International Journal of Hygiene and Environmental Health xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

International Journal of Hygiene and Environmental Health

journal homepage: www.elsevier.com/locate/ijheh

Child's play: Harnessing play and curiosity motives to improve child handwashing in a humanitarian setting

Julie Watson[a,*], Robert Dreibelbis[a], Robert Aunger[a], Claudio Deola[b], Katrice King[b], Susan Long[c], Rachel P. Chase[d], Oliver Cumming[a]

[a] Department for Disease Control, London School of Hygiene and Tropical Medicine, Keppel St, Bloomsbury, London, WC1E 7HT, UK
[b] Save the Children, 1 St John's Ln, Clerkenwell, London, EC1M 4AR, UK
[c] Field Ready, 922 Davis Street, Evanston, IL, 60201, USA
[d] Department of International Health, Johns Hopkins Bloomberg School of Public Health, 615 N Wolfe St, Baltimore, MD, 21205, USA

ARTICLE INFO

Keywords:
Hygiene
Handwashing
Behaviour change
Humanitarian response
Internally displaced person

ABSTRACT

In humanitarian emergency settings there is need for low cost and rapidly deployable interventions to protect vulnerable children, in- and out-of-school, from diarrhoeal diseases. Handwashing with soap can greatly reduce diarrhoea but interventions specifically targeting children's handwashing behaviour in humanitarian settings have not been tested. Traditional children's handwashing promotion interventions have been school-focused, resource-intensive and reliant on health-based messaging. However, recent research from non-humanitarian settings and targeting adults suggests that theory-based behaviour change interventions targeting specific motives may be more effective than traditional handwashing interventions. In this proof-of-concept study we test, for the first time, the distribution of a modified soap bar, designed to appeal to the motives of play and curiosity, in a household-level, rapidly deployable, handwashing promotion intervention for older children in a humanitarian setting - an internally displaced persons camp in Iraqi Kurdistan. Out of five total blocks within the camp, one was assigned to intervention and one to control. 40 households from each assigned block were then randomly chosen for inclusion in the study and the practice of handwashing with soap at key times was measured at baseline and four weeks after intervention delivery. Children in intervention households received transparent soaps with embedded toys, delivered within a short, fun, and interactive household session with minimal, non-health-based, messaging. The control group received plain soap delivered in a short standard, health-based, hygiene promotion session. At the 4-week follow-up, children in the intervention group were 4 times more likely to wash their hands with soap after key handwashing occasions than expected in the counterfactual (if there had been no intervention) based on the comparison to children in the control group (adjusted RR = 3.94, 95% CI 1.59–9.79). We show that distributing soaps with toys embedded inside, in a rapidly deployable intervention, can improve child handwashing behaviour in a humanitarian emergency context. Further studies are needed to determine the longer-term behavioural and health impact of such an intervention when delivered at a greater scale in a humanitarian context.

1. Introduction

Handwashing with soap (HWWS) is one of the most cost-effective public health interventions (Jamieson et al., 2006) and reduces the risk of both diarrhoeal and respiratory disease by over 20% (Aiello et al., 2008; Freeman et al., 2014). Most deaths from diarrhoeal disease and acute respiratory infections (ARIs) occur in children under five (GBD Diarrhoeal Diseases Collaborators, 2017; Liu et al., 2015), but their disease burden is also substantial in older children (Institute for Health Metrics and Evaluation, 2016), categorized as ages 5–14 by the Global Burden of Disease studies (GBD, 2016 Causes of Death Collaborators, 2017). Globally, diarrheal diseases and ARIs account for 12% of all deaths among children ages 5–14 and rank among the leading causes of mortality in this age group (Institute for Health Metrics and Evaluation, 2016). Children are particularly vulnerable in humanitarian emergencies where there is a heightened risk of disease transmission due to compromised public health infrastructure, crowded households, environmental contamination, and limited access to basic water and sanitation facilities (Connolly et al., 2004; Kouadio et al., 2012). It is estimated that 201 million people across 134 countries are in need of

* Corresponding author. Department for Disease Control, London School of Hygiene and Tropical Medicine, Keppel St, Bloomsbury, London, WC1E 7HT, UK.
E-mail address: julie.watson@lshtm.ac.uk (J. Watson).

https://doi.org/10.1016/j.ijheh.2018.09.002
Received 12 July 2018; Received in revised form 4 September 2018; Accepted 6 September 2018

international humanitarian assistance (Development Initiatives, 2018).

Despite the well-known benefits of HWWS, handwashing rates remain low in both stable and humanitarian emergency contexts (Biran et al., 2012; Freeman et al., 2014; Phillips et al., 2015). There is limited evidence for effectiveness of handwashing promotion interventions targeting children in general, but particularly in humanitarian emergencies (Watson et al., 2017). Historically, existing handwashing promotion interventions have focused on caregivers of young children. Those that have specifically targeted children have been predominantly school-based, failing to reach out-of-school children and inappropriate for implementation in the early stages of emergencies when schools and child-friendly spaces have yet to be established (McCambridge et al., 2014; Vujcic et al., 2015).

Traditional handwashing promotion interventions in both stable and emergency settings have also focused on messaging around the health-related risks associated with germs (Biran et al., 2009; Ejemot-Nwadiaro et al., 2015; Phillips et al., 2015; Vujcic et al., 2015), however studies have shown that health is often not an effective motivator of behaviour change (Biran et al., 2009; Curtis et al., 2009) and health-based interventions have had mixed success in a number of emergency settings, including refugee camps in South Sudan, Thailand, Kenya, and Ethiopia (Biran et al., 2012; Phillips et al., 2015). Furthermore, these traditional interventions use education-based and knowledge-based messaging which requires skilled health workers to deliver the messages, who are typically overstretched or undersupplied in emergency settings, so that the messages are difficult to deliver consistently (Contzen et al., 2015; Greenland et al., 2017; Rajaraman et al., 2014). They are therefore not amenable to the rapid deployment necessary in humanitarian response. Hygiene promotion that is less reliant on skilled and trained health workers delivering messages repeatedly may have more success in large scale interventions.

Recent research from stable settings has demonstrated success in handwashing promotion using motivational rather than health-based messages (Biran et al., 2014). The use of motives in behaviour change interventions is supported by the Evo-Eco theory which postulates that 15 latent human motives have evolved to drive behaviour in all human experiences and solve evolutionarily important goals, for example, finding food or a long-term mate (Aunger and Curtis, 2014). In particular, ‘disgust’, ‘nurture’ and ‘social affiliation’ have been used within multiple interventions to change handwashing behaviour in stable settings (Biran et al., 2014). The explicit use of motives to improve children's HWWS behaviour, however, has not yet been implemented in a humanitarian emergency setting. Two of the motives presented in the Evo-Eco theory which seem intuitively relevant for use in handwashing promotion interventions targeting children are ‘play’ and ‘curiosity’ (Perry et al., 2000). Play is essentially concerned with learning new skills in relatively low-risk contexts (for example, playing with dolls can teach nurturing skills), while curiosity is about actively seeking out new information that may prove helpful in solving a variety of future problems. Many handwashing interventions targeting children have involved some elements of play and curiosity, but no previous studies have formally focused on these motives as a mechanism of behaviour change.

In resource scarce environments, education or knowledge-based messaging, whether focussed on health or other motivational drivers, face a number of limitations, as we discuss above. There have, more recently, been some approaches to delivering hygiene promotion that do not rely on this traditional messaging, for example, the modification of tools or hardware to ‘nudge’ children to wash their hands (Dreibelbis et al., 2016). However, though promising, these alternative approaches have been tested in very controlled and limited settings and were largely theoretical in their application (Dreibelbis et al., 2016). Whether the modification of hardware and tools to drive handwashing behaviour can be considered an effective behaviour change technique (Michie et al., 2015) in handwashing promotion for children in emergency settings is yet to be determined.

In this proof-of-concept study we test the hypothesis that a rapidly deployable and simple household intervention, designed to appeal primarily to the motives of play and curiosity using a modified bar of soap delivered in a fun and interactive session, can increase handwashing at key occasions by older children in a humanitarian emergency setting. Our intervention is specifically designed to require little formal training of implementers and is targeted at the household level to reach in- and out-of-school children, both of which are important in the acute and recovery phase of an emergency where schools and child-friendly spaces may not yet be established. Our intervention consists of the distribution of a specially designed soap product - a bar of soap with a toy embedded inside, hereinafter referred to as ‘toy soap’- which, theoretically, should incentivize children to wash their hands with the soap in order to reach the toy. A recent trial of a similar a toy-in-soap product in a non-emergency context suggested that improvements in child handwashing may be associated with the distribution of these modified soaps but some their results lacked statistical power (Burns et al., 2018). Our intervention, led by hygiene promoters, is delivered within a 5–10 min interactive session with a number of children in the household. This session also aims to incorporate play and curiosity using a ‘glitter game’ to demonstrate how germs are transmitted from one hand to another, after which toy soap supplies are handed out.

2. Material and methods

2.1. Study setting

The study took place in Sharia Camp, an Internally Displaced Persons (IDP) camp located in the Dohuk Governorate of the Kurdistan Region of Iraq, a part of the country with a relatively stable security situation. Sharia Camp is easily accessible by road and is managed by the Board of Relief and Humanitarian Affairs (BRHA) – a governmental body within the Dohuk government structure. IDPs in this camp are exclusively from the Yezidi community, originating from the Sinjar region of Northern Iraq. Most have resided in Sharia Camp since 2014 when the Islamic State of Iraq and the Levant (ISIL) entered Sinjar. The camp has a population of over 17,000 with over 37% of this population comprising children under the age of 12 (Duhok Governorate Board of Relief and Humanitarian Affairs, 2016). The camp population is accommodated in tents with access to communal latrine blocks, shower units, and a largely consistent water supply at water points, though many families have purchased water tanks to store water in or near their tent. With the addition of a bucket these water tanks also act as handwashing stations in the home.

2.2. Study design and eligibility criteria

We used a controlled before-and-after (CBA) study design to test the hypothesis that a short and rapidly deployable handwashing intervention which appeals to the motives of play and curiosity can improve the handwashing of older children between the ages of 5 and 12 (primary school-age) in a humanitarian emergency context. The study site was selected in coordination with Save the Children as the IDP population in Sharia camp was stable and access to water and sanitation was consistent.

Sharia Camp was divided into 5 blocks, A-E. Block B and D were selected for participation in this study to minimise intervention contamination as these blocks are the furthest distance apart. Block D was randomly assigned to the intervention group and block B to the control group using a coin toss. Field workers recruited households in each section using a list of household numbers generated with a random number table which included all household numbers in each section. Eligible households had a least one child between the age of 5 and 12 who would likely be at home during a 3-h observation period (9AM-12PM). This observation period was appropriate to capture both school-going and non-school-going children since children in Sharia camp

attend school either in the morning or in the afternoon according to assignment by camp management, which varied between households within each block. At the time of this study, Save the Children were delivering hygiene promotion in schools, child-friendly spaces, and during household visits. Exposure to all past and current hygiene promotion activities was the same across all camp blocks.

2.3. Sample size

A total of 80 households (40 households per study arm) were recruited to the study. As a proof-of-concept study, its main objective was to determine the behavioural impact of the intervention, and specifically whether such an intervention *could* change handwashing behaviour. As such, the sample size of 80 households was not determined through a formal power calculation but by taking in to account population diversity, and budgetary and time constraints. As the entire camp population are of a single ethnicity and since this is a single camp setting, social and environmental factors were anticipated to be similar across households. The sample size was thus deemed sufficient to reflect the range of socio-economic and household dynamics within the study area. We calculated, *a priori*, that 40 households in each study arm would result in a minimum detectable effect (MDE) equivalent to a risk ratio (RR) of 1.45–3.6 for baseline handwashing rates ranging from 10% to 60%, 80% power, and 5% significance.

2.4. Intervention content and delivery

The intervention was delivered over one weekend when children were most likely to be in the home. Hygiene promoters who were already active in the camp with Save the Children were trained to deliver the intervention. In pairs, hygiene promoters delivered five toy soaps to each intervention household. Toy soaps were transparent, and all five soaps featured a different toy animal inside (a photograph is available in the supplementary material). The shape and volume of the toy soap was selected to make breaking the soap open as difficult as possible. Hygiene promoters visited each household and played a glitter game with the children to demonstrate how germs are spread: one child's hands were covered with petroleum jelly and glitter and they were asked to 'high five' other children, transferring the glitter from hand-to-hand, followed by a demonstration of how to remove the glitter 'germs' from their hands using the toy soap and seven steps of handwashing. No health-based messages were given. Children were not instructed on which key occasions to hand wash, but hygiene promoters explained that the more they washed their hands with the soap the faster they would reach the toy. At least one adult of the household, usually a caregiver, was present during intervention delivery but they were not instructed in any way about the use of these toy soaps. All soaps for the study were designed and manufactured in Kurdistan by Field Ready (UK) using insights generated in a prototyping workshop with children from Sharia camp. Children who participated in the insight study were not part of this study. As the toy soaps were previously unknown to the children in the intervention households, the assumption was that presentation in this way would inspire curiosity to learn more about them (for example, to find the toy through use). Similarly, the toy inside the soap signifies to children that the soap can be part of their play activities, which would also stimulate use.

We employed an active control where households received five plain soaps which were identical to the toy soaps in colour, size, shape, volume, and quality except that they did not contain a toy inside. To control for the effects of household delivery, these plain soaps were also distributed to children in the control households by hygiene promoters who delivered a standard Save the Children handwashing promotion session lasting 5–10 min and consisting of standard health-based messages on disease risks associated with germs, the key moments for handwashing, and a demonstration of the seven steps of handwashing. These messages were the same as those given during existing handwashing promotion activities taking place in the camp at the time of the study. Children in control households did not play the glitter game.

2.5. Outcomes of interest

The primary outcome for the study was the proportion of key handwashing occasions that were accompanied by handwashing with soap (both hands) for children age 5–12. The five key occasions specified were: (i) after using the toilet, (ii) before eating, (iii) before preparing food, (iv) before serving food to another person and, (v) after cleaning another child's faeces.

Three secondary outcomes served as indicators of intervention compliance and included the proportion of households reporting 'toy cheats' (households in which children broke one or more soaps to retrieve the toy); the proportion of households which had used at least one soap; and the proportion of households with toy soap that was wet on inspection from those households with at least one toy soap remaining at follow up.

2.6. Data collection

All data collection was undertaken by field workers, recruited from the Sharia camp, who received formal training in the relevant data collection techniques. After enrolment, participating households completed a brief socio-demographic survey and, during the two weeks before intervention delivery, fieldworkers collected baseline data on child handwashing in the household through structured observations. To minimise the risk of bias, households were informed that the field workers would be observing all household activities around water use and did not reveal that they were specifically observing handwashing. Field workers conducting the observations had no involvement in the intervention and households belonging to family or immediate neighbours of the field workers were excluded from participating in the study. No further blinding of study participants was possible. Observations lasted for 3 h (9AM-12PM). Field workers positioned themselves in an unobtrusive location in or near the household tent with a view of the handwashing station or area. One index child between the age of 5 and 12 was selected at random at the time of data collection. Data were collected on all key occasions for handwashing observed and reported whether the child washed hands with soap, just water, or did nothing at the appropriate moment associated with each key occasion.

Four weeks after intervention delivery, field workers returned to the households to conduct an endline structured observation of handwashing for another index child selected at random. Directly after the endline structured observation, field workers recorded information on 'toy cheat' events where children had broken the soap bars to get to the toy.

2.7. Data analysis

Data was cross-checked by the field supervisor on a daily basis. All statistical analysis was undertaken using Stata Version 14 (StataCorp, 2015, USA). As this was a proof-of-concept study, we conducted a per-protocol analysis to estimate the effect of the intervention on handwashing (Hernan and Robins, 2017). To estimate effect, we calculated a risk ratio (RR) using a difference-in-differences (DID) analysis via a multilevel mixed effects Poisson model (Stata command: *meqrpoisson*) to account for within-subject correlation due to repeated measures and clustering at the block level (Austin et al., 2018). Adjusted RRs along with corresponding 95% confidence intervals were calculated to control for the potential confounders determined *a priori* (age, sex, number of children age 5–12 in the household, and number of people earning in the household).

2.8. Ethics statement

The study was reviewed and approved by the London School of Hygiene and Tropical Medicine Ethics Review Committee (Ref: 14,483) and the Hawler Medical University Ethics Review Committee in Erbil (Ref: 1/16). The study was also approved by the Board of Relief and Humanitarian Affairs (Ref: 365) and the Directorate of Preventative Health Affairs in Dohuk Province (Ref: 7787). Written informed consent was sought from all participating households. Control households received the toy-based intervention after completion of the study.

3. Results

3.1. Participants and baseline data

The study ran from March–April 2018. 40 households were enrolled in the control arm and 40 households in the intervention arm. Five households were lost-to-follow-up because they left the camp and two households did not receive the intervention due to failure to locate the correct households during intervention delivery. A further two households were excluded from the analysis because none of the five key handwashing occasions were observed to occur at follow-up. Complete data was obtained from 33 households in the intervention group and 38 households in the control group. Characteristics of the index children observed are shown in Table 1. Household characteristics were similar between groups at baseline (Table 2).

3.2. Intervention compliance

Field workers measured the number of toy cheats and indicators of soap use in the intervention group at the end of the study. Only 3% (n = 1) of intervention households reported toy cheats; all others reported that the children reached the toys via handwashing. At the four-week follow up, 97% (n = 32) of households had finished at least one soap, 61% (n = 20) of households still had some toy soap remaining and, of those households, 85% (n = 17) had toy soap that was wet on inspection.

3.3. Handwashing with soap

Baseline prevalence of handwashing after key handwashing events was 24% (95% CI, 14%–36%) in the intervention group and 32% (95% CI, 23%–42%) in the control group. At endline, the prevalence of HWWS at key events in the intervention group increased by 16 percentage points to 40% (95% CI, 29–53%) and decreased by 19 percentage points to 13% in the control group (95% CI, 8%–21%). After adjustment, children in the intervention group were 4 times more likely to wash their hands with soap after key handwashing occasions compared to the counterfactual represented by children in the control group after adjusting for baseline handwashing rates (adjusted RR = 3.94, 95% CI 1.59–9.79; Table 3).

Table 1
Index child characteristics.

Group	Baseline		Endline	
	Age (mean)	Sex (male)	Age (mean)	Sex (male)
Intervention (n = 33)	8	45%	8	55%
Control (n = 38)	8	50%	8	42%
P value	0.3[a]	0.7[b]	0.4[a]	0.3[b]

[a] Poisson Regression.
[b] Pearson Chi-square test.

4. Discussion

This is the first study to evaluate the use of a novel toy-in-soap product to motivate HWWS behaviour in a humanitarian setting. This proof-of-concept study provides evidence that targeting motives of play and curiosity using a toy soap delivered in a short and rapidly deployable handwashing promotion intervention can improve children's handwashing behaviour in a long term IDP camp. Children receiving our intervention were four times as likely to wash their hands with soap after key events one month after intervention delivery compared to the counterfactual, represented by children in the control group.

Importantly, our study adds to the limited evidence base for WASH interventions in emergencies (Blanchet et al., 2017). The evaluated intervention is rapidly deployable, does not require intensively trained hygiene promoters for implementation, and can reach children outside of schools and child-friendly spaces. These features are important in emergency settings where the risk of disease transmission is high and there is a large influx of people and minimal public health infrastructure, necessitating rapidly deployable and scalable hygiene interventions, especially in the acute phase of an emergency. Our intervention may be more suitable for use in emergency settings than traditional message-based approaches which require highly trained hygiene promoters who are difficult both to find and to sustain in emergency settings, limiting the speed at which the intervention can be deployed and scaled (Phillips et al., 2015; Vujcic et al., 2015).

Thus far, most handwashing promotion interventions for children have relied on education or knowledge-based messaging and didactic informative transfer (Watson et al., 2017). Our findings complement those of a recent cluster-randomised trial preceded by a proof-of-concept study which showed that a non-message-based ‘nudge’ intervention can improve children's handwashing behaviour and is as efficacious as a high-intensity hygiene education intervention (Dreibelbis et al., 2016; Grover et al., 2018a). That intervention combined infrastructural improvements with environmental nudges, including paved pathways connecting latrines to handwashing stations and footprints and handprints on infrastructure, without any other handwashing promotion activities or messages. While our toy soap intervention is incentive-based rather than a ‘nudge’, our results also suggest that innovative design and hardware intervention components together, when combined with minimal, interactive, non-didactic messaging, may achieve large increases in HWWS behaviour among children.

Our findings also add to existing evidence (Aunger et al., 2010; Biran et al., 2009, 2014) that the use of motivational drivers - primarily nurture and disgust (Curtis et al., 2009) - can support successful handwashing promotion interventions, although there are also examples where such interventions have had limited success (Greenland et al., 2016). Here we show that a toy-in-soap intervention that aims to appeal to the motives of play and curiosity can be effective in changing child handwashing behaviour in an emergency setting and may be well suited to hygiene interventions specifically targeting children.

Previous research on the use of motivational drivers in handwashing promotion has come from interventions predominantly targeted at caregivers of young children (Biran et al., 2014; Greenland et al., 2016). While not the target of our intervention activities, caregivers may have also had an important role to play in the success of this intervention. Our intervention was delivered to children in the household in the presence of their caregivers and these caregivers may likely have encouraged children to use the toy soap and prevented them from breaking the soap to reach the toy inside; only one household in our study reported ‘toy cheats’. Though this very low number of toy cheats presumably reflects a degree of response bias, it is likely the number would have been substantially higher in the absence of caregiver supervision. Delivering our handwashing intervention at the household level may have enhanced or even determined the effectiveness of the intervention via the additional caregiver input.

Five toy soaps were distributed to each intervention household at

Table 2
Household characteristics at baseline.

Variable	Intervention (N = 33)	Control (N = 38)	P Value
Number of household members earning	0.4	0.4	0.7[a]
Household head education level (score)	0.2	0.3	0.8[b]
Total number in household	7.2	7.7	0.5[a]
Number of < 5 children in household	1.0	1.1	0.8[a]
Number of children 5–12 in household	2.4	2.8	0.3[a]
Length of time in the camp (months)	38.6	39.7	0.4[a]
Soap present in household (%)	88	79	0.3[c]
Water available in household (%)	97	100	0.3[c]
Handwashing station in the household (%)	97	97	0.6[c]
Handwashing prevalence (%)	24	32	0.3[c]

[a] Poisson Regression.
[b] Two-sample Wilcoxon rank-sum test.
[c] Pearson Chi-square test.

Table 3
Effect of the intervention on handwashing with soap.

	HWWS Prevalence			DID analysis		
	Baseline	Endline	Difference	Risk Ratio[a]	95% CI	*P*-value
Intervention	24%	40%	+16%	3.94	1.59–9.79	0.003
Control	32%	13%	−19%			

Difference-in-difference analysis via multilevel mixed effects Poisson model.
[a] Adjusted for age, sex, number of children age 5–12 in the household, and number of household members earning an income.

the start of the study. At the four-week follow-up, 97% of intervention households had finished at least 1 bar of toy soap, indicating that nearly every household had engaged to some extent with the intervention. 39% of households had finished all 5 bars of soap. Of the intervention households who did have toy soap remaining, 85% had a bar of toy soap that was wet on inspection indicating at the four-week follow-up households were still engaging with the intervention.

We report a large behavioural impact four weeks post-intervention delivery; however, we did not assess whether these behaviours were sustained beyond this. It is unclear how long children's interest in the toy soap would continue, the duration of which is likely the key determinant of the intervention's behavioural and health impact. If interest in the toy soap proves to be short-term, this intervention is likely to be most useful in the acute and recovery phase of a humanitarian emergency (typically the first six months) when disease transmission is highest, resources are stretched, and before basic public health infrastructure, such as adequate drinking water and sanitation, may have been established (Connolly et al., 2004). An alternative hypothesis that warrants investigation is that frequent use of the toy soap may lead to habit formation such that the targeted behaviour of HWWS might be sustained after the toy soap is finished and/or after the children have lost interest in the toy soap. Future trials might adjust analysis for soap remaining at endline to assess if the increased HWWS behaviour seen in this study continues after toy soap is finished.

Our study has important limitations. Although our groups appeared well balanced, there was a differential drop-out rate in the intervention (7/40) and control (2/40) groups that may reflect some underlying difference between these two groups that may bias our results. We used structured observations to measure handwashing. While this is considered to be the 'gold standard' of measuring handwashing behaviour (Biran et al., 2008) it is still at risk of social desirability bias (Ram et al., 2010) and observer bias, especially as blinding of observers and participants was not possible. The 'Hawthorne Effect' (McCambridge et al., 2014) is also a risk; children may modify their behaviour in response to their awareness of being observed (Grover et al., 2018b; Ram et al., 2010). The HWWS prevalence in both groups recorded at baseline was relatively high (32% control, 24% intervention). At endline, HWWS prevalence in the control group was significantly lower at 13% (−19 percentage points) which suggests some degree of reactivity bias observed in our baseline data then dissipating at endline. Future studies may benefit from multiple observations prior to the intervention period to better assess reactivity in baseline observations. We hypothesize that our intervention effectively targeted the motives of play and curiosity in this context; however, we were unable to develop specific measurements of these latent, complex constructs. This is a common limitation of motive-based interventions (Biran et al., 2014) and highlights a need for better measurement systems that allow individual motives to be tested.

Our proof-of-concept study was limited to 71 households in just one IDP camp with an entirely Yezidi population, and in one humanitarian context. Trials with a larger number of households and across different humanitarian contexts are needed to validate the findings and ascertain the generalisability of our intervention to different humanitarian emergency populations. Furthermore, this intervention was purposefully conducted in an IDP camp where water supply was consistent and plentiful. In some humanitarian emergency settings where water is scarcer, use of the toy soap may be less frequent, potentially altering the impact of our intervention. In Sharia camp, the setting for our intervention, children were also receiving health-based handwashing messages from hygiene promoters in school and child-friendly spaces at the time of our intervention. More research is needed to determine if our intervention can standalone or if its success is interlinked with the presence of other handwashing promotion activities.

5. Conclusions

Our study demonstrates that the use of a theory-based hygiene intervention designed to target both play- and curiosity-based motives through innovative hardware and software components is associated with increases in handwashing with soap among older children. Our results provide evidence that this readily deployable intervention may be effective at increasing child handwashing practices in a humanitarian setting while facilitating rapid implementation in an often chaotic humanitarian emergency context. We argue that hardware intervention components should no longer be viewed as distinct from software 'behaviour change' components, as has been the tradition in handwashing interventions, especially in emergency settings (Vujcic et al., 2015). This approach should be considered an effective behaviour change technique in handwashing promotion for children. Our positive findings provide justification for future efficacy studies to assess the effect of such an intervention on handwashing behaviours and related health outcomes (such as diarrhoea) when delivered at greater scale and in the context of a humanitarian response.

Conflicts of interest

The authors declare no conflict of interests.

Acknowledgements

Funding for this project was provided by the Humanitarian Innovation Fund. We are extremely grateful to all the participating households without whom this study would not have been possible. We also extend our gratitude to the enumeration team for their careful work, to the intervention team for their enthusiasm and passion for finding new ways to protect public health in Sharia camp and to the translator, Shana Osman, for her invaluable support throughout the project. We also thank Save the Children International, especially the WASH team, for their support during implementation.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.ijheh.2018.09.002.

References

Aiello, A.E., Coulborn, R.M., Perez, V., Larson, E.L., 2008. Effect of hand hygiene on infectious disease risk in the community setting: a meta-analysis. Am. J. Publ. Health 98, 1372–1381.

Aunger, R., Curtis, V., 2014. The evo-eco approach to behaviour change. In: David, L., Mhairi, G. (Eds.), Applied Evolutionary Anthropology. Advances in the Evolutionary Analysis of Human Behaviour. Springer, New York, NY, pp. 271–295.

Aunger, R., Schmidt, W.P., Ranpura, A., Coombes, Y., Maina, P.M., Matiko, C.N., Curtis, V., 2010. Three kinds of psychological determinants for hand-washing behaviour in Kenya. Soc. Sci. Med. 70 (1982), 383–391.

Austin, P.C., Stryhn, H., Leckie, G., Merlo, J., 2018. Measures of clustering and heterogeneity in multilevel Poisson regression analyses of rates/count data. Stat. Med. 37, 572–589.

Biran, A., Rabie, T., Schmidt, W., Juvekar, S., Hirve, S., Curtis, V., 2008. Comparing the performance of indicators of hand-washing practices in rural Indian households. Trop. Med. Int. Health: TM & IH 13, 278–285.

Biran, A., Schmidt, W.-P., Zeleke, L., Emukule, H., Khay, H., Parker, J., Peprah, D., 2012. Hygiene and sanitation practices amongst residents of three long-term refugee camps in Thailand, Ethiopia and Kenya. Trop. Med. Int. Health 17, 1133–1141.

Biran, A., Schmidt, W.P., Varadharajan, K.S., Rajaraman, D., Kumar, R., Greenland, K., Gopalan, B., Aunger, R., Curtis, V., 2014. Effect of a behaviour-change intervention on handwashing with soap in India (SuperAmma): a cluster-randomised trial. The Lancet Global Health 2, 145–154.

Biran, A., Schmidt, W.P., Wright, R., Jones, T., Seshadri, M., Isaac, P., Nathan, N.A., Hall, P., McKenna, J., Granger, S., Bidinger, P., Curtis, V., 2009. The effect of a soap promotion and hygiene education campaign on handwashing behaviour in rural India: a cluster randomised trial. Trop. Med. Int. Health: TM & IH 14, 1303–1314.

Blanchet, K., Ramesh, A., Frison, S., Warren, E., Hossain, M., Smith, J., Knight, A., Post, N., Lewis, C., Woodward, A., Dahab, M., Ruby, A., Sistenich, V., Pantuliano, S., Roberts, B., 2017. Evidence on public health interventions in humanitarian crises. Lancet 390, 2287–2296.

Burns, J., Maughan-Brown, B., Mouzinho, Â., 2018. Washing with hope: evidence of improved handwashing among children in South Africa from a pilot study of a novel soap technology. BMC Publ. Health 18, 709.

Connolly, M.A., Gayer, M., Ryan, M.J., Salama, P., Spiegel, P., Heymann, D.L., 2004. Communicable diseases in complex emergencies: impact and challenges. Lancet 364, 1974–1983.

Contzen, N., Meili, I.H., Mosler, H.J., 2015. Changing handwashing behaviour in southern Ethiopia: a longitudinal study on infrastructural and commitment interventions. Soc. Sci. Med. 124 (1982), 103–114.

Curtis, V.A., Danquah, L.O., Aunger, R.V., 2009. Planned, motivated and habitual hygiene behaviour: an eleven country review. Health Educ. Res. 24, 655–673.

Development Initiatives, 2018. Global Humanitarian Report 2018.

Dreibelbis, R., Kroeger, A., Hossain, K., Venkatesh, M., Ram, P.K., 2016. Behavior change without behavior change communication: nudging handwashing among primary school students in Bangladesh. Int. J. Environ. Res. Publ. Health 13.

Duhok Governorate Board of Relief and Humanitarian Affairs, 2016. IDPs and Refugees in Duhok Governorate: Profile and General Information Duhok Governorate Board of Relief and Humanitarian Affairs, Dohuk, Kurdistan.

Ejemot-Nwadiaro, R.I., Ehiri, J.E., Arikpo, D., Meremikwu, M.M., Critchley, J.A., 2015. Hand washing promotion for preventing diarrhoea. Cochrane Database Syst. Rev.(9).

Freeman, M.C., Stocks, M.E., Cumming, O., Jeandron, A., Higgins, J.P., Wolf, J., Pruss-Ustun, A., Bonjour, S., Hunter, P.R., Fewtrell, L., Curtis, V., 2014. Hygiene and health: systematic review of handwashing practices worldwide and update of health effects. Trop. Med. Int. Health 19, 906–916.

GBD 2016 Causes of Death Collaborators, 2017. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet (London, England) 390, 1151–1210.

GBD Diarrhoeal Diseases Collaborators, 2017. Estimates of global, regional, and national morbidity, mortality, and aetiologies of diarrhoeal diseases: a systematic analysis for the Global Burden of Disease Study 2015. Lancet Infect. Dis. 17, 909–948.

Greenland, K., Chipungu, J., Chilekwa, J., Chilengi, R., Curtis, V., 2017. Disentangling the effects of a multiple behaviour change intervention for diarrhoea control in Zambia: a theory-based process evaluation. Glob. Health 13, 78.

Greenland, K., Chipungu, J., Curtis, V., Schmidt, W.P., Siwale, Z., Mudenda, M., Chilekwa, J., Lewis, J.J., Chilengi, R., 2016. Multiple behaviour change intervention for diarrhoea control in Lusaka, Zambia: a cluster randomised trial. Lancet. Global health 4, e966–e977.

Grover, E., Hossain, M.K., Uddin, S., Venkatesh, M., Ram, P.K., Dreibelbis, R., 2018a. Comparing the behavioural impact of a nudge-based handwashing intervention to high-intensity hygiene education: a cluster-randomised trial in rural Bangladesh. Trop. Med. Int. Health: TM & IH 23, 10–25.

Grover, E., Hossain, M.K., Uddin, S., Venkatesh, M., Ram, P.K., Dreibelbis, R., 2018b. Social influence on handwashing with soap: results from a cluster randomized controlled trial in Bangladesh. Am. J. Trop. Med. Hyg. https://doi.org/10.4269/ajtmh.17-0903. [Epub ahead of print].

Hernan, M.A., Robins, J.M., 2017. Per-protocol analyses of pragmatic trials. N. Engl. J. Med. 377, 1391–1398.

Institute for Health Metrics and Evaluation, 2016. Global Burden of Disease Study 2016 (GBD 2016): Results. IHME, Seattle, United States.

Jamieson, D., Bremen, J., Measham, A., Alleyne, G., Claeson, M., 2006. Disease Control Priorities in Developing Countries. Oxford University Press, Oxford.

Kouadio, I.K., Aljunid, S., Kamigaki, T., Hammad, K., Oshitani, H., 2012. Infectious diseases following natural disasters: prevention and control measures. Expert Rev. Anti-infect. Ther. 10, 95–104.

Liu, L., Oza, S., Hogan, D., Perin, J., Rudan, I., Lawn, J.E., Cousens, S., Mathers, C., Black, R.E., 2015. Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis. Lancet 385, 430–440.

McCambridge, J., Witton, J., Elbourne, D.R., 2014. Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects. J. Clin. Epidemiol. 67, 267–277.

Michie, S., Wood, C.E., Johnston, M., Abraham, C., Francis, J.J., Hardeman, W., 2015. Behaviour change techniques: the development and evaluation of a taxonomic method for reporting and describing behaviour change interventions (a suite of five studies involving consensus methods, randomised controlled trials and analysis of qualitative data). Health Technol. Assess. 19, 1–188.

Perry, B.D., Hogan, L., Marlin, S.J., 2000. Curiosity, Pleasure and Play: a Neurodevelopmental Perspective.

Phillips, R.M., Vujcic, J., Boscoe, A., Handzel, T., Aninyasi, M., Cookson, S.T., Blanton, C., S Blum, L., Ram, P.K., 2015. Soap is not enough: handwashing practices and knowledge in refugee camps, Maban County, South Sudan. Conflict Health 9, 39.

Rajaraman, D., Varadharajan, K.S., Greenland, K., Curtis, V., Kumar, R., Schmidt, W.P., Aunger, R., Biran, A., 2014. Implementing effective hygiene promotion: lessons from the process evaluation of an intervention to promote handwashing with soap in rural India. BMC Publ. Health 14, 1179.

Ram, P.K., Halder, A.K., Granger, S.P., Jones, T., Hall, P., Hitchcock, D., Wright, R., Nygren, B., Islam, M.S., Molyneaux, J.W., Luby, S.P., 2010. Is structured observation a valid technique to measure handwashing behavior? Use of acceleration sensors embedded in soap to assess reactivity to structured observation. Am. J. Trop. Med. Hyg. 83, 1070–1076.

StataCorp, 2015. Stata Statistical Software: Release 14. StataCorp LP, College Station, TX.

Vujcic, J., Ram, P., Blum, L.S., 2015. Handwashing promotion in humanitarian emergencies: strategies and challenges according to experts. J. Water, Sanit. Hyg. Dev. 5, 574–585.

Watson, J.A., Ensink, J.H.J., Ramos, M., Benelli, P., Holdsworth, E., Dreibelbis, R., Cumming, O., 2017. Does targeting children with hygiene promotion messages work? The effect of handwashing promotion targeted at children, on diarrhoea, soil-transmitted helminth infections and behaviour change, in low- and middle-income countries. Trop. Med. Int. Health: TM & IH 22, 526–538.