.0001). If the two groups had been comparable in knowledge at baseline, there likely wouldn't be a significant increase in the control group compared to the intervention group at posttest 2.

The significant improvement in knowledge of wetting hands with clean water first is also echoed in structured Tippy Tap observations and video observations, which often showed children adding soap to their hands before first wetting hands at baseline, "Most student applied the soap before washing their hands." Focus groups showed little confusion around how to HWWS; other than a few children who only said to rub hands together with water and soap and weren't more specific about the steps.

WHEN to Handwash

Knowledge of critical times to handwash was very high at baseline, with over 96% of the sample recognizing one should HWWS before eating, after toilet use, and after changing a baby. Over 81% of the sample at baseline also correctly identified before cooking and before feeding a baby as times one should HWWS. In addition, at baseline the comparison group was more likely to know that HWWS before preparing a meal keeps people healthy (94% vs. 91%, p=0.01). Focus groups also revealed there may have been confusion around whether the survey question was asking about times to HWWS when hands are dirty versus times to HWWS to prevent germ transfer. Therefore, Handwashing with Ananse did not significantly increase knowledge of when to HWWS.

Findings

1

1.4 Participants are more likely to communicate content through personal narratives of play

Children used songs, stories, and games to describe what makes it easier to remember what they learned about handwashing. The most commonly cited component of Handwashing with Ananse that children mentioned in focus groups is the "water and soap" song. Most children either mentioned or started singing the song when asked how to HWWS.

"When my siblings and I use the toilet we come back to wash our hands and sing"

"I am able to remember to wash my hands after using the toilet so that I don't end up like how Ananse went to toilet and didn't wash his hands"

Some children also suggested that what makes it easier to remember what they learned about HWWS is that Ananse's pockets were broken and knowledge of HWWS was released to everyone.

"When all the people gained knowledge again, they were all happy and I was also happy"

"The part where Ananse broke the pot containing knowledge about hand washing was what I liked"

1.5 Participants make associations between actions they took during play and moral dilemmas they have faced in their lives

Children in the intervention group often contextualized what they learned from Handwashing with Ananse to issues they have faced in their own lives. For example, some explained that if one does not HWWS, resulting illness causes the family a financial burden.

"If you play and you don't wash your hands and you fall sick, your mother may not have money to buy food for you so you will just be there lying down, vomiting"

As one child explained what happened in the Week 1 story, they added that those who went to the feast contracted cholera, which suggests the child was contextualizing the story within their own life.

Focus groups also revealed there may be some confusion around which illnesses handwashing with soap can prevent. For example, one child mentioned contracting malaria as a risk of not washing hands.

2

Objective #2

Participation in the curriculum increases the frequency and propensity for participants to tell their peers about HWWS (peer education).

Participants talked to peers and family about handwashing within the past week much more than non-participants [DID: 8.6% at posttest 1 (p=0.034) and 9.7% at posttest 2 (p=0.015)]. Children most often taught their friends, siblings, or mother.

"I educated my mother and siblings about hand washing"

"My brother used the toilet and so before he ate I taught him how to wash his hands"

Children are strongly motivated to teach others to protect themselves and others from illness.

"I don't want them to fall sick from germs because they didn't wash their hands"

"They could fall sick if I don't teach them"

Findings

Many children also shared Handwashing with Ananse because they wanted to enjoy the curriculum with others.

"The game is entertaining that is why I taught them"

"We chip in the game when we are feeling bored in our classroom"

Children mostly share the "water and soap" song and general lessons on HWWS.

"When I went home I sang the water & soap song"

"I taught them when to wash their hands and how to wash their hands"

Some children also said that Handwashing with Ananse taught them how to share knowledge with others.

"How to teach my siblings to wash their hands"

During implementation, observers recorded how often, either during or after the day's lesson, they noticed a student explaining curriculum content to other students. Curriculum observations showed the children were more likely to share content after the lesson had ended, during break time, rather than while they were actually playing. Fewer children were observed sharing content after Lesson 3 compared to the first two lessons.

Video observations showed some children singing the "water and soap" song with each other as they used Tippy Taps, consistent with findings from the focus groups, in which children mentioned singing the song to remember key content. The survey did not show a significant comparative increase in children reporting they HWWS at the same times most days at school [DID: 3.3% at posttest 1 (p=0.198) and 1.9% at posttest 2 (p=0433)].

At baseline, 95% of children in the study reported it is important to them that their friends and family know they HWWS when they should [DID: 1.5% at posttest 1 (p=0.368) and 2.5% from at posttest 2 (p=0.180)]. The intervention did not show a significant comparative increase in children reporting they speak up when they see a peer not HWWS when they should [DID: 2.3% from baseline to posttest 1 (p=0456) and 5.2% from baseline to posttest 2 (p=0.109)].

Some children in the focus groups said they would speak up if they saw someone not HWWS when they should, although it was usually a sibling. One explained that they would not tell a peer at school to HWWS, which suggests perhaps children have difficulty speaking up when it is someone they do not know as well.

"When we were coming to eat at home my brother had not washed his hands so I told him to go and wash his hands because all of us had already washed our hands... because if he doesn't wash his hands he will get sick."

"Sir if the person is not my sibling I will not tell him anything I will leave him to go home but if it is my sibling I would make sure he washes his hand so that he does infest me with the germs."

Findings

Objective #3

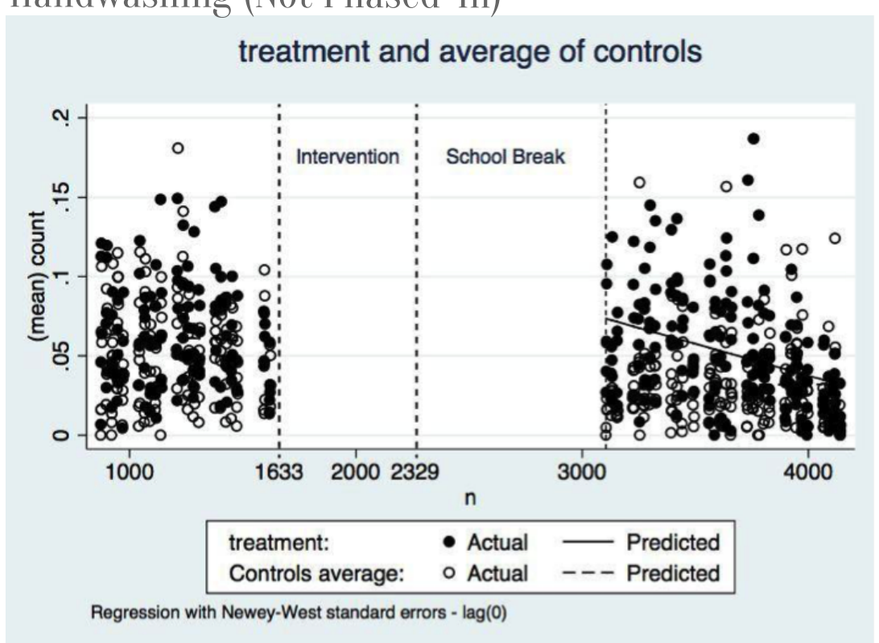
3.1 Participants HWWS at critical times at school more often than non-participants

The survey, video and structured observations, and soap measurements all show a significant increase in HWWS in the intervention group. The survey asked children the number of times they ate, used the toilet, helped prepare a meal, and washed their hands with soap and water since they woke up that morning. We created a ratio for each child for the number of times the child should have washed their hands, and the number of times they did, and compared the ratios. Children in the intervention group reported HWWS 5.1% more of the time when they should HWWS at posttest 1 (p=0.000), and 3.9% at posttest 2 (p=0.000). Tippy Tap observations also showed more improvement in handwashing before eating and after toilet use at intervention schools. Soap use increased in the intervention group and decreased in the comparison group after a two-month break. However, this change was not significantly different between the intervention and comparison groups.

Video observations showed that after a two-month break of the intervention and school holiday, the intervention group showed a significant increase in handwashing while the comparison group declined. The intervention group showed a significant level shift of 0.03 handwashing attempts per child per hour (p=0.002) but also a significant decrease in slope of -1.98 (p=0.048) compared to the control group. It should be noted that both of these values are measured 2 months after the beginning of the intervention and not directly after the intervention like in most ITS. For one month of that time, children were not at school at all and therefore had no reinforcement to HWWS. In our opinion, the significant level shift reflects both the initial impact and lasting results of Handwashing with Ananse better than the slope.

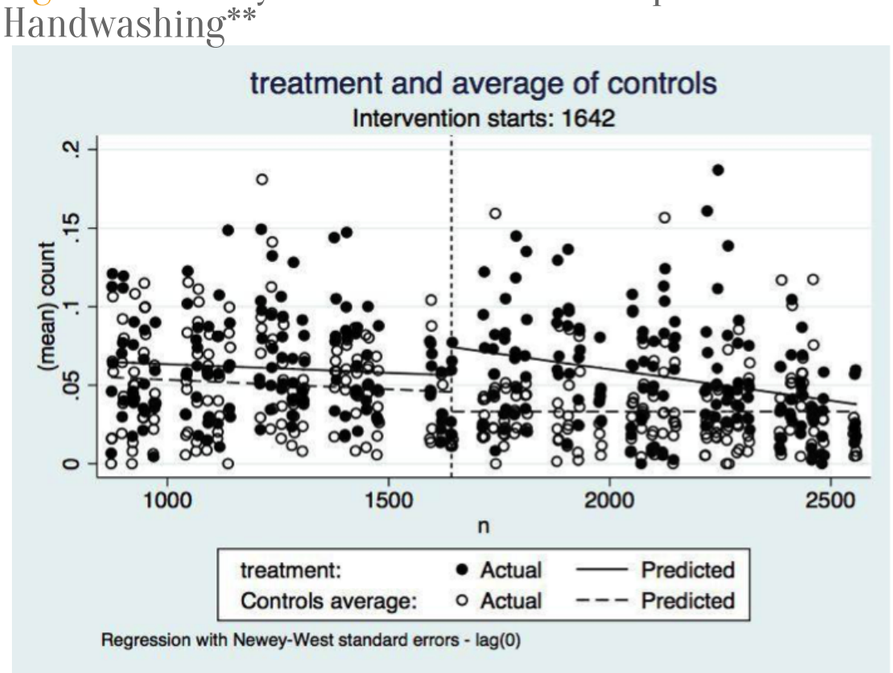
Figures 1 and 2 below show the output from the interrupted time series analysis. Each dot represents a data point: black dots show the number of handwashing attempts in schools that participated in Handwashing with Ananse, and white dots show the number of handwashing attempts in schools that did not participate. The vertical y-axis shows the average number of videos of handwashing attempts per child at each school. The horizontal x-axis represents time; it shows a timeline of when the study began (Hour 0) through when it ended. Lines that best fit the data in both groups of schools are drawn on the graph to show an average number of handwashing attempts over time in the two different study groups. The dotted vertical lines show a two month period (10 March to 10 May 2017) when Handwashing with Ananse was implemented and then children were out of school on holiday. Handwashing behavior was analyzed before and after this period of time. Looking at changes in slope (i.e., rate of change over time) and level (i.e., the height of the line on the y-axis, or the number of handwashing attempts) helps us see there was a significant increase in the number of handwashing attempts and a decrease in slope at follow-up in the intervention group.

Figure 1. Hourly Video Counts of Attempted Handwashing (Not Phased-In)*



*Standardized by School Enrollment and Weighted so each School Contributes Equal Number of Hours in the Pre- and Post-Period. Intervention starts at Hour 1633 (March 10, 2017). School Break starts at 2329 (April 8, 2017). Post-period starts at 3105 (May 10, 2017).

Figure 2. Hourly Video Counts of Attempted Handwashing**



**Standardized by School Enrollment and Weighted so each School Contributes Equal Number of Hours in the Pre- and Post-Period. Intervention starts at Hour 1642. The intervention line in this figure represents 1633-3104 from Figure 1.

Findings

3.2 Participants use proper HWWS technique more often than non-participants

Handwashing quality was defined as the proportion of children who followed each of the seven steps of proper handwashing with soap. The seven steps include: wet hands with clean water; add soap; wash palms, fingers, thumbs; wash back of hands; wash in between fingers; wash fingernails; and rinse. Desired behavior was defined as observations of "All" or "Most" children completing all 7 steps of HWWS. Tippy Tap observations show more improvement in HWWS quality among participants:

- 83% of intervention schools and 33% of control schools improved between baseline and posttest 1
- 50% of intervention schools and 38% of control schools improved between baseline and posttest 2

Objective #4

4.1 Participants are less likely to experience symptoms of diarrheal and respiratory infections.

Self-reported illness decreased in both the intervention and comparison groups, but significantly more in the intervention group. In intervention schools, self-reported illness dropped by 4.7% more at posttest 1 (p=0.240) and 8.2% more at posttest 2 (p=0.041) than comparison schools. This suggests a positive additive effect of Handwashing with Ananse in addition to handwashing infrastructure at schools.

"Sir I don't fall sick as often as I use to fall sick again"

4.2 Participants are not more likely to have access to soap post-intervention.

Self-reported soap access at home in the intervention group increased by 6.4% from baseline to posttest 1, but dropped back down at posttest 2. Overall, soap access at home in both the intervention and comparison groups remained constant, with a comparative effect in the intervention group of 4.8% from baseline to posttest 1 (p=0.235) and -0.1% from baseline to posttest 2 (p=0.980).

Conclusion

Handwashing with Ananse has shown to be an effective intervention in several important ways: changes in knowledge, attitude, and behavior led to a decrease in reported illness. The significant decrease in reported illness in the intervention group, as opposed to the comparison group that received only handwashing infrastructure, is the most promising finding. It can be explained by looking at several key positive indicators.

Knowledge

The study demonstrates a significant increase in knowledge of how to HWWS. As demonstrated in previous HWWS studies, knowledge of HWWS tends to be quite high, making it difficult to show significant changes. And while Handwashing with Ananse did not seem to have an impact on When and Why to handwash, it did demonstrate impact on How. This is likely due to the interactive and playful nature of the curriculum, where details of how to handwash were embedded into song and games. The nuance of how to handwash can easily get lost in more traditional approaches.

Attitude

Ananse motivated significant peer-to-peer learning. Children were eager to share what they learned and to communicate their positive attitudes about handwashing with peers. Children were most likely to share what they learned with siblings and friends outside of school, either because they wanted to prevent sickness, or because they wanted to enjoy playing the activities with others. They most often mentioned sharing the “water and soap” song with others. Again, this is a direct result of the nature of the intervention, where being immersed in the narrative of Ananse over several weeks motivated the children to share their experience. They were eager to bring people into the narrative they were experiencing and share with them their victories of defeating the mischievous spider.

Behavior

Behavior is the gold standard of handwashing interventions. Our study demonstrates that children in the intervention group practiced HWWS significantly more than those in the comparison group, and also improved observed handwashing quality over the comparison group. The video data provides important texture to traditional measures, shedding light on the challenges of providing consistent infrastructure and ensuring access over time.

Recommendations

Making small changes to Handwashing with Ananse's content and facilitation could potentially improve outcomes. In addition, further study on its effects in a population with more limited pre-existing knowledge on why, when, and how to HWWS may be useful, as well as making small changes to the evaluation instruments to reduce confusion around certain questions.

Facilitators Clarify Concepts in Lessons 1 and 3

Lesson 1 may benefit from clarifying how germs make people sick, specifying that HWWS does not make one invincible to disease, and specifying which illnesses HWWS can prevent, as some children confused HWWS with preventing diseases that are not spread by hand-to-hand contact. Lesson 3 may benefit from clarifying how soap removes germs from hands, and why the five critical times are unique from other times people handwash when their hands are dirty. Some children mentioned in focus groups that they must HWWS whenever they shake hands with someone; it is important to clarify that it is when someone touches their mouth, food, or water with contaminated hands that they can get sick.

Implement with >1 Facilitator if in Large Student Groups, and Ensure Instructions are in Local Language

Handwashing with Ananse is ideally played with 20-30 children per facilitator; therefore, large classes over 30 students would require more than one facilitator.Enlisting the support of students' teachers can be doubly beneficial, as it not only encourages students to behave well but can also increase buy-in from participating schools by more actively engaging them in the curriculum. While stories and some songs are in English, observers noted that especially for younger students, "understanding the lesson in English is difficult but in their local language is much better". Observers found that students were much more engaged in the handwashing games when lessons were taught in their local language. As one observer put it, "If (the) instructor uses the local language, the student(s) will be much (more) engaged and will remember the lesson." Ensuring that instructions are translated into the children's local language would likely result in better engagement.

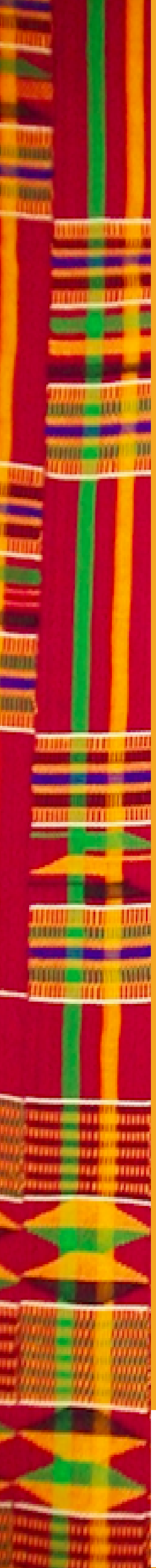
Handwashing with Ananse is Suitable for Scale-Up

This evaluation provides ample evidence that Handwashing with Ananse is effective in shifting HWWS knowledge, attitudes and behaviors among children 7-11 years old and should be considered for wider implementation. There are several factors to consider before scaling up, however.

1. The curriculum requires trained facilitators. The current group of facilitators from Right to Play could run Train the Trainer workshops to expand the number of people capable of facilitating the curriculum.
2. Handwashing infrastructure needs to exist prior to facilitating the curriculum. Handwashing with Ananse should only be in schools with existing handwashing facilities or accompany the installation of Tippy Taps.

Future Considerations

1. One challenge with a school-based intervention is that it is difficult to extend behavior change to the home. If there is no HWWS infrastructure at home, then it is difficult for a child to continue the behavior. Finding a direct way for the curriculum to reach adults should be a consideration for future implementations.
2. While this study focused on the in-school implementation of the curriculum, it is possible that the curriculum could be facilitated through community-based organizations (CBOs). The challenge would be maintaining consistency of participants over time. However, it might be the case that the curriculum serves to attract children and their families to the CBO and provides opportunity for the curriculum to reach both children and adults.



The evaluation study is guided by the UNICEF procedures for Ethical Research Involving Children (ERIC). There were minimal risks associated with this study. Participants could have found survey questions to be uncomfortable, as they pertained to personal hygiene, but all were told they have the ability to opt-out at any time. The potential benefits, increased HWWS and decreased illness, were determined to far outweigh the risks. TNS obtained informed consent from all study participants. Study data was only shared with study personnel with human subjects research training. All attempts were made to maintain privacy and confidentiality of subjects. Participants were not individually compensated but received Tippy Taps, water, and soap throughout the study. Tippy Taps remained at schools after the study concluded.

Ethical approval was obtained from both Emerson College in Boston, USA and the Ghana Health Service Ethical Review Committee. The Institutional Review Board (IRB) at Emerson College reviewed the research protocol prior to data collection. The mission of the Emerson College Human Research Subjects Committee/IRB is to ensure quality research involving human subjects conducted under the auspices of the College. The IRB is guided by ethical principles outlined in the Belmont Report (1979) and legal mandates outlined in the Code of Federal Regulations Title 45, Part 46 (2009). In accordance with United States and Massachusetts regulations, all projects conducted at Emerson involving human subjects must be reviewed and approved by the IRB prior to the initiation of any investigation. The Emerson College IRB also provides continuous oversight of all research projects for changes in protocol which may alter the investigational situation.

TNS RMS is also a member of the European Society of Market Research (ESOMAR) and Charted Institute of Marketing Ghana (CIMAG) and complies with ethical guidelines on the conduct of research that this entails, and other laws of Ghana. The TNS research team has received training in Human Subjects Protection (HSP), which is renewed annually. As an active member of ESOMAR, an international organization for the promotion of best practice in market and social research and self regulation, TNS fully adheres to the International Code of Market and Social Research and guiding principles in the Belmont Report. TNS sought informed consent from all participants, and made the voluntary nature of participation clear during recruitment. TNS did not subject respondents to any form of coercion, undue inducement, or intimidation. TNS described the purpose and procedures of all components of the study to children before starting data collection.

Engagement Lab

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