Effect of a behaviour-change intervention on handwashing with soap in India (SuperAmma): a cluster-randomised trial

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Summary

Background Diarrhoea and respiratory infections are the two biggest causes of child death globally. Handwashing with soap could substantially reduce diarrhoea and respiratory infections, but prevalence of adequate handwashing is low. We tested whether a scalable village-level intervention based on emotional drivers of behaviour, rather than knowledge, could improve handwashing behaviour in rural India.

Methods The study was done in Chittoor district in southern Andhra Pradesh, India, between May 24, 2011, and Sept 10, 2012. Eligible villages had a population of 700–2000 people, a state-run primary school for children aged 8–13 years, and a preschool for children younger than 5 years. 14 villages (clusters) were selected, stratified by population size (<1200 *vs* >1200), and randomly assigned in a 1:1 ratio to intervention or control (no intervention). Clusters were enrolled by the study manager. Random allocation was done by the study statistician using a random number generator. The intervention included community and school-based events incorporating an animated film, skits, and public pledging ceremonies. Outcomes were measured by direct observation in 20–25 households per village at baseline and at three follow-up visits (6 weeks, 6 months, and 12 months after the intervention). Observers had no connection with the intervention and observers and participant households were told that the study was about domestic water use to reduce the risk of bias. No other masking was possible. The primary outcome was the proportion of handwashing with soap at key events (after defecation, after cleaning a child's bottom, before food preparation, and before eating) at all follow-up visits. The control villages received a shortened version of the intervention before the final follow-up round. Outcome data are presented as village-level means.

Findings Handwashing with soap at key events was rare at baseline in both the intervention and control groups (1% [SD 1] *vs* 2% [1]). At 6 weeks' follow-up, handwashing with soap at key events was more common in the intervention group than in the control group (19% [SD 21] *vs* 4% [2]; difference 15%, p=0·005). At the 6-month follow-up visit, the proportion handwashing with soap was 37% (SD 7) in the intervention group versus 6% (3) in the control group (difference 31%; p=0·02). At the 12-month follow-up visit, after the control villages had received the shortened intervention, the proportion handwashing with soap was 29% (SD 9) in the intervention group and 29% (13) in the control group.

Interpretation This study shows that substantial increases in handwashing with soap can be achieved using a scalable intervention based on emotional drivers.

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See **Comment** page e118

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See **Online** for an audio interview with Katie Greenland

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Introduction

Improved hand hygiene has the potential to reduce morbidity and mortality from infections spread by faecal-oral routes and person-to-person contact. Infections preventable by improved hand hygiene include gastrointestinal infections,[1,2] respiratory infections,[1,3,4] trachoma,[5] fatal neonatal infections,[6,7] and possibly worm infections.[8] Diarrhoea and respiratory infections remain the two most important causes of child death globally.[9] Improved hand hygiene can also improve child development and school attendance.[10–13] Hygiene promotion has been suggested to be one of the most cost-effective interventions for prevention of infectious disease.[14]

Knowledge about the health benefits of handwashing is widespread. For example, 92% of respondents in Kenya knew that germs on hands cause diarrhoea.[15] However, in studies in several countries including India,[16] Ghana,[17] China,[15] Bangladesh,[18] and Kenya[19] only between 2% and 29% of participants washed their hands with soap after defecation or toilet use. Even in the UK, where soap and water are conveniently available and education levels are high, handwashing remains suboptimum from a public health perspective.[20,21] These data suggest that effective behaviour change might need more than just communication of information.

Several social cognitive models are commonly used to explain health behaviours. These models, and the behaviour change interventions they inform, generally focus on beliefs about target behaviours.[22] By contrast, research[15] done by our group into the motivations underlying handwashing practice across several

countries, suggested that emotional drivers, notably nurture (the desire for a happy, thriving child), disgust (the desire to avoid and remove contamination), affiliation (the desire to fit in with what others in a reference group are perceived to be doing), status (the desire to have greater access to resources than others in the group), and habit, had a more important role than rational health beliefs. Thus far, efforts to change handwashing behaviour on a large scale have had little success,[16,23–25] possibly because they have focused on beliefs about the health benefits of handwashing with soap and given relatively little attention to the effect of emotional drivers.

Our group has used the emotional driver disgust to promote handwashing with soap in behaviour-change campaigns in Burkina Faso[26] (where avoiding the smell and mess associated with faecal contamination of the domestic environment was used to drive the uptake of children's potties) and Ghana[27] (where a television advert was used to graphically depict the spread of contamination from the latrine to food via hands), but as far as we are aware the effectiveness of an intervention to promote handwashing with soap using non-health messages has never previously been assessed in a controlled trial. We aimed to test the effect of such an intervention on handwashing behaviour.

Methods

Study design and population

The study was done in two *mandals* (sub-district administrative units) in Chittoor district in southern Andhra Pradesh, India, between May 24, 2011, and Sept 10, 2012. 14 villages (clusters) were selected by simple random sampling from a list of 57 that were eligible. Eligibility criteria were: having a population of between 700 and 2000 people, having a state-run primary school attended by children aged between 8 and 13 years, and having an *anganwadi* centre (preschool) attended by children younger than 5 years. Any village less than 3 km away from a previously selected study village was replaced by a new, randomly selected village.

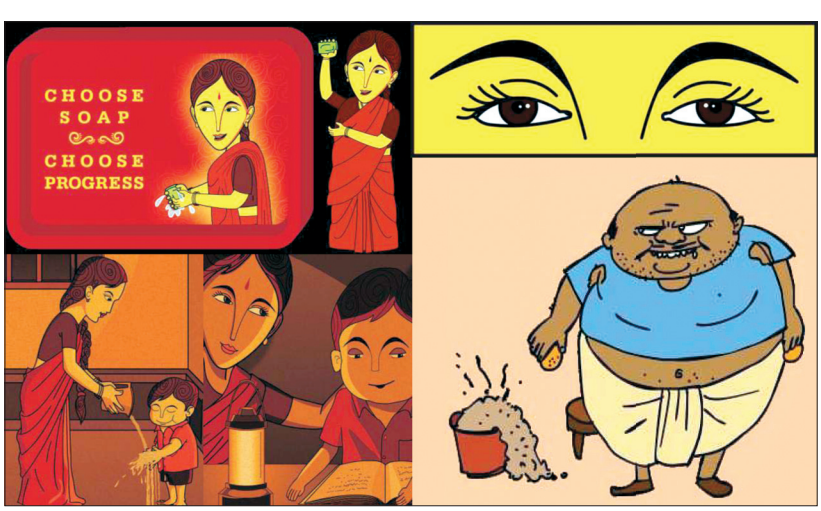

Figure 1: Images from the campaign materials

Written, witnessed, informed consent was obtained from all household members aged 14 years and older. The written and witnessed informed consent of a parent or guardian was obtained for children younger than 14 years. Ethics approval for this study was granted by the ethics committees of the London School of Hygiene & Tropical Medicine and St John's National Academy of Health Sciences, Bangalore.

Randomisation and masking

Clusters were enrolled by the study manager. Random allocation was done by the study statistician in the UK using a random number generator in Microsoft Excel. Villages were randomised within two strata based on population size (<1200 population *vs* >1200 population). Seven villages were assigned to receive the intervention; seven control villages received no intervention. Outcomes were measured by observers who had no connection with the intervention. Observers were not told that the study was assessing an intervention and the intervention was never mentioned to the observers. To minimise the effect of the presence of the observers on behaviour, observers and participant households were told that this was a study of domestic water use. Participants were not explicitly told that they were taking part in a study about handwashing. Presence of observers in the household was mentioned in the consent form. No further masking of participants or investigators was possible because of the nature of the intervention.

Procedures

Data were collected at baseline, 6 weeks after the intervention, and again at 6 months after the intervention. A final round of data collection was done 6 months later. Data for handwashing practices were collected through direct structured observation, as used in previous studies.[16,19,26] Observations took place from 0530 h to 0830 h when most householders were present and when the behaviours of interest were likely to be seen.[17] Observers recorded the handwashing behaviour of all household members. All occurrences of the four key event types (after defecation, after cleaning a child's bottom, before food preparation and before eating) were recorded as well as the age and gender category of the actor involved (man, woman, school-aged child, preschool child).

The intervention was designed on the basis of formative research, done at the study site and at sites in other countries, to understand the influences and constraints on handwashing practice and the opportunities for intervention.[15,17,19,28] We used the Evo-Eco model[29] as a framework to help guide the interpretation and analysis of formative research data. The model draws on evolutionary theory, psychology, and neuroscience to propose a systematic means of classifying the influences and drivers of human behaviour. The model components

	Content	Purpose
Day 1		
Meet with the village chairman*	Flip chart presentation explaining and outlining activities Chairman photographed washing hands with soap and filmed making a statement of support	Gain support of leadership and prominent individuals Creation of role-model posters and video
Put up posters*	SuperAmma posters around village	Generate interest
Campaign truck*	Display campaign logo and broadcast campaign song	Generate interest
Invitations to community event*	Delivery of invitation cards door to door	Boost attendance at the community event
School event*	Flip-chart presentation to teachers explaining and outlining the planned activities Skit on the disgusting nature of handling food without HWWS Discussion about daily routines involving hands All children make a group pledge Badge distribution (showing a boy or girl character using soap) Children record their handwashing practices and those of other household members for a week; cards checked daily by teacher Children colour and carry an invitation for their mothers to attend the community event Handwashing station set up in school playground; monitors oversee HWWS before eating Children parade through the village banging drums, waving placards, and chanting SuperAmma slogans)† Teacher photographed washing hands with soap and filmed making a statement of support for the campaign	Gain support of teachers for the intervention Disgust motive Insert HWWS into routines Establish a group norm Marker of belonging to HWWS group Children influence their families to HWWS and establish habit Increase attendance at the community event Reinforce habit of HWWS before eating Generate interest Creation of role-model posters and video
AWW meeting‡	Flip-chart presentation explaining and outlining the planned activities AWW photographed washing hands with soap and filmed making a statement of support	Gain support of AWW for intervention Creation of role-model posters and video
Community evening event*	Drive truck through village announcing the event and play campaign song Screening videos, or statement of support from village chairman, teacher, or AWW Screening of animations Comic skit Pledging ceremony for women Distribution of gift (cut-out model of SuperAmma) and certificate for pledge participants Prize draw (for mobile phone)	Raise awareness of and increase attendance at the event Locally relevant role models to endorse campaign and promote HWWS Disgust, nurture and status motives Disgust, nurture and status motives Establish group norm Reward to encourage others to take part and to serve as a reminder to participants Increase attendance at the event
Day 2 (long intervention)		
Household visit*	Door-to-door visits by promoters or a village volunteer Campaign logo sticker on the door of pledged households SuperAmma sticker in the bathrooms of pledged houses	Remind women to HWWS, invite to anganwadi event, identify pledged women HWWS norms spreading through village; pledged households identify with the campaign Cue to perform HWWS, encourage habit formation
Posters of role models*	Posters of the chairman, teacher, and AWW HWWS put up around village	Legitimise campaign, create interest, encourage social norm, link HWWS to respected role models
Anganwadi event	Screening of videos, comic skit, discussion and pledging as Day 1 event	As above for those who did not attend previously
School visit	Check that facilities are in place and that HWWS is being organised before lunch Check report cards	Maintain HWWS towards establishing habit Reminder for children and families about the importance of HWWS
Honour board	Erect a large board in a prominent, public place listing names and photographs of pledgees	HWWS as a social norm
Ad hoc men's meetings	Promoters discuss the campaign with groups of men	Encourage men to support HWWS
Neighbourhood pledging*	Gather small groups of women outside their houses; show animated films on laptop; pledging and stickers	To reach women who did not attend the previous events
Community evening event	As for Day 1 Announcement of results of household survey	To reach people who did not attend the Day 1 event Encourage impression of social norm of HWWS
Days 3–16 (long intervention); Days 2–8 (short intervention)§		
Household survey	Door to door visits by a village volunteer	As described for Days 1 and 2
Report cards*	Completed by children and checked by teachers	As described for Days 1 and 2
School lunchtime HWWS*	Organised HWWS for children before lunch	As described for Days 1 and 2
Day 17 (long intervention)		
Neighbourhood pledging	As for Day 2 of long intervention	Reach women who have not attended events on Day 1 and on Day 2 of the long intervention
Update honour board	Add stickers against the names of pledgees	HWWS as a social norm
Ad hoc men's meetings School visit	As for Day 2 of long intervention	As for Day 2 of long intervention

(Table 1 continues on next page)

	Content	Purpose
(Continued from previous page)		
Days 18–24 (long intervention)		
Interim activities as previously	As previously	As previously
Day 25 (long intervention); Day 9 (short intervention)		
Neighbourhood pledging Update honour board	As for Days 2 and 17 of long intervention	As for Days 2 and 17 of long intervention
Video testimonials*	Film short interviews with local people who have taken part in activities	For use in the community event to draw attendees and reinforce norms
School event*	Check report cards "Poo tag", a chasing game (disgusting things being spread by touch and the use of soap to prevent this) Flip-chart stories (about children who have bad manners, do not wash with soap and are rejected by their peers; followed by interactive discussion) Class pledge Distribution of certificates and small gifts to children and teacher to celebrate the fact that this is a "handwashing class"	Link HWWS to avoidance of disgust Link HWWS to social norms and affiliation Reinforcement and reminder Reinforce idea that the class has a norm of HWWS Reinforce idea that the village has a norm of HWWS
Community event*	Congratulations to village on becoming HWWS village Screening video testimonials Screening animations Comic play Pledging ceremony Speech by chairman Gift to the village—certificates and small bars of soap in SuperAmma packaging Final group pledge	Reinforce idea that the village has a norm of HWWS As for Day 1 As for Day 1 As for Day 1 Link HWWS to respected role model Reinforce village HWWS norm and serve as a reward and reminder to households Reinforce village HWWS norm

HWWS=handwashing with soap. AWW=*anganwadi* worker. *Component retained in the revised, short version of the intervention (retained components that took place on days 2 and 17 of the long intervention were added to days 1 and 9 of the short intervention). †This element of the intervention was dropped from the schools component of the short intervention. ‡Pre-school. §Interim activities by teachers and village volunteers (these activities occurred during this period but not necessarily every day).

Table 1: **Components of the intervention**

form a theory-based checklist of factors that an intervention might seek to alter to achieve behaviour change. Thus we considered the physical and social environments, existing behavioural routines, and fundamental human motivations[15,30] associated with handwashing practice. The final intervention design was informed by the formative research but also shaped by financial and logistical constraints.

A Bangalore-based creative agency designed communication concepts based on nurture, disgust, affiliation, and status as motivational drivers of handwashing.[15] The concepts were refined through pilot testing with groups of mothers from non-study villages.

The campaign that emerged focused on a central character (SuperAmma)—an appealing, forward-thinking rural mother who had a loving, nurturing relationship with her son, teaching him good manners and ensuring that they both used soap for handwashing. It also featured a comical, male character whose disgusting habits were humorously contrasted with those of SuperAmma. Figure 1 and the video show some of the campaign materials.

See Online for video

A professional events management agency (henceforth referred to as the implementation agency) with experience in organisation and implementation of community events, was engaged to deliver the intervention using a team of four people (two facilitators, an audio-visual technician, and a driver). The facilitators were members of a street theatre troupe with experience of creation and delivery of performances relating to social issues. We used one delivery team, which maintained the same members throughout the study.

Delivery of the intervention by the implementation agency took place on 4 days in each village. The first 2 days of delivery were consecutive, the third day of delivery occurred 14 days later, and the fourth day of delivery after a further 8 days. The spacing of intervention delivery days was determined by the logistics of working in seven villages and allowing rest days for the team. All villages received the first 2 days of delivery before the implementation agency returned to the first village to begin their third day of delivery across all villages and then their fourth day of delivery. The order in which villages were visited remained constant.

Activities delivered by the implementation agency included community and school-based events incorporating a *SuperAmma* animated film, skits contrasting the clean habits of SuperAmma with her dirty comic counterpart, and public pledging ceremonies during which groups of women promised to wash their hands with soap at key event times and to help ensure their children did likewise. The pledge followed a specific script intended to link handwashing to social identity and included an element of theatre (the women stood together with one hand raised), intended to add some solemnity to the activity. The names of those who had pledged were placed on a public display board and posters featuring images of local opinion leaders washing hands were prominently displayed around the villages. Provision of soap was not part of the intervention. Interim activities

took place in villages between the visits of the implementation agency. These components were intended to maintain the visibility of the campaign and to encourage repeated practice of the target behaviours.

A short version of the intervention focusing on elements shown to be promising (according to the process assessment of the original intervention) was implemented in the control villages after the second follow-up survey. This step was done to explore whether a shorter and therefore more scalable intervention could achieve much the same outcomes as the longer intervention. The short version used two visits by the implementation agency separated by a gap of 8 days during which some interim activities took place.

Table 1 outlines the intervention content. The numbering of days in table 1 refers to the duration of activities in one village. Thus day 1 is the first day on which intervention activities took place, day 24 is the last day on which intervention activities took place in the long intervention, and day 9 is the last day of the short intervention. This outline assumes an ideal delivery sequence of 6 working days followed by a rest day. In practice, minor deviations occurred as a result of public holidays, religious festivals, and bad weather. A film describing the intervention, the animated film, and more details of the intervention components including the pledging ceremony can be found at the SuperAmma campaign website.

All villages had water supplied through hand-pumps and gravity-fed public standpipes with intermittent supply. More than 80% of households were within a few metres of a standpipe and 20% of households had a standpipe within their yard. Open defecation in the surrounding fields was the norm in all villages. Soap (often more than one bar) was present in all houses, usually kept on a shelf at the bathing place or on a windowsill.

We employed young, female observers who would not be regarded as intimidating. One observer was placed in the courtyard of each house. The observers were replaced by a new set of observers before the second follow-up round. Intervention and control villages were observed in parallel (two at a time, based on logistical convenience) to control for any secular trends. The observers used coded sheets to record their observations and wrote a short description for each observation. All record sheets were checked for completeness and internal consistency each day.

For each village, outcomes were assessed in a random sample of 25 households that had at least one child aged between 8 and 13 years who attended the state-run primary school in the village. Class registers provided the basis for the sample frame. For the 6-month observation, 15 participating households in each village were excluded at random and replaced with 10 new households selected at random according to the same selection procedure, providing a total of 20 households per village. This procedure was done to study the potential for reactivity attributable to repeated observation.

Outcomes

The primary outcome measure was the proportion of key events (after defecation, after cleaning a child's bottom, before food preparation, and before eating) on which hands were observed to be washed with soap at all follow-up visits. Secondary outcome measures were the proportion of all observed handwashes that used soap and the total number of handwashes observed at all follow-up visits. Social, demographic, and economic data were collected from all participating households through a verbally administered questionnaire.

Statistical analysis

We calculated that a sample of 14 clusters (villages) with 25 households per cluster would allow us to detect a difference at 6 weeks in handwashing with soap of 20% between control and intervention (5% handwashing with

For the **campaign website** see http://www.SuperAmma.org

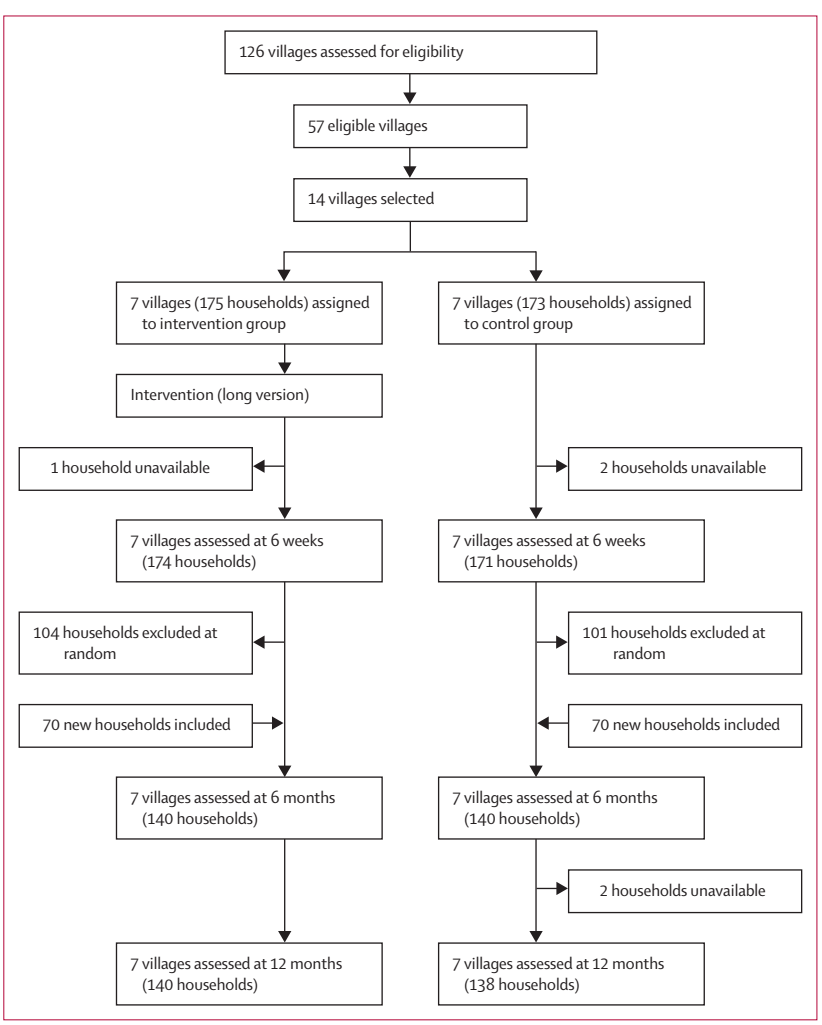

Figure 2: **Trial profile**

soap in control group, 25% in intervention group), with 80% power (α=0·05). We assumed an average of 12 observed handwashing occasions (ie, when hands could have been washed or not) per household per 3 h observation period and a between-cluster coefficient of variation of 0.[5] Data were double entered into a spreadsheet using Epi Info and statistical analyses were done using STATA (version 11).

We used a cluster-level analysis to account for the village-level allocation of the intervention. Analysis of cluster-level proportions, as opposed to analyses done at the level of participants or individual handwashing occasions, is a suitable method to account for clustering of handwashing prevalence in villages if the total number of clusters is small.[31] In a cluster-randomised trial, this approach commonly also accounts for lower-level clustering, which is expected to increase between-village variability.[31] We calculated prevalence of cluster-level handwashing and soap use at baseline and follow-up for each village. Since the distribution of the village-level proportions deviated from normal in the intervention group, we used a permutation test on the standard *t* test (the permute command in STATA) for the estimation of statistical significance, stratified by randomisation blocks of different population size.[31]

Planned subgroup analyses were stratification by sex, socioeconomic status, caste, and level of education. We used principal component analysis of proxies of socioeconomic status (ownership of land, animals, household assets, water access, and house characteristics) to classify households by socioeconomic status. Statistical support for effect modification was assessed by computing the differences in handwashing prevalence between subgroups within each village and then comparing the mean differences between intervention and control villages using the permutation test.[32] We calculated intraclass correlation coefficients using STATA's loneway command.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. KSV, AB, and W-PS had full access to all the data in the study. AB made the final decision to submit for publication.

Results

Selected villages ranged in size from 732 to 1857 people (median 962). At baseline there were 175 households in the seven intervention villages and 173 in the seven control villages (figure 2). Intervention and control households had much the same social and demographic characteristics (table 2). We observed 15 handwashing occasions (SD 7; when hands could have been washed) per 3 h observation period per household in the intervention group versus 14 occasions (7) in the control group at baseline, 17 (8) versus 15 (7) occasions at 6 weeks, 22 (8) versus 26 occasions (11) at 6 months, and 20 (9) versus 22 occasions (10) at 12 months. About a third of handwashes could be clearly associated with key events (after defecation, after cleaning a child's bottom, before food preparation, and before eating). The most common occasion observed was "handwash at other time" (ie, handwashes not associated with key events).

Handwashing with soap at key events was rare at baseline in both the intervention and control groups (1% [SD 1] *vs* 2% [1], figure 3). We identified strong evidence that, at 6 weeks' follow-up, handwashing with soap at key events was more common in the intervention group than in the control group (19% [SD 21] *vs* 4% [2]; difference 15%, p=0·005, figure 3). Restriction of the analysis to occasions with potential faecal contact (after toilet or child cleaning) showed much the same result (28% [SD 33] *vs* 7% [8], p=0·18), as did handwashing with soap before eating or food preparation (17% [SD 19] *vs* 3% [2] p=0·003), and overall soap use for handwashing (36% [SD 15] *vs* 19% [3]; p=0·001, figure 3). At 6 weeks, there were substantial differences between intervention villages in handwashing with soap (figure 4), suggesting a substantial initial heterogeneity in intervention effect. The last three villages to receive the intervention had much higher prevalence of handwashing with soap after intervention than did the

	Control (N=173 HH)	Intervention (N=175 HH)
Village size (mean, range)	1088 (732–1675)	1095 (773–1857)
Family size (mean, SD)	5·2 (1·7)	5·1 (1·9)
Land ownership	118 (68%)	123 (70%)
Irrigated land ownership	64 (37%)	56 (32%)
Ration (BPL) card	168 (97%)	168 (96%)
Electricity	157 (91%)	156 (89%)
Latrine or toilet	5 (3%)	11 (6%)
Water source for bathing or washing		
Tap or standpipe	151 (87%)	144 (82%)
Open or closed well	5 (3%)	9 (5%)
Handpump	7 (4%)	18 (10%)
Reservoir	7 (4%)	4 (2%)
Other	2 (1%)	2 (1%)
Water source located in compound	35 (20%)	30 (17%)
Highest education level of adults		
None	29 (17%)	40 (25%)
Some primary	42 (24%)	26 (15%)
Primary completed	35 (20%)	30 (17%)
Some secondary	40 (23%)	39 (22%)
Secondary completed or higher education	28 (16%)	39 (22%)
Caste (%)		
Other (forward) caste	9 (5%)	19 (11%)
Backward castes	100 (58%)	100 (57%)
Scheduled caste	52 (30%)	33 (19%)
Scheduled tribe	2 (1%)	11 (6%)
Muslim	10 (6%)	11 (6%)

Data are n (%) unless otherwise specified. HH=households. BLP=below poverty line.

Table 2: **Social and demographic characteristics of the study population at baseline**

earlier villages (figure 4).

At 6 months' follow-up, handwashing with soap at any key events had increased further in the intervention group (37% [SD 7]) but remained largely stable in the control group (6% [SD 3] difference 31%, p=0·002, figure 3); handwashing at other occasions followed the same pattern (data not shown). This further increase (figure 3) was entirely attributable to an increase in handwashing with soap in villages that had previously shown little change, whereas villages that had initially had a large change in handwashing behaviour remained stable at the level of the initial increase (data not shown). The short intervention implemented in the control group achieved much the same increase in handwashing with soap when assessed at the 12-month visit (ie, 6 months after the intervention; figure 3).

The prevalence of not washing hands at all key events decreased substantially in the intervention group from 79% (SD 4) at baseline to 57% (16) at 6 weeks' follow-up (prevalence at 6 weeks in the control group was 69% [8], p=0·11). At 6 months, prevalence decreased further to 37% (SD 8) versus 59% (7) for control (p=0·01)—ie, the effect of the intervention was not only attributable to the addition of soap to existing handwashing practice but also to an increase in handwashes.

Comparison by actor could only be done for overall soap use for handwashing because too few key events were observed in men. The intervention increased soap use by all household members. Handwashing with soap by children was generally higher than in adults; prevalence was much the same in men and women. For example, at 6 weeks' follow-up in the intervention group, handwashing with soap had increased from 32% (SD 3) to 51% (13) in school-aged children (no difference by sex), from 10% (5) to 28% (17) in women, and from 13% (4) to 31% (12) in men, while remaining unchanged in men, women, and children in the control group (data not shown). On the basis of data from the 6-week follow-up, the effect size seemed to be higher in better-educated households (table 3). Effect size did not differ significantly by socioeconomic status or caste (table 3). Households with water in the compound did not practise more handwashing with soap than those without, either at baseline or at follow-up; the effect of the intervention was almost identical in households with and without water access in the compound (data not shown).

The village-level intraclass correlation coefficient of handwashing with soap after key events was 0·004 at baseline and 0·04 at final follow-up. The corresponding within-household intraclass correlation coefficient was 0·07 at baseline and 0·21 at last follow-up.

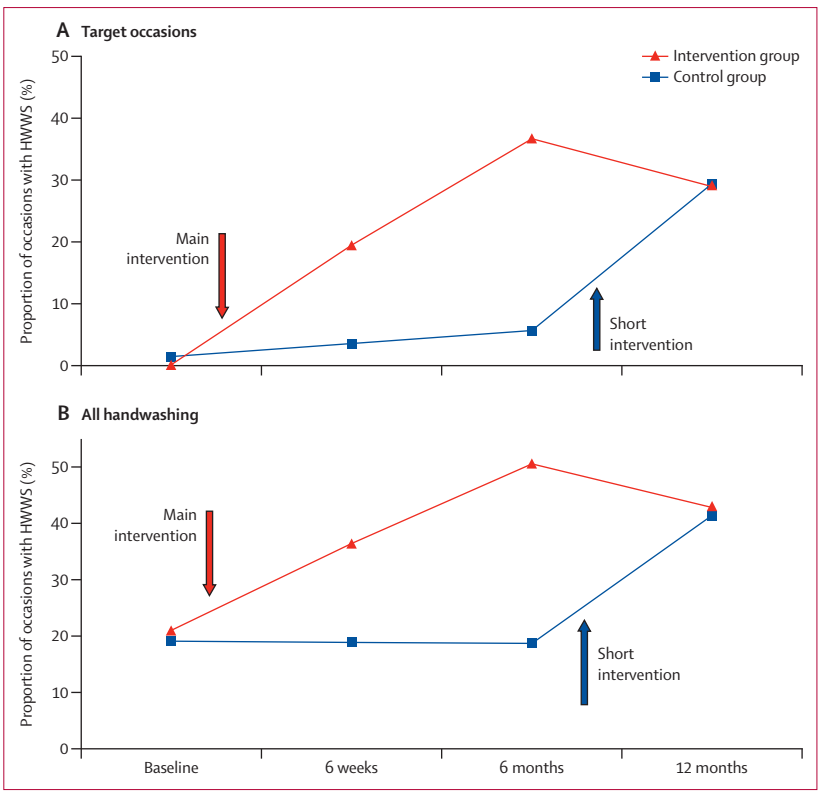

Figure 3: **HWWS before and after intervention, by study group**
(A) HWWS at specified key occasions (after defecation, after cleaning a child's bottom, before food preparation, or before eating). (B) Proportion of soap use at any time hands were washed whether or not a reason for handwashing was identified. HWWS=handwashing with soap.

Discussion

A behaviour-change intervention, based on emotional drivers, was effective in significantly increasing the prevalence of handwashing with soap in villages in rural India (panel). Increased handwashing behaviour was sustained for 12 months. Handwashing with soap increased significantly at key event times (after defecation, after cleaning a child's bottom, before food preparation, and before eating) and overall. The overall increase in handwashing with soap was noted in children and in men and women.

The intervention also increased the prevalence of handwashing with soap at all times when hands were washed. The intervention seems to have been both effective in making people switch from handwashing with water to handwashing with soap and also in making people wash hands when previously they did not. However, the importance of the slight reduction in handwashing at the last follow-up might deserve further exploration (figure 3).

We attribute the success of the intervention to the attention paid to understanding the drivers of handwashing behaviour and a design process that allowed full use of these insights. The delivery mode of the intervention was inspired by commercial practices used to deliver branded campaigns to millions of consumers across India. The SuperAmma campaign was designed to be scaled up in a similar manner. Combination of the 2-day intervention with the use of mass media to increase the reach and frequency of contact achieved by the

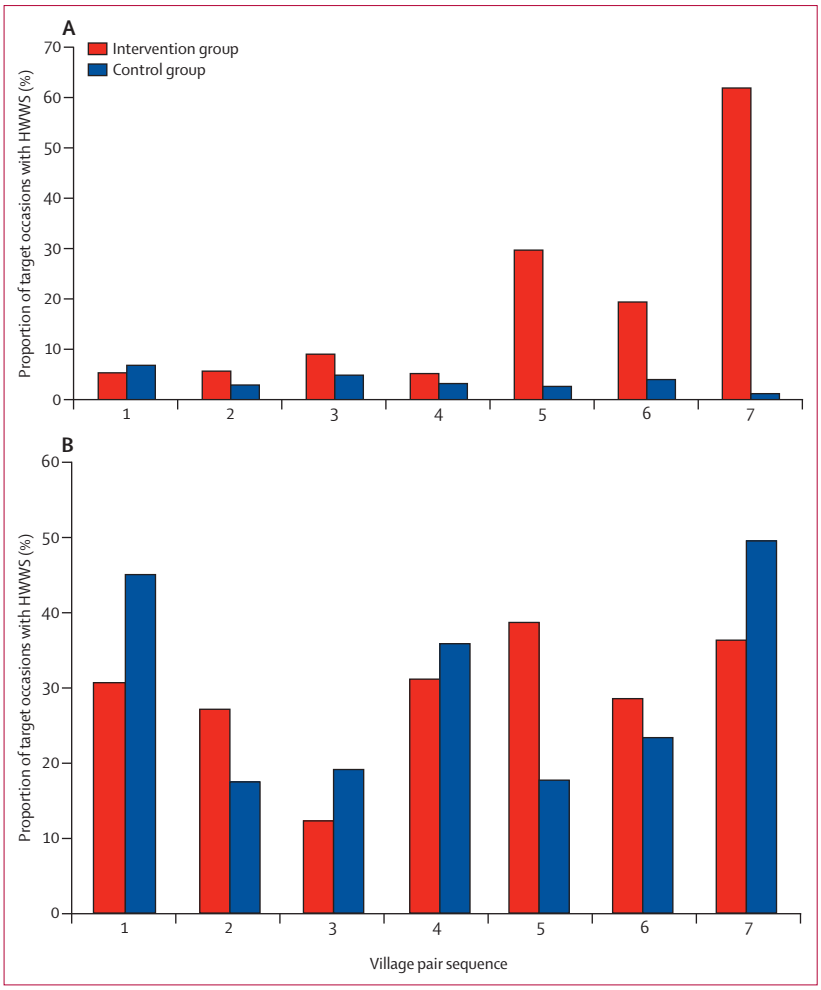

Figure 4: **Village-level prevalence of handwashing with soap at key events**
(A) 6 weeks after the long intervention was delivered to the intervention group. (B) 6 months after the short intervention was delivered to the control group (12 months after the long intervention in the intervention group). Village pairs are ordered according to the sequence in which the intervention and outcome observation were implemented (ie, the intervention was implemented at village 1 first, followed by village 2, village 3, etc. Observation followed in the same order). Pairing is for illustration only—the trial was not pair-matched. Elapsed time between outcome observation in pairs 1 to 7 was about 6 weeks. HWWS=handwashing with soap.

	Number of key events observed	Difference in handwashing, intervention–control (%)	Test for interaction*
Socioeconomic status†			
Low	622	16%	p=0·39
Middle	729	15%	..
High	739	19%	..
Level of education			
None or primary school not completed	809	13%	p=0·07
Primary school completed	822	16%	..
Secondary school completed or higher education	451	22%	..
Caste			
Forward caste, other backward caste	1382	15%	p=0·87
Scheduled caste, scheduled tribes	496	16%	..

Analysis restricted to first follow-up data. *Permutation test based on the standard *t* test of the village-level differences between households of the different strata. For the test, the low and middle categories for socioeconomic status and education were collapsed. †The socioeconomic factor was created by principal component analysis and explained 26% of the variance of included variables.

Table 3: **Subgroup analyses of handwashing with soap at key events by socioeconomic status, education, and caste**

animated film and key campaign messages might offer a promising route to scale. Implementation at scale would require additional implementation teams and supervision, which could affect the quality of the intervention. We cannot conclude that an equivalent degree of behaviour change would necessarily be achieved at scale.

Although the intervention mainly targeted women and school-aged children, it seems to have been successful at changing the handwashing practices of men. We do not know the route by which this change was achieved; however, the process assessment of the intervention (unpublished) showed that adult audiences at the community events were on average 39% men (range 31–48) and the intervention included several ad-hoc meetings with men to build support for the campaign.

The effect of the intervention was substantially greater in the final three villages of implementation than in the first four. Monitoring reports (records of the activities implemented and of any technical or other problems arising) suggest that the quality of the intervention improved as the implementation team became more skilled in its delivery and initial technical difficulties were resolved. The team also learnt how to better elicit the support of key village figures such as the chairman and schoolteachers.

The increase in handwashing between the 6-week and 6-month observations is not easy to explain. Medium-term changes in social norms might have caused delayed intervention effects. However, since it is not possible to mask a study of handwashing behaviour, the observed behaviour of participants might be subject to bias because of differential reactivity between study participants in intervention and control groups to the presence of an observer.[33] Although we cannot discount reactivity, especially with regard to the delayed intervention effect, we identified no evidence for it in a previous similar study.[17] To reduce the potential for reactivity, we replaced a set number of households at the second follow-up. We did not identify any differences in handwashing between previously observed and newly enrolled households (data not shown). Observers, despite being masked to the object of the study, might have become aware that a handwashing intervention had taken place in some villages and not others, which could have influenced

Panel: Research in context

Systematic review

We did not do a systematic review before undertaking this trial. This trial tested an intervention to change a health behaviour without the use of health messages. The intervention was innovative, being grounded in a theoretical understanding of the many influences on behaviour and delivered through a discrete, scalable package of activities. We believe this innovation justifies the trial, particularly in view of present levels of spending on the promotion of handwashing globally. As far as we are aware, no trials on this particular behaviour change approach are available in the scientific literature.

Interpretation

Previous hygiene interventions have often used health messages that seem to be ineffective in achieving sustained changes in handwashing behaviour. The implication of our study is that a carefully designed, scalable hygiene promotion campaign that meets the aspirations of the target audience has the potential to increase handwashing with soap and reduce the associated risk of infectious diseases. In view of our promising results, public health practitioners should consider behaviour change campaigns designed along the lines of the approach presented in this Article.

their coding. For the last round of follow-up, we used a different team of observers, which makes observer bias less likely. Previous studies using direct observation to assess handwashing interventions in India[16] and Bangladesh[23] have shown that differential reactivity is low or absent if participants make no direct link between intervention and assessment. However, we used frequent observations (baseline and three follow-up visits over 1 year) to monitor the immediate effect and sustainability. Future studies could further reduce the possibility of reactivity by not doing a baseline observation and having only one follow-up observation several months after intervention.

We are not able to distinguish the effects of the different components of the intervention, for example, whether disgust, nurture, status, or affiliation was the most important driver of behaviour change. Neither can we say for how long the effects of the campaign will last. Process analysis and follow-up studies will attempt to address these issues.

Whether the observed increase in handwashing with soap is sufficient to reduce infection remains unclear. The promising effect of this intervention on school-aged children suggests that hygiene promotion might need to be planned long term, with the full potential perhaps only realised once schoolchildren become parents.

Contributors

AB and W-PS designed the study. VC, RA, AB, and BG designed the intervention. DR, KSV, RK, AB, and KG contributed to study implementation. DR, KSV, and W-PS analysed the data. AB, KG, VC, RA, DR, KSV, and W-PS wrote the report.

Declaration of interests

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