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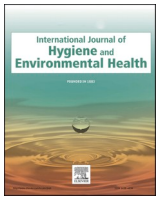

Effect of a novel hygiene intervention on older children's handwashing in a humanitarian setting in Kahda district, Somalia: A cluster-randomised controlled equivalence trial

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ABSTRACT

Introduction: Improving handwashing with soap (HWWS) among children in humanitarian emergencies has the potential to reduce the transmission of several important infectious diseases. However, there is limited evidence on which approaches are effective in increasing HWWS among children in humanitarian settings. One recent innovation – the "Surprise Soap" intervention – was shown to be successful in a small-scale efficacy trial in a humanitarian setting in Iraq. This intervention includes soap with embedded toys delivered through a short household session comprising a glitter game, instruction of how and when to wash hands, and HWWS practice. Whilst promising, this approach has not been evaluated at programmatic scale in a complex humanitarian setting.

Methods: We conducted a cluster-randomised controlled equivalence trial of the Surprise Soap intervention in IDP camps in Kahda district, Somalia. Proportionate stratified random sampling was employed to recruit 200 households, with at least one child aged 5–12, across the camps. Eligible households were randomly allocated to receive the Surprise Soap intervention (n = 100) or an active comparator handwashing intervention in which plain soap was delivered in a short household session comprising standard health-based messaging and instruction of how and when to wash hands (n = 100). The primary outcome was the proportion of pre-specified occasions when HWWS was practiced by children aged 5–12 years, measured at baseline, 4-weeks, 12 weeks, and 16 weeks post invention delivery.

Results: HWWS increased in both groups (by 48 percentage points in the intervention group and 51 percentage points in the control group, at the 4-week follow up), however, there was no evidence of a difference in HWWS between the groups at the 4-week (adjusted RR (aRR) = 1.0, 95% CI 0.9–1.1), 12-week (aRR = 1.1, 95% CI 0.9–1.3), or 16-week (aRR = 1.0, 95% CI 0.9–1.2) follow-up.

Conclusions: In this complex humanitarian setting, where soap availability and past exposure to handwashing promotion was low, it appears that well-designed, household-level targeted handwashing interventions that include soap provision can increase child HWWS and potentially reduce disease risk, but the Surprise Soap intervention offers no marginal benefit over a standard intervention that would justify the additional costs.

1. Introduction

In humanitarian emergencies, conditions such as overcrowding, unclean water and sanitation facilities, limited access to healthcare, and environmental contamination leave people at high risk of disease (UNHCR, 2015, Toole and Waldman, 1997; Connolly et al., 2004; Kouadio et al., 2012). Faecal-oral diseases such as diarrhoea, for example, are responsible for up to 40% of all deaths in the acute phase of

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an emergency (Connolly et al., 2004).

In these high-risk environments, handwashing with soap (HWWS) can be an effective means of preventing disease transmission. Systematic reviews consistently show that HWWS is effective in reducing diarrhoeal disease by up to 48% (Curtis and Cairncross, 2003; Freeman et al., 2014; Fewtrell et al., 2005; Cairncross et al., 2010; Waddington and Snilstveit, 2009; Ejemot-Nwadiaro et al., 2015; Wolf et al., 2018) and it is ranked as one of the most cost effective of all public health interventions (Horton and Levin, 2016; Jamison et al., 2006; Walker et al., 2010). HWWS can also reduce the risk of acute respiratory infections (ARIs) by 21–23% (Aiello et al., 2008; Rabie and Curtis, 2006) and has been linked to the reduction of certain neglected tropical diseases, such as trachoma (Stocks et al., 2014) and certain soil-transmitted helminth infections (STHs) (Strunz et al., 2014).

Children can account for more than half of the population in humanitarian settings (UNHCR, 2015). Diarrhoeal diseases and ARIs are responsible for most deaths among children, and the burden of trachoma and STHs are also concentrated in this age group (Vos et al., 2020). Increasing HWWS among children in humanitarian settings has the potential to achieve a large public health impact, not only via direct improvements in health outcomes but also via extended benefits such as improvements in school attendance (Willmott et al., 2015; Nandrup-Bus, 2009; Talaat et al., 2011; Azor-Martinez et al., 2016; Mohamed et al., 2020) which may lead to improved academic attainment (Lamdin, 1996; Morrissey et al., 2014) and associated economic and health benefits later in life (Gakidou et al., 2010).

HWWS interventions that aim to reduce the infectious disease burden among young children are predominately targeted at their caregivers – a logical approach considering they assume responsibility for much of the child's behaviour. Older children (classified as children between the age of 5–14 by the Global Burden of Disease studies (Vos et al., 2020)), however, spend more time outside the household, for example at school, and are often expected to have responsibility for washing their own hands. Increasing HWWS among older children is of public health importance, not only to reduce disease transmission risk among this group but also as they may act as effective agents of change for behavioural practices in the community and can take an active role in their handwashing practices as well as that of other family members (Bresee et al., 2016; Onyango-Ouma et al., 2005, Winter et al., 2021; Blanton et al., 2010; Tidwell et al., 2020). Currently though, there is limited evidence around which approaches are effective in increasing HWWS among older children in humanitarian settings (Watson et al., 2017). Even in stable settings, few rigorous studies of HWWS promotion interventions targeting older children have been published and the effects of these have been mixed (Watson et al., 2017, 2021).

One recent intervention that has shown promise in a humanitarian setting is a novel motive-based intervention, referred to as the 'Surprise Soap' intervention (Watson et al., 2019). This intervention aims to encourage older children's HWWS by appealing to their innate motives of play and curiosity. It involves the delivery of bars of Surprise Soap – transparent soaps with a toy embedded inside – in a short, fun household session that does not rely on traditional health-based messaging, which research has shown to be a poor motivator of behaviour change, particularly among children (White et al., 2020; Biran et al., 2009; Curtis et al., 2009; Rheinländer et al., 2015). The theorised mechanism of change for the Surprise Soap intervention is simply that children are more motivated to wash their hands with soap when there is a toy inside.

In 2018 this intervention was evaluated in an internally displaced persons (IDP) camp in Iraq (Watson et al., 2019) in a small proof-of-concept trial. At the 4-week follow-up, children in the intervention group were observed to practice HWWS almost 4 times more often compared to the counterfactual, a standard health-based household-level handwashing intervention (adjusted RR = 3.94, 95% CI 1.59–9.79) (Alexander et al., 2013). These findings are promising and indicate that this rapidly deployable intervention might be an effective means to increase children's HWWS in humanitarian emergencies and thereby reduce the risk of infectious disease. However, this pilot study was conducted in just one IDP camp with a homogeneous population (100% Yezidi), in which children already had a high exposure to hygiene promotion and good access to soap and water, we do not know if it can be effective in more complex humanitarian settings. The study follow-up was also limited to only 4 weeks whereas the acute phase of emergencies may last significantly longer, requiring interventions that can sustain HWWS over longer periods.

To address this information gap, we conducted a cluster-randomised controlled equivalence trial over 16 weeks to compare the effectiveness of the Surprise Soap intervention and a household-level intervention comprising of standard messages and plain soap, in a complex humanitarian setting where the population is mixed, access to handwashing facilities is limited, and past exposure to extensive handwashing promotion is low. Findings will both contribute to the limited evidence base for HWWS interventions targeting children and guide humanitarian agencies' decisions on the deployment of the Surprise Soap intervention at scale.

2. Materials and methods

2.1. Study design and participants/eligibility

This study was a cluster-randomised controlled equivalence trial with an intervention arm and an active control arm. Households were eligible to participate in the study if they included at least one child between the age of 5 and 12 and had no plans to travel away for more than one week over the ensuing six months. Individual households were then randomly assigned (1:1) to an intervention arm receiving the Surprise Soap intervention or the active control arm receiving a standard handwashing promotion intervention.

2.2. Study setting

The study took place across three IDP camps – Banaaney Two, Samadeq, and Alkowsar - in the Kahda district of the Banadir region of Somalia. The Kahda district is one of 17 districts in the Banadir region with a population of almost half a million, comprising host and IDP communities (Camp Coordination and Camp Management Cluster (CCCM). 2022). It is one of the districts with the largest IDP populations in the Banadir region with a growing population of displaced persons due to ongoing and protracted humanitarian emergencies (Camp Coordination and Camp Management Cluster (CCCM). 2022). We included three camps where the humanitarian agency, Action Against Hunger is engaged and where access to education, food security and livelihoods, health, housing, land and property, protection, shelter and non-food items, and water, sanitation and hygiene are all classed as 'extreme' or 'severe' by the Camp Coordination and Camp Management Cluster (CCCM) (Camp Coordination and Camp Management Cluster (CCCM). 2022). Most of the population in these camps live in self-made shelters known as 'buul'. They access drinking water from paid communal water points, water kiosks, or from vendors and shops. Very few households report having access to a functioning handwashing station with soap and water and children in these settings have had little previous exposure to hygiene promotion.

2.3. Intervention content and delivery

Households assigned to the intervention group received the Surprise Soap intervention, and households assigned to the active control group received a standard handwashing promotion intervention. Each intervention was delivered to children at their house the day after baseline observation was carried out. Hygiene promoters, already active under Action Against Hunger were trained to deliver both interventions. The main features of the two interventions are presented in Table 1 and further details given below.

Table 1
Overview of intervention activities in each study arm.

	Intervention group	Active control group
Intervention	Surprise Soap Intervention	Standard Intervention
Setting	Household	Household
Intensity	One-off session	One-off session
Session length	10 minutes	10 minutes
Approach	Motive-based	Education-based
Products	Surprise Soap x 5 bars, plus later replenishments	Plain soap identical to Surprise Soap but minus the toy x 5 bars, plus later replenishments
Activities	Glitter game to demonstrate germs spreading Demonstration of handwashing technique Information on key times to wash hands Children practicing handwashing with Surprise Soap	Handwashing-related health-messaging using F-diagram Demonstration of handwashing technique Information on key times to wash hands
Delivery agent	Action Against Hunger hygiene promoters	Action Against Hunger hygiene promoters

2.4. Surprise Soap intervention

The Surprise soap intervention consisted of distribution of Surprise Soap bars within a short (approximately 10-min) household session. Surprise Soaps are round transparent glycerine soaps with toy animals embedded inside (Fig. 1). All soaps were manufactured by the company, KIMA, in Jordan. Brief formative work which involved showing photos of potential toy options and soliciting feedback from IDP camp leaders, hygiene promoters, and adult residents of the camps, was undertaken by Action Against Hunger to ensure the toys were culturally appropriate. On arriving at their designated household, hygiene promoters gathered the children of the household together and initiated a "glitter game" to demonstrate how germs spread: petroleum jelly and glitter were applied to one child's hands who then 'high fived' the other children, transferring the 'glitter germs' between hands. The hygiene promoter then revealed the Surprise Soap bars to the children, explaining that the more often they wash their hands with the soap, the faster they will reach the toy inside, and listing five key handwashing times (before eating, before preparing food, before serving food to another person, after using the toilet, and before cleaning another person's faeces). The hygiene promoter then gave a demonstration of ideal handwashing technique and invited the children to practice washing the glitter from their hands using the Surprise Soap and then left a parcel of five Surprise Soaps with the children in the household. 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. Directly after the 4-week, 12-week, and 16-week follow-up household observations, the hygiene promoters visited the households again to distribute further packages of Surprise Soap but did not repeat the household session. No handwashing messages were delivered during these follow-up visits.

Fig. 1. Surprise Soap image.

2.5. Standard intervention

The standard intervention consisted of the distribution of plain soap, identical to the Surprise Soap in colour, size, shape, volume, and quality but without a toy inside, delivered within a short household session (approximately 10 minutes – comparable to the length of the Surprise Soap household session) to control for the effects of soap provision and household-level delivery. The household session focused on standard health-based messages using some of Action Against Hunger's existing handwashing promotion material. Hygiene promoters gathered the children and showed them the F-diagram, explaining how the spread of germs from faeces to mouths via hands can lead to diseases such as diarrhoea. They explained that HWWS can prevent these diseases, listed five key times to practice HWWS (as above), and demonstrated ideal handwashing technique. A parcel of five plain soaps were left with the children. Plain soap was also replenished directly after the 4-week, 12-week and 16-week follow-up household observations, in the same quantities as Surprise Soap, without repeating the household session.

2.6. Outcomes

The primary outcome for the trial was the proportion of five key potential handwashing occasions that were accompanied by HWWS (both hands) for children aged 5–12 years. The five 'key potential handwashing occasions' were: (i) after defecation or 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. This outcome was measured at all follow-up visits. The two secondary outcomes were: the proportion of all observed handwashing events (handwashing with water) where soap was also used, across all timepoints; and the total number of observed HWWS events across all timepoints.

In addition, a series of indicators of intervention compliance were also assessed in the arm receiving the Surprise Soap intervention. These included the number of bars of Surprise Soap remaining at endline, whether a bar of Surprise Soap was wet on inspection at endline, the reported time in days required to reach the toy in the Surprise Soap, reported incidents of "toy cheats" (i.e. where Surprise Soap was broken to access the toy prematurely), and reported use of the Surprise Soap by other household members (children <5 years of age, and adults), and for other purposes than hand hygiene (bathing, laundry, washing dishes, or any other uses).

2.7. Data collection

All data collection activities were undertaken by a team of trained enumerators, recruited by Action Against Hunger, who had no role in the delivery of the intervention. The research team from the London School of Hygiene and Tropical Medicine (LSHTM) provided a three-day training to field supervisors, involving both classroom and practical sessions, and supervisors subsequently trained enumerators in the local

language. Basic background social and demographic data were collected at the time of recruitment using a verbally administered questionnaire. During the four weeks before intervention delivery, one enumerator returned to each enrolled household to conduct direct structured observations of child handwashing practices and to record data on household handwashing facilities using spot-check observations. Structured observations started at approximately 9:30AM and continued for 3 h – a period when most children would be home. Data were collected for all children aged 5–12 years present in the household during the observation period. Enumerators positioned themselves in an unobtrusive location in or near the household where they had the best view of the children and the handwashing facility (where available). Every instance of the five key handwashing occasions (as defined above) and the associated handwashing practice (hands not washed, washed with water only, washed with soap and water) was recorded. Any instances of HWWS that were not associated with these five key occasions was also recorded. To be recorded as 'washed with water only' or 'washed with soap and water' both hands had to be washed. If only one hand was washed this was recorded as 'hands not washed'. Structured observations were repeated 4 weeks, 12 weeks, and 16 weeks post intervention delivery. In intervention households only, directly after the 16-week structured observation, field workers also recorded information on intervention compliance. All data were collected using Open Data Kit (ODK) on android tablets and uploaded onto a dedicated encrypted server at the end of each data collection day for the research team at LSHTM to cross check the data daily.

2.8. Sample size and randomisation procedure

We calculated that a sample size of 200 households (i.e., clusters) was needed to detect an absolute difference in HWWS after key occasions of 10% between control and intervention groups (15% HWWS after key occasions in the control group, 25% in the intervention group), with 80% power ($\alpha = 0{\cdot}05$). We assumed an average of seven observed HWWS occasions (i.e., when hands could have been washed or not) per household per 3 hour observation period, a within-household intracluster correlation coefficient (ICC) of 0.21 (Biran et al., 2014), and a loss to follow-up (LTF) of 20%.

Each of the three IDP camps was considered as separate stratum and proportionate stratified random sampling was employed to select households across the three strata using complete lists of all households in the sites, randomised within Stata. If a household on the randomised list was non-eligible the next household on the list was approached, and so on until a total of 200 households were enrolled across each stratum. Within each stratum, households were randomly assigned to intervention or control group with a 1:1 ratio using a random number generator in Stata, Version 16.1 (StataCorp, 2019).

2.9. Blinding

The precise nature of the data being collected was not disclosed to participants, instead they were informed that the enumerators would be observing children's routines to build an understanding of how children's health and wellbeing can be improved in the area. Enumerators were informed that all participating households would receive a hand hygiene intervention, but they were not informed of the nature of the intervention received by intervention and control arms, and they had no role in the intervention delivery. Due to the nature of the intervention, no further blinding of study participants or enumerators was possible.

2.10. Statistical analysis

All statistical analyses were undertaken using Stata, Version 16.1 (StataCorp, 2019). We analysed the effect of the intervention on the proportion of key handwashing occasions accompanied by HWWS using a Poisson GEE model for rates, in which the number of handwashes with soap was offset by the total number of key occasions (possible handwashing occasions) per child. The proportion of all handwashes that used soap, was similarly assessed using a Poisson model for rates in which the total observed children's handwashes that used soap was offset by the number of observed handwashes per child. Finally, the total number of observed handwashes with soap was analysed using a Poisson GEE model for counts. In all models, clustering was accounted for at the highest level, the household (because children were nested within the household) and IDP camp was added as a fixed effect because randomisation was stratified across three IDP camps. To increase precision, adjusted rate (or count) ratios were found, adjusting for factors determined a priori to be associated with the outcome (age, sex, number of children aged 5–12 in the household, and number of people earning in the household.)

2.11. Ethics statement

The study was reviewed and approved by the London School of Hygiene and Tropical Medicine Ethics Review Committee (Ref: 22905) and the Research and Ethics Committee at the Ministry of Health, Somalia (Ref: MOH&HS/DGO/0014/2021). Written informed consent was sought from all participating households.

The trial is registered on the Open Science Framework (OSF), osf.io/va9yn.

3. Results

3.1. Participants and baseline data

200 households - 100 intervention and 100 control - were enrolled and completed the study between October 2021 to March 2022. No households were lost to follow up and complete data was obtained from all households (Fig. 2). Baseline prevalence of HWWS after key handwashing occasions was 7% in the intervention group and 5% in the control group. Child-level and household characteristics appeared well balanced between intervention and control group. Baseline characteristics are presented in Table 2.

5.2. Prevalence of handwashing with soap after intervention

The prevalence of HWWS after key occasions increased after baseline observations in both the intervention (+48 percentage points) and control group (+51 percentage points) and remained relatively stable throughout the 16-week follow up (Fig. 3).

3.3. Availability of a handwashing station and soap after intervention

The proportion of households with a handwashing station available increased in both groups, from 81% at baseline to 96% in the intervention group and 93% in the control group. Availability of soap at the handwashing station also increased in both groups. At endline, 99% of intervention households, and 98% of control households with a handwashing station were observed to have soap available at the station, up from baseline levels of 36% and 23%, respectively.

3.4. Primary outcome

There was no evidence of a difference in the proportion of key handwashing occasions that were accompanied by HWWS for children aged 5–12 between the intervention and control group at the 4-week follow-up, the 12-week follow-up, or the 16-week follow-up (16-week follow up: RR 1.0, 95% CI 0.9–1.2, p value = 0.6) (Table 3).

3.5. Secondary outcomes

There was no evidence of a difference in the proportion of all

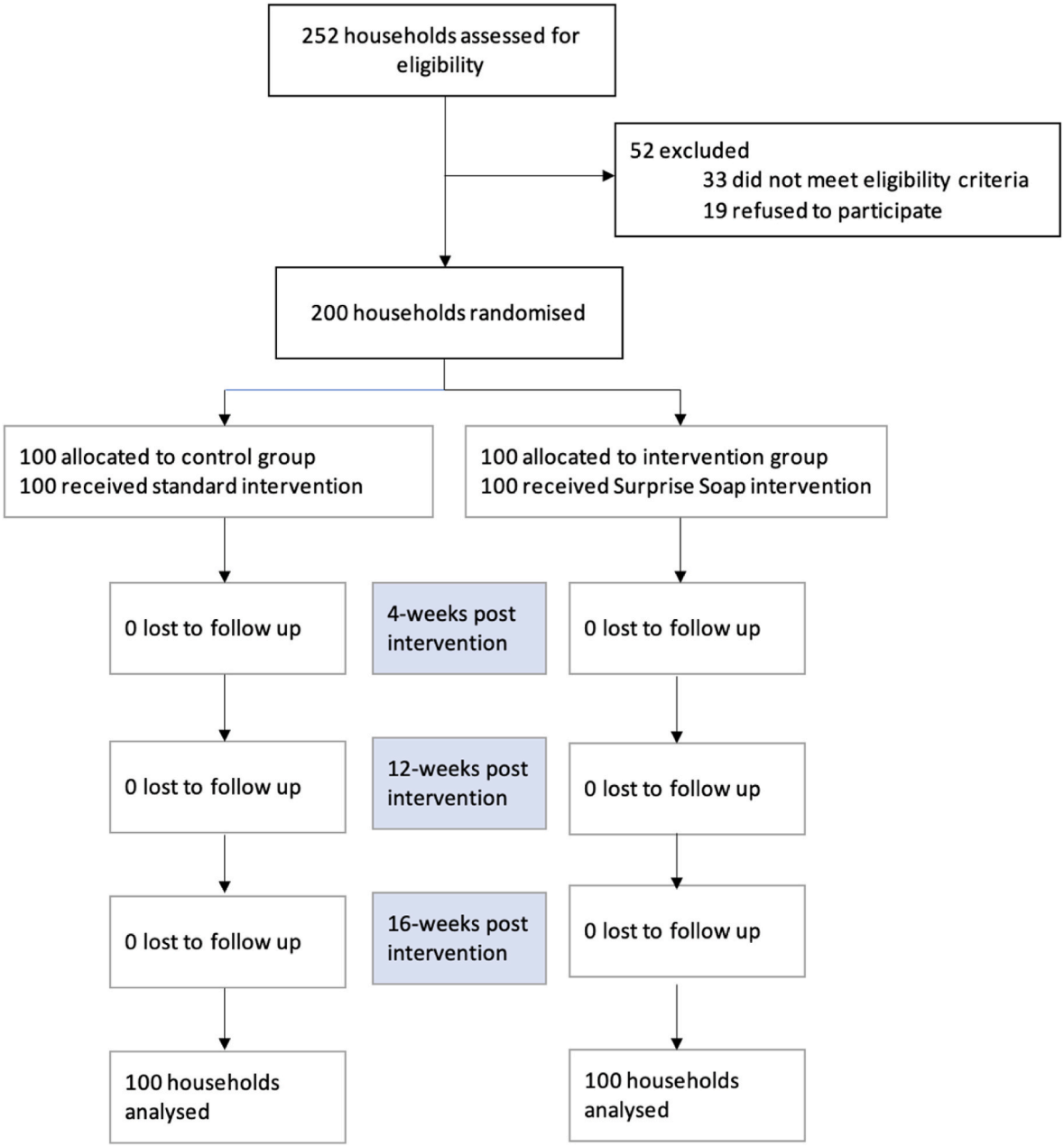

Fig. 2. Trial profile.

handwashes that used soap between the intervention and control group at the 4-week follow-up, the 12-week follow-up, or the 16-week follow-up (16-week follow-up: RR 1.1, 95% CI 1.0–1.3, p value = 0.2) (Table 4).

There was no evidence of a difference in the total number of handwashes with soap between the intervention and control group at the 4-week follow-up, the 12-week follow-up, or 16-week follow-up (CR: 1.1, 95% CI 0.9–1.4, p value = 0.2) (Table 5).

3.6. Surprise Soap compliance

At the 16-week follow up, all households reported that they had finished at least 1 bar of Surprise Soap, indicating they had all engaged with the intervention. 88% (n = 88) of households still had at least 1 bar of Surprise Soap remaining, with a mean of 2 Surprise Soaps remaining per household. Of these households, 91% (n = 80) had a bar of Surprise Soap that was wet on inspection indicating that most households were still engaging with the intervention 16-weeks later. Caregivers reported that it took approximately 5.5 days for children to reach the toy by washing their hands. 77% of households reported 'toy cheats', however, of the 17 Surprise Soaps received per household over the intervention period, only between 1 and 2 Surprise Soaps per household were reported to have been purposefully broken. 28% and 31% of households reported that children under the age of 5 and adults in the household also used the Surprise Soaps, respectively. Only 1 household reported that soap was used for purposes other than handwashing.

4. Discussion

In our trial, we found no evidence that the novel Surprise Soap intervention was more effective in increasing child HWWS than the standard approach of delivering health-based messages, information on how and when to wash hands, and providing bars of plain soap. These findings contrast with those of a previous proof-of-concept trial in an IDP camp in Iraq which found the Surprise Soap intervention to be

Table 2
Baseline characteristics.

Variable	Overall	Intervention	Control
Handwashing			
n (number of potential key handwashing occasions)	1052	517	535
HWWS accompanying key occasions (n, %)	66 (6.3%)	38 (7.4%)	28 (5.2%)
Child			
n (number of children observed)	571	284	287
Age, years (mean, sd)	8.2 ± 2.3	8.0 ± 2.3	8.3 ± 2.3
Sex, male (n, %)	268 (46.9%)	131 (46.1%)	137 (47.7%)
Household			
n (number of households)	200	100	100
Household head education score (mean, sd)	1.2 ± 0.4	1.2 ± 0.4	1.2 ± 0.4
Number earning income (mean, sd)	0.9 ± 0.7	0.8 ± 0.7	0.9 ± 0.7
Number household members (mean, sd)	7.4 ± 2.4	7.1 ± 2.4	7.6 ± 2.4
Number of children <5 (mean, sd)	1.5 ± 1.0	1.5 ± 1.0	1.4 ± 1.0
Number of children 5–12 (mean, sd)	2.6 ± 1.1	2.5 ± 1.2	2.8 ± 1.1
Length of time in residence, months (mean, sd)	30.9, 14.9	29.0, 13.5	32.8, 16.0
Handwashing station available (n, %)	162 (81.0%)	81 (81.0%)	81 (81.0%)
Soap available at station (n, %)	48 (29.6%)	29 (35.8%)	19 (23.5%)
Water available at station (n, %)	160 (98.7%)	81 (100%)	79 (97.5%)
Station reachable by children (n, %)	162 (100%)	81 (100%)	81 (100%)

approximately four times more effective than the standard intervention, which also comprised of household-level health-based messaging and provision of plain soap (Watson et al., 2021).

Although no significant difference in effectiveness was found between the two interventions in Somalia, both interventions – the experimental Surprise Soap intervention, and the standard handwashing intervention that served as an active control – were associated with a large increase in HWWS that was sustained over the 16-week follow-up. Our trial was not designed to assess the independent effects of these two interventions, only to assess whether the Surprise Soap intervention was more effective than the standard approach. However, the strong and sustained association observed suggests that both the standard and the Surprise Soap interventions were similarly effective in increasing and sustaining child HWWS.

Two key differences between the Somalia and Iraq contexts may explain the different results. The first is that children in Somalia had little past exposure to handwashing promotion (information shared by Action Against Hunger) of the type delivered in the active control arm, contrasting with high levels of exposure to such programmes in Iraq. As such, in the Somalia setting, both the Surprise Soap intervention and the standard handwashing intervention may have been similarly novel and therefore both were likely to have engaged children more compared to the populations in Iraq, where standard handwashing messaging was frequently encountered. Although it is often asserted that health messages do not strongly motivate behaviour change (Biran et al., 2009; White et al., 2020; Curtis et al., 2009), more recent studies have

Table 3
Effect of intervention on the proportion of key handwashing occasions accompanied by HWWS.

	Intervention	Control	Rate Ratio[a]	95% CI	P value
Baseline (n, %)	38 (7.4%)	28 (5.2%)	1.3	0.7–2.3	0.3
Week 4 (n, %)	280 (55.1%)	291 (56.4%)	1.0	0.9–1.1	0.6
Week 12 (n, %)	281 (55.0%)	251 (48.8%)	1.1	0.9–1.3	0.5
Week 16 (n, %)	306 (58.0%)	281 (55.3%)	1.0	0.9–1.2	0.6

Poisson for rates generalized estimating equations analyses accounting for clustering at the household level.

[a] Adjusted for age, sex, number of children aged 5–12 in the household, and number of household members earning an income.

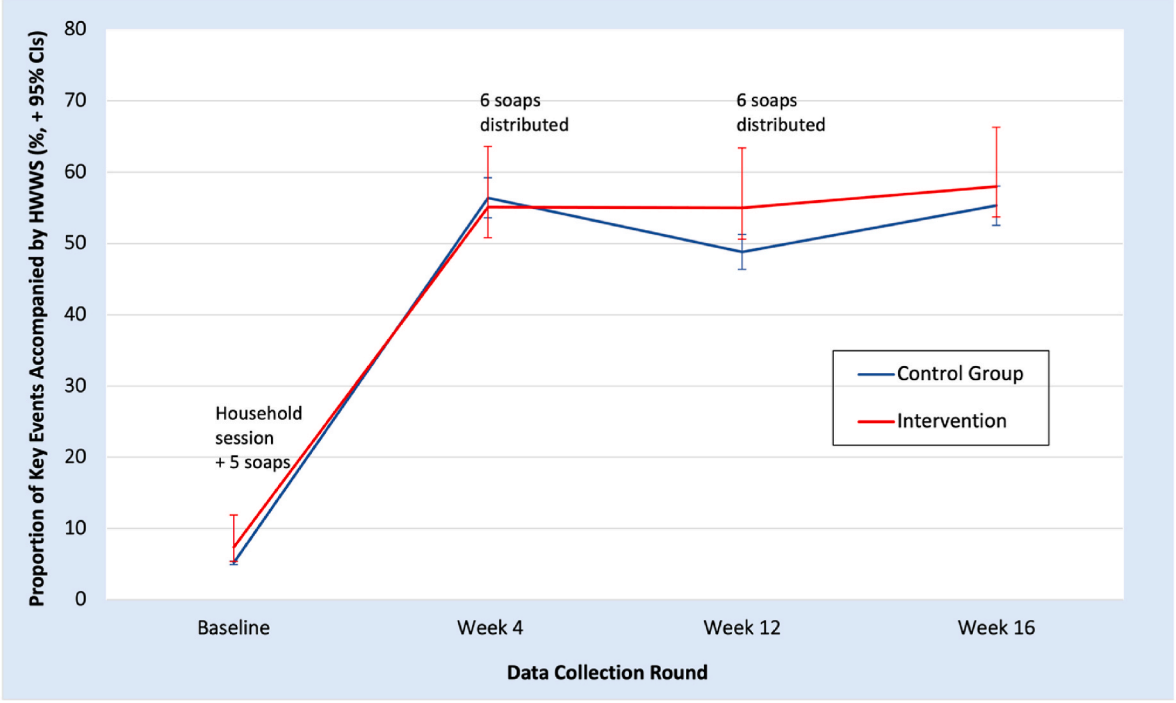

Fig. 3. Prevalence of handwashing with soap over the study period.

Table 4
Effect of intervention on the proportion of all handwashes that used soap.

	Intervention	Control	Risk Ratio[a]	95% CI	P value
Baseline (n, %)	53 (8.6%)	39 (6.3%)	1.3	0.8–2.1	0.3
Week 4 (n, %)	368 (58%)	362 (55.5%)	1.0	0.9–1.2	0.7
Week 12 (n, %)	342 (55.7%)	298 (48.3%)	1.1	0.9–1.3	0.3
Week 16 (n, %)	364 (57.2%)	321 (50.1%)	1.1	1.0–1.3	0.2

Poisson for rates generalized estimating equations analyses accounting for clustering at the household level.

[a] Adjusted for age, sex, number of children aged 5–12 in the household, and number of household members earning an income.

Table 5
Effect of intervention on the total number of handwashes with soap.

	Intervention	Control	Count Ratio[a]	95% CI	P value
Baseline (n)	53	39	1.3	0.8–2.1	0.3
Week 4 (n)	368	362	1.0	0.9–1.2	1.0
Week 12 (n)	342	298	1.1	0.9–1.4	0.3
Week 16 (n)	364	321	1.1	0.9–1.4	0.2

Poisson for counts generalized estimating equations analyses accounting for clustering at the household level.

[a] Adjusted for age, sex, number of children aged 5–12 in the household, and number of household members earning an income.

provided evidence that health messaging in handwashing interventions targeting older children can be effective (Watson et al., 2020, 2021; Okello et al., 2019; Khan et al., 2021). Our study indicates that health-messages can be effective in contexts where they provide new knowledge or present related information in a novel fashion. It also indicates that the effectiveness of the Surprise Soap intervention is not dependant on high levels of health-related handwashing knowledge – as was the case in Iraq – since the intervention appeared to be associated with increased HWWS in a population with low exposure to health-related handwashing promotion. The effectiveness of the Surprise Soap intervention however is likely to be a function of providing soap, information on key times to wash hands, and giving demonstrations of correct handwashing technique. These behaviour change techniques (BCTs) were employed in both the Surprise Soap and the standard intervention. All three BCTs have been found to contribute positively to intervention effectiveness and combining them in child targeted HWWS interventions has been recommended previously (Watson et al., 2021). Our results also indicate that future handwashing interventions should also incorporate these BCTs.

The second key difference between the two contexts is that soap availability in the household was much lower in Somalia than in Iraq. Providing any soap (plain or Surprise Soap) enables those, who are so inclined, to wash their hands with soap more often (Ashraf et al., 2017; Luby et al., 2009; Nizame et al., 2016). In Somalia, the baseline prevalence of HWWS was much lower than in Iraq (6.3% vs 28%), likely a function of the lack of access to soap and low exposure to handwashing promotion, so it is plausible that providing plain soap would be enough to motivate some children to practise more HWWS, whereas, in contexts where access to soap is already high, as in Iraq, providing further plain soap is unlikely to lead to an increase in HWWS (Phillips et al., 2015). Ensuring the physical environment enables HWWS should always be a key consideration when implementing any handwashing intervention.

It should be noted that the standard intervention used in this study was standard in terms of content, however, targeting children at the household level is not standard practice; children are typically targeted in schools within larger programmes (Watson et al., 2021). We chose to deliver the standard intervention at the household level to control for the effects of household delivery, hypothesising that targeting children in the household may give them more ownership of their handwashing practices and encourage caregivers to reinforce the messages. Though we cannot say for certain, the household-level delivery may be associated with the increase in HWWS observed in both groups. Additionally, like the Surprise Soap intervention, the standard intervention entailed a short, simple, one-off session. Both interventions were therefore relatively low-resource, quick to implement, and rapidly deployable, overcoming common challenges facing handwashing interventions (Saboori et al., 2011, Antwi-Agyei et al., 2017; Deroo et al., 2015; Alexander et al., 2013; Alexander et al., 2016) and making them feasible to deliver in emergency settings.

When considering whether to implement the Surprise Soap intervention, we urge practitioners to undertake formative work to understand the context – specifically the level of exposure to past handwashing promotion and availability of soap in the households. If they find that children have not had much exposure to handwashing promotion and soap availability is low, as in the IDP camps we worked in for this study, then it is probably more cost effective to implement a standard household-level intervention and distribute plain soap, perhaps switching to the Surprise Soap intervention when the standard intervention no longer increases or maintains higher rates of HWWS. However, if exposure and soap availability is high, the Surprise Soap intervention may be a more effective option, justifying the higher cost of bars of Surprise Soap (2 USD vs 1.5 USD for plain soap – costs in our study). Ultimately, what our study indicates is that, in emergencies, specifically targeting children with low-resource, rapidly deployable, handwashing promotion at the household level, creating a physically enabling environment (i.e., ensuring soap and water are available), and making sure they know when and how to practise HWWS is an important public health intervention.

This study has several limitations. Firstly, given the nature of the intervention, it was not possible to blind the enumerators to intervention status, which may have introduced observer bias. It was also not possible to blind the participants to intervention status. Due to time and budgetary restraints, we randomised at the household-level and not at camp-level, so it is likely that participant households were aware that some households received Surprise Soap and others plain soap, possibly leading to courtesy bias in the intervention group. Secondly, randomising at the household level presents the risk of contamination across arms which may have biased the estimate of intervention effect towards the null. However, it is unlikely that households in the intervention arm shared their bars of Surprise Soap with households in the control arm, so we perceive this risk to be low.

Thirdly, we used structured observations to measure handwashing. Although considered the 'gold standard' for measuring handwashing (Biran et al., 2008), this method is still at risk of social desirability bias (Ram et al., 2010), observer bias, and the 'Hawthorne Effect' or reactivity (McCambridge et al., 2014), where children modify their behaviour in response to their awareness of being observed (Grover et al., 2018; Ram et al., 2010). The large increases in HWWS prevalence in both study arms post intervention delivery may partly be attributed to this since, after receiving either of the interventions, households may have become aware that their handwashing practices were being observed. However, we used prolonged observation periods (3 h) and observation took place at multiple time points which likely reduces the risk of reactivity bias (Halder et al., 2013). During spot checks we also observed a large increase in the availability of soap at handwashing stations in both study groups. Given this is considered a proxy indicator of HWWS (Ram PK et al., 2014), it adds support to the hypothesis that the increased rates of HWWS observed in both groups were attributed to the intervention, as do the indicators of compliance we recorded for the intervention group which suggest most households were using Surprise Soap at endline.

Fourth, we employed an active control and saw no evidence of a difference in effectiveness between this and the intervention arm.

Although both interventions were associated with similarly large increases in HWWS, our trial design does not permit causal inference with regard to the independent effects; for this, a passive control group would be required. Finally, and this is not a limitation per se, but it should be noted that, because the plain soap, delivered as part of the standard intervention was identical to the Surprise Soap minus the toy, it was a different type of soap than the households would usually purchase (it was scented and colourful and, anecdotally, perceived to be of higher quality and more attractive). This may have provided an additional motivation for children to use it. As such, we cannot say for certain that distributing 'regular' plain soap within a standard household session would lead to the same results, especially considering that quality of handwashing materials has been reported as an important determinant of child handwashing in humanitarian settings (Watson et al., 2020).

5. Conclusions

Across selected IDP camps in the Kahda District of Somalia, where soap availability and exposure to hygiene promotion is low, it appears that well-designed, household-level handwashing interventions that directly target children and include the provision of soap, can increase children's HWWS and potentially reduce disease risk. In these camps, the Surprise Soap intervention offers no marginal benefit over a standard household-level handwashing intervention that would justify the additional costs, both were similarly effective. Knowledge of context, specifically related to hygiene promotion exposure and availability of handwashing hardware, should inform selection of future handwashing promotion approaches.

Declaration of competing interest

The authors declare no conflict of interests.

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