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Measuring the effect of a hygiene behaviour intervention by indicators of behaviour and diarrhoeal disease

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Abstract

A social marketing approach used both qualitative and quantitative methods to develop a hygiene behaviour intervention in rural north-east Thailand. Behaviours were preselected from a previous study and the intervention was designed to promote hand washing, especially before feeding a baby, cooking, eating, and after defaecation or cleaning a baby's bottom, and dish washing immediately after eating. A bacteriological indicator (enumerating faecal streptococci using a finger impression technique) was developed to measure changes in hand washing behaviour and observation (spot checks) of dirty dishes to indicate dish washing practice. There was a significant improvement in both behaviours and a significant reduction in diarrhoeal disease as a result of the intervention. Furthermore, both indicators were retrospectively found to be positively related to diarrhoeal disease incidence. However, receiving and being able to recall the intervention messages was not necessarily sufficient to ensure behaviour change, as some adults found it difficult to change old habits. Villages showing the greatest improvement tended to have a stronger sense of community than others and to have more people actively involved in the intervention.

Keywords: hygiene behaviour, intervention, evaluation, diarrhoeal disease

Introduction

Hygiene behaviour is receiving increasing attention as an important strategy for preventing faecal–oral disease transmission in developing countries. However, education programmes are notorious for generating long lists of 'good' behaviours in the hope that these will be adopted by the target group and consequently lead to a reduction in disease transmission. LOEVINSHOHN (1990) suggested that successful health education depends on using few messages of proven benefit, repeatedly and in many forums. Unfortunately, the evidence and documentation describing the effectiveness of health education programmes remains weak (FEACHEM, 1984; LOEVINSHOHN, 1990). This has also led to a lack of empirical evidence for selecting the behaviours that are most effective in disrupting disease transmission in any given environment.

There is an obvious need to study how and why people behave, so as to understand the socio-economic and cultural influences which affect hygiene behaviour (BOOT & CAIRNCROSS, 1993). Qualitative information obtained by open interviews and observations is crucial to this process (PATTON, 1990), but behaviour is notoriously difficult to measure quantitatively. Although questionnaire type interviews may be useful for obtaining information about knowledge, evidence suggests that they lead to over-reporting of 'good' behaviours (STANTON *et al.*, 1987; CURTIS *et al.*, 1993). Structured observations made by continuous monitoring have been successfully applied to interventions involving behaviour modification (STANTON & CLEMENS, 1987; BENTLEY *et al.*, 1990). However, this method is time consuming, difficult to standardize and requires a great deal of skill in design to avoid reactivity. Consequently, there is a need to develop simple indicators of behaviour.

Materials and Methods

Site and study outline

The study was conducted in Khon Kaen province in north-eastern Thailand, the largest and poorest region of the country. Most of the population live in rural villages which are fairly cohesive clusters of 60 to about 200 homes. Poor soils and unreliable patterns of rainfall have led to a low-risk approach to farming and a large number of people rely on seasonal migrant work to supplement their income. Typically, villagers rely on a variety of water sources for their domestic needs. Water from conveniently located tube wells is commonly used for washing activities. However, much of the groundwater is saline and rarely used for drinking because of its adverse taste. Artificial ponds provide softer water and are sometimes preferred for specific washing activities. Drinking water is traditionally supplied by shallow wells located in special sites outside the village. However, rainwater harvesting has developed dramatically over the last decade and, when abundant, this is used for both drinking and washing activities. Pour-flush toilets have also proved popular and estimates suggest 70–80% coverage.

Although mortality rates from diarrhoeal disease have diminished in Thailand due to effective measures for treatment, morbidity rates are still high. Over the past decade, there has been a sustained effort to improve the health network in rural areas. All subdistricts now have a clinic staffed by trained personnel and most districts contain a hospital. In each village, there are volunteer

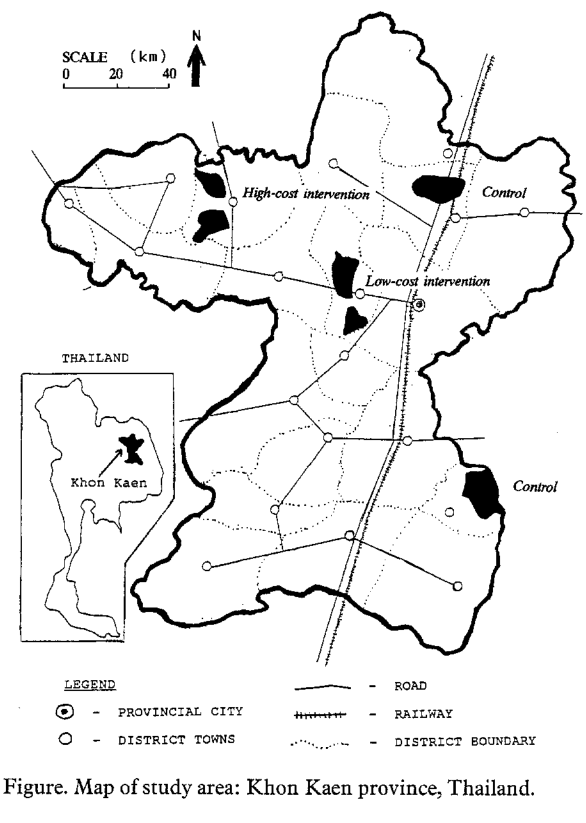

Figure. Map of study area: Khon Kaen province, Thailand.

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village health workers (VHW) who generally assist clinic staff in their work.

This study comprised 2 main parts. Initially, a case study phase was used to formulate the hygiene intervention, train workers, and develop simple indicators of hygiene behaviour. The information obtained was used to design an intervention study able to demonstrate changes in the behavioural indicators, rather than diarrhoeal disease. However, data on diarrhoeal disease were readily available and this information was used to select subdistricts for the study.

Subdistricts in Khon Kaen province were ranked by their incidence rate of diarrhoeal disease as recorded by health services. Those containing large towns and district hospitals were excluded, and the 6 remaining, with the highest rates, were selected for the study. The intervention was varied in terms of cost (high or low) and administered to 25 villages in 4 subdistricts (Figure). Random allocation was overridden by logical considerations, 2 districts containing a pair of subdistricts each being assigned to the intervention. The remaining 12 villages in 2 subdistricts from separate districts were assigned to the control. A sample of homes (random sampling provided at least 20% of homes in each villages) from 3 of 6 villages in each subdistrict were subjected to the hand washing indicator and the questionnaires for measuring message knowledge. All homes in the 37 villages were subjected to the dish washing indicator (see 'Monitoring instruments', below).

Selection of behaviours

Two hygiene behaviours had previously been selected in a study investigating the relationship between human behaviour and faecal contamination within the home (PINFOLD, 1990a, 1990b), which showed contamination of all water sources to be far less than that found in the home. Furthermore, comparing bacterial levels from stored water and fingertips with observed behaviour, food handling and other cooking-related activities were found to be associated with much higher levels of contamination than drinking-related activities. In selecting behaviours the following conditions were considered: messages should be simple and few in number; behaviours should already be practised by at least some members of the community (thus ensuring acceptability); and behaviour change should require very little extra effort or cost. Cooking and eating utensils were often left to soak, thus providing a favourable environment for bacterial growth. During food-related activities, cross-contamination was identified as the major mechanism for transmitting faecal bacteria. Thus, only the 2 following behaviours were identified.

(i) Dish washing: emphasizing dish washing immediately after, rather than before, meal times.

(ii) Hand washing: emphasizing hand washing before feeding a baby, cooking or eating, and after defaecation or cleaning a baby's bottom.

Description of the intervention

During the case study phase, a mixture of qualitative and quantitative methods was used to collect information about hygiene practice and develop a strategy for socially marketing the behaviours. Diarrhoeal disease was not stressed in the messages, as it was rarely mentioned as a problem unless prompted. Most villagers, apart from health workers, connected those behaviours with cleanliness (religiously associated with spiritual cleansing) and avoiding 'germs' (locally defined as invisible bodies causing illness or bringing bad spirits). Therefore, the communication strategy was based on these terms, with the added incentive of strong healthy children, as this was identified as a high priority amongst parents. Use of soap was not emphasized too strongly for fear of alienating poorer families.

For the intervention study phase, a variety of media (posters, stickers, leaflets, comic books, songs, slide shows, T-shirts, badges) was developed to create awareness and support activities promoting the behaviours. All printed media were illustrated, so messages could be understood by the illiterate, and a project 'logo' provided continuity. Songs about the hygiene messages were recorded in the traditional folk music, and tapes of this, as well as a community-produced play, were broadcast through village loudspeakers. The slide show demonstrated the effect of hand washing on 'germs' similar to those used in other media. Bacterial plates were handed round after the show to help stimulate more discussion. Plastic containers with taps were developed to facilitate hand washing in the home. These were distributed to homes with young children (<5 years of age) but only in those intervention villages (in both high cost and low cost schemes) subjected to the hand washing indicator.

The high cost intervention received a greater amount and variety of communication materials than the low cost scheme, in which slide shows and comic books were not included. A free sample of soap was provided with the leaflets to villagers in the high cost area. The costs shown in Table 1 are for this specific research study, where a variety of media was tested, and it should be noted that actual costs are likely to be much lower for a large scale intervention, especially if the existing health infrastructure is effectively utilized. Each plastic con-

Table 1. Details of intervention costs

Materials	Cost per item (UK £)	Low cost scheme: No. of items, Village	School	Total cost (UK £)	High cost scheme: No. of items, Village	School	Total cost (UK £)
T-shirts	2.00	119	68	374	180	72	504
Posters	0.40 & 1.00	103	44	59	88	23	111
Leaflets	0.20	1382	–	276	1724	–	345
Soap bars	0.10	–	204	20	1594	228	182
Stickers (small)	0.10	1265	156	142	1751	340	209
Stickers (large)	0.25	623	40	166	1180	89	317
Badges	0.30	29	222	75	281	205	146
Folk song tapes	4.00	26	12	152	24	9	132
Comic books	0.40	–	–	–	500	144	258
Slide show	300	–	–	–	12	–	300
Washing facilities	–	–	14	380	–	12	300
Drawing competition	–	–	14	280	–	9	220
Project workers	£100/month	4 persons		1500	4 persons		1500
Transport	–	–	–	300	–	–	300
Total costs (UK £)				3724			4823
Approximate costs per caput (UK £)				0.37			0.71

tainer cost about UK £4.00 to produce, but this was not included in Table 1 as only a small selection of the homes received these containers.

At the beginning of the intervention phase, school and village delegates were invited to workshops at the subdistrict level, to discuss project aims and examples of promotion activities. Participants were then invited to generate their own ideas during 'brainstorming' sessions. Two staff members were assigned to each subdistrict for a period of 3 to 6 months and arranged further meetings in each of the villages and schools under their responsibility. The workshops were designed to stimulate community involvement in the planning and implementation of the communication strategy. Although the main target was the maternal heads of the households and mothers of young children, other family members were not excluded.

A participatory approach in villages proved less effective and more difficult to organize than that in primary schools. Although pupils were not the main target group, it was hoped that they could be influential as agents of change in their homes. The most successful school activities were constructing dish washing and hand washing facilities suited to the type of school water supply, and drawing competitions (in conjunction with art classes), with the best posters being displayed in the villages. The actual involvement of villagers depended more on individual personalities than official roles. Wherever possible, village activities were adjusted to stimulate interaction amongst villagers—e.g., the organization, preparation and distribution of media.

Monitoring instruments

Questionnaires. A simple questionnaire was developed to measure message reception and recall. Questions on the content of the messages were worded so as to eliminate leading questions and bias. Two separate questions were asked for hand washing: 'before/after which activities do you think you should wash hands?' Respondents were prompted for 2 answers per question, thus providing a maximum of 4 correct answers: before cooking and eating, and after defaecation and cleaning a baby's bottom. For washing dishes, the question was simply: 'should you wash dishes immediately before or after eating?'

Indicators of behaviour. Since hand washing, in this context, is concerned with preventing faeco-oral disease transmission, a microbiological indicator was developed which involved examining the fingertips for the presence of transient faecal indicator bacteria. Faecal streptococci were preferred because *Escherichia coli* is short-lived on the skin and its inability to survive remote cross contamination makes it an unsuitable indicator of hand washing practice (KALTERNTHALER & PINFOLD, 1995).

Previously, a finger-rinse technique had been developed to determine the number of bacteria on fingertips (PINFOLD *et al.*, 1988). This method was simplified to a finger impression technique. Each fingertip was pressed directly on to KF *Streptococcus* agar plates (9 cm diameter), which are large enough to sample both hands, leaving 10 prints. Plates were incubated at 37°C for 48 h and enumerated by counting the number of prints containing faecal streptococci. As this was a novel technique, particular attention was paid to the strain of organisms grown. *Staphylococcus* colonies, a common contaminant, were sometimes visually indistinguishable from *Streptococcus*, and were identified by their ability to produce gas from hydrogen peroxide.

Although hand washing is an individual activity, the local environment and practices of other household members may also affect hand contamination. During the case study phase, finger impression samples were taken from 45 families visited on 4 occasions over a period of 6 weeks. Analysis of variance showed the variance within families to be far less than that between families ($P<0{\cdot}0001$). No apparent influence was detected of sex, age, or number of family members. Therefore, it was decided to produce a household index where the mean fingertip counts (0–10) of at least 3 family members represented the whole family (thus providing a more normal distribution). In the results section, FSB ('faecal streptococci before') refers to this index before intervention and FSA ('faecal streptococci after') refers to the index after the intervention was completed. To help reduce daily variability, all sampling during the intervention study phase was conducted in the evening when most people were at home.

In contrast to hand washing, dish washing behaviour can be easily assessed by the presence of dirty dishes. This greatly facilitated data collection, as the outcome could be readily defined and it took only a few minutes to check each home. Continuous observation of dish washing behaviour, meal times, and number of dishes washed on each occasion helped to refine this method and validate the indicator. More dishes were left dirty in the afternoon, but this also depended on whether there were people present during the day. To help control for this effect, all subsequent checks were conducted during the morning.

Diarrhoeal disease. Active surveillance of children less than 5 years of age was conducted in the same villages as those in which the hand washing indicator was administered, including 6 villages from the high cost intervention, 6 from the low cost scheme, and 6 from the control. The survey took place during the seasonal peak of diarrhoea incidence, but only after the intervention period. VHW were trained in diarrhoeal surveillance and mothers were issued with special calendars for recording diarrhoea episodes of their children. For 3 months, VHW visited homes every week whenever possible. Each month, project workers collected calendars from the VHW and monitored their work by visiting a random selection of homes. Diarrhoea was defined as 3 or more watery stools per day. About 75% of homes returned calendars each month that were validated by interviews with VHW. In addition, information on the reported incidence of diarrhoeal disease, for all ages, was collected from hospitals and clinics serving the study area. These data were checked with those compiled at the regional health centre.

All quantitative data were entered on a micro-computer and analysed by the Statistical Package for Social Scientists (SPSSx). Unless otherwise stated, Student's *t*-test or analysis of variance (ANOVA) were used for comparing group means.

Results

Socio-economic data for the intervention study villages are summarized in Table 2. The mean duration of education was 4–6 years, and this did not vary considerably between villages. Although primary school attendance is now compulsory, few pupils (<5%) from the project areas went on to secondary school or further edu-

Table 2. Socio-economic details of study population

	Control	Low cost scheme	High cost scheme
Numbers			
Subdistricts	2	2	2
Villages	12	13	12
Homes	1653	1842	1379
Schools	13	12	8
Population	8092	10017	6551
Proportions			
<5 years old	9%	9%	9%
With toilet	72%	70%	79%
With wealth indicator[a]	37%	36%	23%
With rain jars[b]	67%	68%	48%

[a]Homes with bricks or blocks enclosing area beneath house.
[b]Homes with 2 or more large rain jars (2000L).

Table 3. Respondents' knowledge of intervention messages

	Control			Low cost scheme			High cost scheme		
Villages	No. of homes	HW[a]	DW[b]	No. of homes	HW[a]	DW[b]	No. of homes	HW[a]	DW[b]
1	25	37%	35%	24	50%	63%	29	59%	83%
2	26	40%	58%	32	58%	69%	34	61%	85%
3	28	46%	48%	42	57%	64%	33	66%	76%
4	25	46%	72%	23	48%	61%	27	52%	67%
5	30	57%	60%	31	52%	68%	33	58%	82%
6	24	36%	54%	31	59%	77%	31	63%	71%
Totals[c]	158	44%	55%	183	55%*	67%*	187	60%***	78%***

[a]Hand washing scores (expressed as a percentage).
[b]Dish washing (expressed as percentage answering correctly).
[c]Significance of differences (ANOVA) compared with control values is expressed thus: *$P<0{\cdot}05$, *** $P<0{\cdot}001$.

Table 4. Comparison of fingertip contamination in villages before and after intervention

	Control				Low-cost scheme				High-cost scheme			
Villages	No. of homes	FSB[a]	FSA[b]	Difference[c]	No. of homes	FSB[a]	FSA[b]	Difference[c]	No. of homes	FSB[a]	FSA[b]	Difference[c]
1	26	5·6	3·3	41%	25	6·4	1·4	78%	30	4·4	1·0	77%
2	26	5·0	2·6	48%	35	5·6	2·1	62%	35	4·3	1·2	72%
3	32	4·0	2·2	45%	42	3·4	2·3	32%	35	4·1	1·3	68%
4	27	3·8	2·8	26%	26	2·9	1·6	45%	27	3·9	1·3	66%
5	30	3·5	2·3	34%	34	2·9	1·1	52%	33	3·5	1·3	63%
6	25	3·3	3·0	9%	33	2·1	1·6	24%	32	2·2	1·5	32%
Totals /means[d]	166	4·1	2·7	34%	195	3·8	1·7***	55%	192	3·7	1·3***	65%

[a]Household index of finger contamination before intervention.
[b]Household index of finger contamination after intervention.
[c]Improvement from FSB to FSA expressed as a percentage.
[d]Significance of differences (ANOVA) compared with control values is expressed thus: *** $P<0{\cdot}001$.

cation. Without exception, the main occupation was agriculture, and in only 2 subdistricts, both located on major roads, did a significant proportion of families (but still fewer than 5%) cite non-agricultural work as their main occupation. Shallow wells, tube wells, rain jars and ponds were the main water sources.

The main messages given during the intervention reached the vast majority of people in the intervention area, and less than 1% of those interviewed reported that they had not heard about the intervention; respondents were mainly female (98%) with a mean age of 39 years (range 10–76). Table 3 gives a summary of knowledge of the messages after intervention. Concerning hand washing, villagers receiving the intervention were more knowledgeable than the controls, especially those from the high cost area ($P<0{\cdot}01$). Knowledge of dish washing practice followed a similar pattern. A previous random survey of the intervention area before intervention had shown respondents to be less knowledgeable than those in control villages, suggesting that there may have been some contamination of the latter.

The results from the hand washing indicator before (FSB) and after (FSA) intervention are shown in Table 4. Although there was a significant reduction from FSB to FSA in the control villages, the reduction in the intervention villages was much greater. Comparing villages, FSB was similar in all groups but FSA was significantly less than the control value in both the low cost ($P<0{\cdot}01$) and high cost ($P<0{\cdot}001$) intervention areas; villages in the high cost scheme also gave lower values than those in the low cost area ($P<0{\cdot}05$). The provision of plastic containers tended to show a marked improvement only in the homes in low cost intervention villages with the highest mean FSA values; overall, there was no significant difference between homes receiving containers and homes not receiving them. In order to test sustainability and reactivity, a selection of villages not previously subjected to the hand washing indicator was surveyed some 5 months later. Four control villages produced a mean fingertip faecal streptococci index of 3·3, but intervention villages gave significantly lower values, 1·8 from 4 low cost intervention villages ($P<0{\cdot}001$) and 1·9 from 4 villages in the high cost scheme ($P<0{\cdot}05$).

All homes were subjected to the dish washing indicator. Overall, there were significant improvements in both high cost ($P<0{\cdot}05$) and low cost intervention villages ($P<0{\cdot}05$), with no apparent change in the control value. Six of 25 intervention villages showed a significant improvement at the 1% probability level and 4 more at the 5% level, while 2 deteriorated; 3 of the 12 control villages improved while 4 deteriorated (at the 5% probability level).

Active surveillance of diarrhoeal disease in young children was conducted only after the intervention during the seasonal peak of summer diarrhoea in 6 control and 12 intervention villages. Diarrhoea was less common in young children from the intervention villages, with 11 villages having lower incidence rates of diarrhoea than 5 control villages ($P<0{\cdot}05$; Mann–Whitney *U* test); overall this amounted to a 39% reduction.

Further evidence to support these results was provided by comparing the hand-washing indicator with diarrhoeal disease data. Among a total of 220 homes, those with sick children had higher mean FSA values than those recording no diarrhoea ($P<0{\cdot}05$). Despite there being only 50 valid cases, the same relationship held true for the control villages, with mean values of 2·4 for homes without diarrhoea and 3·6 for those with diarrhoea ($P<0{\cdot}05$).

As might be expected, about 10 times more cases of diarrhoea in young children were recorded through active surveillance than reported to clinics and hospitals. The study was not designed to show any significant difference in reported diarrhoea, and there was no notable difference as a result of the intervention or in comparison to the control. However, homes reporting no diarrhoea to health services in the year before intervention had mean FSB values of 3·8, compared to 4·6 in homes reporting one or more cases ($P<0{\cdot}001$). In the intervention villages, the same held true for FSA, with means of 2·1 for 34 homes reporting diarrhoea after intervention and 1·2 from 107 homes with no diarrhoea ($P<0{\cdot}01$). Some of the biases in reporting were eliminated by including only homes reporting diarrhoea in the previous 2 years.

In the control villages, 3 separate surveys of dish washing behaviour were conducted at intervals of 4 months. Comparing 2 extremes of this indicator, homes in which no dirty dish was seen in any of the 3 surveys reported a mean of 0·31 episodes of diarrhoea, while those in which dirty dishes were seen at all 3 surveys reported a mean of 0·6 episodes, a 45% difference in the disease incidence ($P<0{\cdot}01$). Intervention homes with no dirty dish after intervention reported 0·13 cases of diarrhoea (after intervention) compared with 0·17 from homes with dirty dishes ($P<0{\cdot}05$). The results from the questionnaire showed no notable relationship with any of the diarrhoea data.

Discussion

In questionnaires, hand washing before eating was invariably identified as routine practice and more important than at other times such as after visiting the latrine or before cooking. However, observation before intervention revealed that, although hand washing was practised at ceremonies or when entertaining special guests, it was rarely done before ordinary meals with family, relatives or friends. Hand washing was far more common after eating when fingers were sticky, especially after eating the staple diet of glutinous rice. This was confirmed by information obtained from open interviews and group discussions, when hand washing was said to be more often done when hands were dirty rather than being motivated by another activity. These findings are in agreement with other studies on the limitations of using questionnaires for measuring behaviour (STANTON *et al.*, 1987; CURTIS *et al.*, 1993).

In comparison to continuous structured observation, the 2 indicators of behaviour readily provided quantifiable data. The dish washing indicator was rather more straightforward, because there were tangible signs of this activity. Hand washing, on the other hand, is a difficult practice to measure by any means. Although the finger impression technique appeared to be useful as an indicator of general hand washing practice, it did not show specifically when hands were washed in relation to key activities. However, it may be a better overall indicator of the importance of different hygiene practices for disrupting faeco–oral disease transmission, as fingers play a major role in cross contamination at the oral end of this cycle. Even with good hand washing practice, the hand washing indicator would still reflect a contaminated local environment (e.g., from handling food, utensils, kitchen surfaces). Earlier studies have shown that householders living in modern homes with multiple water points, surfaces which are easy to clean, sinks for containing contamination, and refrigerators for food have considerably less hand contamination than those in the present study (PINFOLD, 1990a). Thus the finger impression technique provides a simplified method for appraising the need for modifying hygiene behaviour.

Seasonal factors appeared to affect both indicators. Dish washing practice appeared to be largely affected by agricultural requirements, when rice planting and rice harvesting demand intensive labour by the whole family at certain times of the year. Climatic changes definitely affect fingertip contamination, with much higher levels apparent in the wet season than in the dry season (KALTENHALER *et al.*, 1991; PINFOLD *et al.*, 1991). This may partly explain the reduction in fingertip contamination found in the control villages and the high incidence of diarrhoea usually found at the beginning of the rainy season. Despite the fact that surveys for each indicator were never administered on the same day, families with many dirty dishes after the intervention had higher levels of fingertip contamination than those with none ($P<0{\cdot}01$). No similar relationship was found in the control villages, implying that families conforming to the intervention advice were likely to adopt both practices rather than being selective. For larger programmes promoting 2 or more behaviours, it may be easier to select the simplest indicator when a similar relationship of adoption can be demonstrated.

Health education programmes often assume that, once their messages have been received by the intended audience, behaviour change will invariably follow. In this study, although villages with better overall knowledge of the messages appeared to have less hand contamination, this relationship did not hold true when analysing homes within villages. Furthermore, unlike the indicators of behaviour, knowledge of the messages within the intervention group showed no significant relationship with diarrhoeal disease. Interviews conducted in depth after intervention revealed that, although most people knew the messages well, this alone was not enough to change behaviour. The main reason for non-compliance was the difficulty experienced by adults, as opposed to children, in breaking habits. On the other hand, conformers gave a higher priority to cleanliness and avoiding 'germs'. The results also suggested that active involvement in the intervention and discussion amongst the community about the promoted behaviours were important factors for sustained improvement in the behaviours. Thus, actual practice was reinforced when these actions were supported by neighbours, friends, relatives, and schoolchildren. This process was more successful in villages with a stronger sense of community.

In this intervention more attention was placed on what the 'consumer' perceived to be the immediate benefit from practising these particular hygiene behaviours. Education interventions usually emphasize disease prevention without seeking knowledge of how benefits are perceived by the target group. When people are sick there is a definite need to find a cure. However, people are not sick most of the time and, given the poor recall of past episodes of illness (STANTON *et al.*, 1987), it is difficult to envisage disease prevention as a priority need. Moreover, an individual would not be able to notice changes in disease rates for his or her family, even with the advantage of hindsight. Therefore, to some extent health education programmes are relying on the communities' faith in their proficiency. However, communities are likely to lose that trust if exposed to continual programmes that fail to take into account their environmental constraints, and use messages that are patronizing.

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