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### A systematic review of community hand washing interventions leading to changes in hygiene behavior in the developing world

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#### ABSTRACT

**Background:** Educational interventions in hygienic practices have shown to be cost effective methods of controlling diarrhea and other diseases spread through poor hygiene. Hand washing is one method of breaking the chain of transmission between household contacts, and especially between mother and child. Effective interventions to promote this behavior should be expanded and encouraged in the developing world. **Objectives:** To determine the extent and credibility of intervention studies done to promote uptake of improved hand washing behaviors in communities. To assess these interventions on their results in terms of behavior change, and identify factors contributing to their success or failure. **Methods:** The investigators searched the databases SCOPUS, EMBASE (1980-2010), and Pubmed for English papers written about hygiene promotion interventions in developing countries. Interventions included were community based control trials examining the effectiveness of increased hygiene education through measured behavior change. Only studies measuring behavior change using structured observation or demonstration of hand washing skills were used. **Results:** The search terms: hand washing, health education, hygiene promotion, behavior change, and diarrhea were used, resulting in a total of 330 titles. The investigators scanned the titles and abstracts to narrow down to 13 hygiene interventions measuring behavior change. Only five control trial interventions met the observation measurement criteria. Behavior change measurements were compiled and compared based on the length of intervention and the degree of change noted with each study. **Conclusion:** Encouraging uptake of hand washing behavior is possible using educational interventions to promote improved hygiene. The most significant impacts were seen from interventions running for longer periods of time. More robust and long term control trials are necessary to gather conclusive data on the sustainability of behavior change after educational interventions. Statistically sound methods of measurement of hand washing behavior change should be encouraged in future studies.

**Key words:** Hand washing, behavior change, structural observation and demonstration.

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**Introduction:** Diarrhea and respiratory infections are responsible for 40% of all child deaths around the world each year.

The majority of these deaths occur in South Asia (38%) and Africa (46%), with India having the highest burden of child deaths due to diarrhea.<sup>[1]</sup> One of the major causes leading to increased rates of transmission of both diarrhea and respiratory infections is poor sanitation and hygiene, a persistent challenge in developing countries. In resource poor settings, complete improvement of sanitation infrastructure is a long term, ongoing goal and unevenly distributed across communities. In order to reduce the transmission of diarrhea and respiratory

pathogens, more cost effective and short-term solutions are needed. Hand washing and health education to promote improved hygiene has come forward as a cost effective technique for reducing disease incidence.<sup>[2-4]</sup> Effective hand washing with soap can break the transmission of infective agents and therefore help control the spread of disease to vulnerable children. The most critical times for hand washing identified in order to prevent transmission are after using the toilet, after cleaning a child's bottom, and before handling food. Mothers are the

ones most often carrying out two of these three activities, making them one of the critical targets for increased hand washing campaigns. The World Health Organization recently recognized improved hand washing as number five of its proposed 7-point program to reduce diarrhea mortality.<sup>[1]</sup> To date this goal has been unrealized, as few developing countries have come up with a comprehensive state or nation-wide program for improved hand washing behaviors.

Many studies in developing countries have experimented with different hygiene promotion and education interventions as measures of reducing diarrhea (measurement of impact on respiratory infections has yet to be done in developing countries). Varying degrees of interventions have taken place, from simple educational messages communicated during clinical interactions (Parker et al, 2006), to large-scale media education schemes (Curtis et al, 2001).

There have also been several interventions providing soap (Luby et al, 2004; Wilson et al, 1993) and even one that provided hand pumps for water in the rural community (Alam et al, 1989). Some of these studies have measured outcomes through disease incidence, and fewer through measurement of behavior change.

If hygiene promotion interventions are to be taken up by policy makers in developing countries, a review of their effectiveness in terms of behavior change and replicability is required.

## Method

In this paper the authors reviewed intervention studies done to promote uptake of improved hand washing behaviors in developing country communities. The interventions were compared in terms of behavior change and the characteristics contributing to their success or failure. Interventions included were community-based control trials examining the effectiveness of increased hygiene education through measured behavior change. These trials were done in the general community, rather than in a particular group (such as a self-help group focus discussion), or a particular setting (for example, in a school), in concurrence with the World Health Organization's call for community involvement in hygiene education and health-promotion activities.<sup>[1]</sup> Interventions were included if they were control trials and measured behavior change using structured observation or hand washing demonstration techniques. Only studies conducted in the developing world were reviewed. The databases SCOPUS, EMBASE (1980-2010), and Pubmed were searched using combinations of the following keywords: hand washing, health education, hygiene

promotion, intervention, behavior change, and diarrhea (Figure 1). Approximately 330 results were reviewed and relevant titles were chosen, resulting in a total of 67 papers related to the subject of interventions to increase hand-washing behaviors. Titles and abstracts were again reviewed to isolate 32 papers specifically describing interventions. 11 papers detailing studies in developed countries, schools, and daycares (non-community interventions) were removed. Of the remaining 21 community hygiene promotion intervention studies, 8 measured outcome using disease incidence. The 13 studies measuring behavior change comprised of 6 using only surveys or other self-reported means, while 7 papers described interventions measured through structured observations or hand washing demonstrations. Finally, one study (Parker, 2006) was removed due to a lack of control group. The remaining 6 papers made up 5 community control trials in hygiene promotion that measured behavior change outcomes through structured observation or hand washing demonstrations and were determined to be the most statistically competent.

## Results and Analysis

Effective community interventions require funds to run smoothly, especially if media is to be used as a mode of educational communication.<sup>[5]</sup> To justify the continued resources necessary for community education interventions it is necessary for robust data to be available. Unfortunately, many of the studies that have been done on hand washing behavior in developing countries have not been able to provide the quality of data necessary for compiling a statistically persuasive compliment to the intuitive solution of hand washing interventions. In some cases, where excellent methodology has been observed in trial implementation, outcomes are measured in disease incidence rather than behavior uptake. Finally, the measurement of behavior uptake is a difficult task in itself and some strategies have been found to be more reliable indicators than others in reflecting true levels of behavior change.<sup>[6]</sup> The particular challenges and desired standards of hygiene promotion interventions are outlined below.

### Study Methodology: Control trials vs. Prospective studies

Control trials are useful when studying community interventions because it is critical to determine whether behavior change was due to the intervention or due to random variation in the behaviors of the population. With prospective studies measuring simply before and after effects of an intervention it becomes more difficult to determine whether the intervention would be possible in a

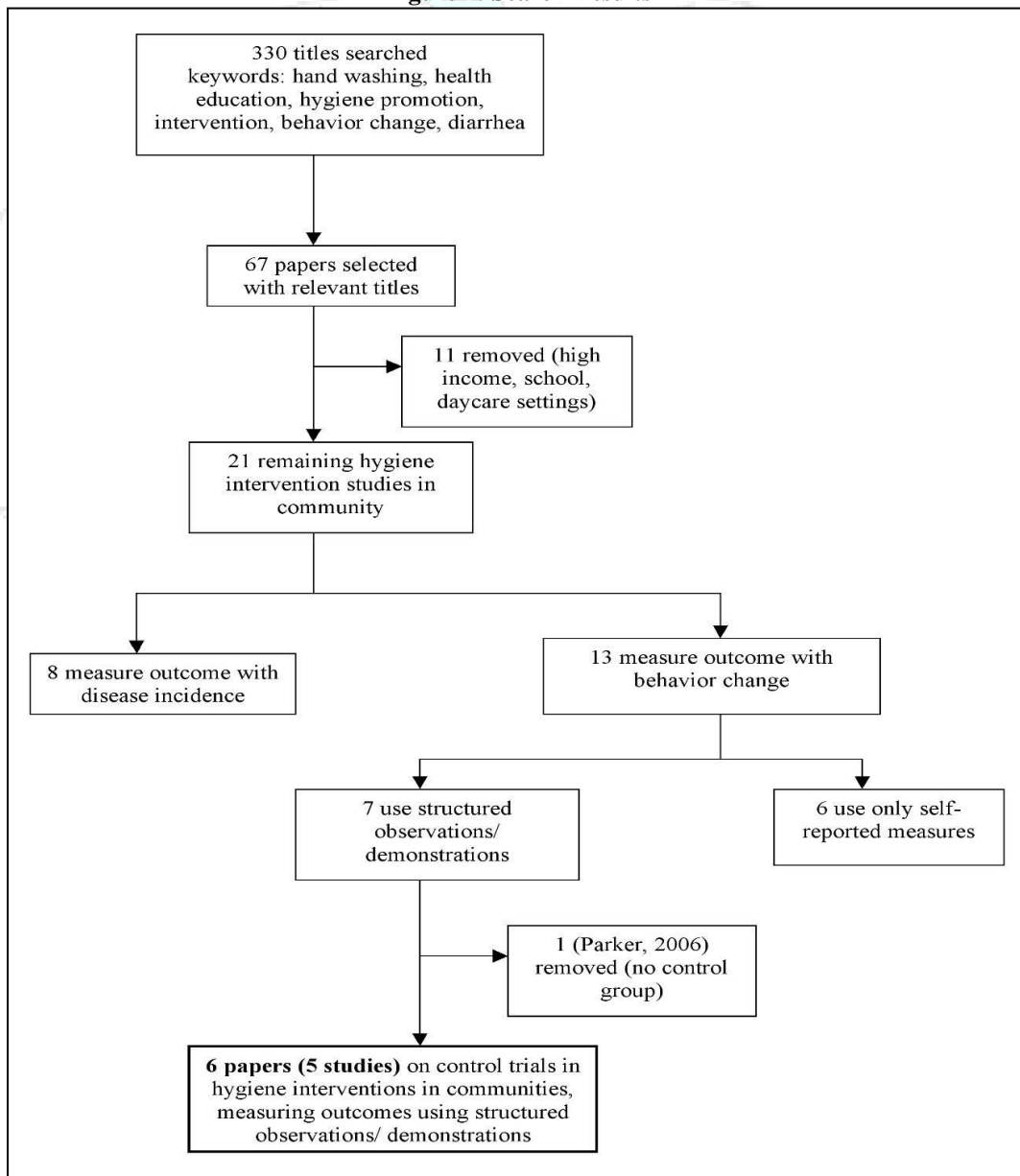
different situation. Replicability of an intervention should be a primary concern for investigators if population-wide public health gains are to be made.

For a control trial to be effective, confounding factors and elements of bias must be eliminated. In community interventions, the Hawthorne effect must be controlled for, a bias that occurs when a trial community is changed due to the increased attention it receives in the intervention rather than the effect of the intervention itself.<sup>[7]</sup> Of the hygiene promotion control trials that have been carried out in developing countries, only one study has considered this outcome and initiated a “placebo” intervention. No significant difference between

control and trial communities was found in this case, a result that cannot as yet be taken as conclusive evidence in the absence of any similar studies to compare it to.

Furthermore, care must be taken to control for confounding factors between control and trial communities. Only three of the five studies reviewed (Biran et al, 2009; Clemens & Stanton, 1987; Haggerty et al, 1994) paired communities using baseline data on disease incidence to make sure the trial and control groups were as similar as possible. Clear and accurate methodology is necessary before true results of behavior change can be measured.

**Figure 1: Search Results**



## Measuring Outcomes: Behavior Change vs. Disease Incidence

In terms of hand washing behavior up take, more reliable data can be generated by measuring the degree of behavior change, rather than the change in disease incidence which can be influenced by random or seasonal fluctuations in endemic levels.<sup>[5]</sup> Furthermore, behavior change, especially hygiene behavior change, can have effects beyond the prevention of any one specific disease and is desirable in itself in a population for general health promotion. Collection of data on diarrhea incidence is also difficult in a community setting, as many mothers are unsure of the definition of diarrhea and recall bias may be a considerable problem especially where diarrhea is considered a normal occurrence.<sup>[8]</sup> This point is illustrated with both Luby et al's 2004 study in Pakistan and Haggerty et al's 1994 study in Zaire. In both studies, though the behavior change was notably different between trial and control groups, the level of diarrhea incidence was not found to be significantly different.

## Measuring Behavior Change: Observations vs. Self Reporting

Even where hygiene promotion interventions do measure behavior change through uptake of increased hygienic practices, it is not always done in a consistent or reliable manner. The most common methods are self-reported survey/questionnaire followed by structured observations, hand washing demonstrations, environmental check for soap, and pocket voting.

A study conducted by Biran et al. in 2008 sought to identify the most reliable method for measuring uptake of hand washing behaviors.<sup>[6]</sup> It was found that most indicators (pocket voting, self-reported surveys, environmental check) significantly overestimated the extent of hand washing actually practiced. The only indicators found to be closely related to actual practice were structured observation (where an investigator visited the house under survey and observes the family, making note of desired behaviors), and demonstrations of hand washing (where an investigator visits the house under survey and asks a family member to demonstrate hand washing skills, making note of ability).

Although structured observation would seemingly introduce bias by having an investigator present in the household, prompting a higher incidence of desirable behavior, a study in 1996 by Cousens et al. in Burkina Faso found that this was not the case. Their study on the hand washing behaviors

of mothers found no behaviors to be "reactive" to the presence of an investigator, despite ongoing interventions in the community promoting these behaviors as socially desirable.<sup>[9]</sup> Biran et al. replicated this finding later in 2009 when no influence on hand washing behavior was found with the presence of an observer.<sup>[10]</sup> This was confirmed with the use of electronic soap use loggers, which tracked the movement of soap bars. No marked difference between observed behavior and electronically logged soap movements was found, indicating that the actual use of soap was statistically similar to the observed usage. It has been noted that in order to maintain a lack of bias with structured observation it is essential not to inform the household which behaviors are being monitored.<sup>[10]</sup> Structured observation cannot yet be considered the "gold standard" of measurement of hand washing behavior.<sup>[6]</sup> However, it is currently the most consistently proven and reliable technique for indicating a behavior change in hand washing habits.

Likewise there is always a gross over reporting when the outcome measures are overestimated (Figure: 2) where usually the outcome measure is improvement in awareness of the community rather than whether they are actually practicing it, which can be measured through structural observation.

## Discussion

In resource poor settings, there are multiple factors that need to be addressed when designing useful hygiene promotion interventions. One of these is access to facilities, mainly water. In Biran's 2009 study it was found that families with access to water in the household were observed to practice hand washing 6% more than households without access.<sup>[10]</sup> One key commonality between the studies measured here is that all of them have done formative research in the community to determine the current hygiene practices in the community and possible messages to be used for intervention.

Hygiene promotion programmes can change behavior if there are use locally appropriate channels of communication repeatedly and for an extended time.<sup>[5]</sup> Sanitation and hygiene interventions when implemented with 99% coverage would bring down diarrhea by upto 30% also contributing to lowering of under nutrition.

Tropical enteropathy and not diarrhea is primary causal pathway between low sanitation and hygiene and under nutrition which can be evaded by handwashing after fecal contact.<sup>[11]</sup>

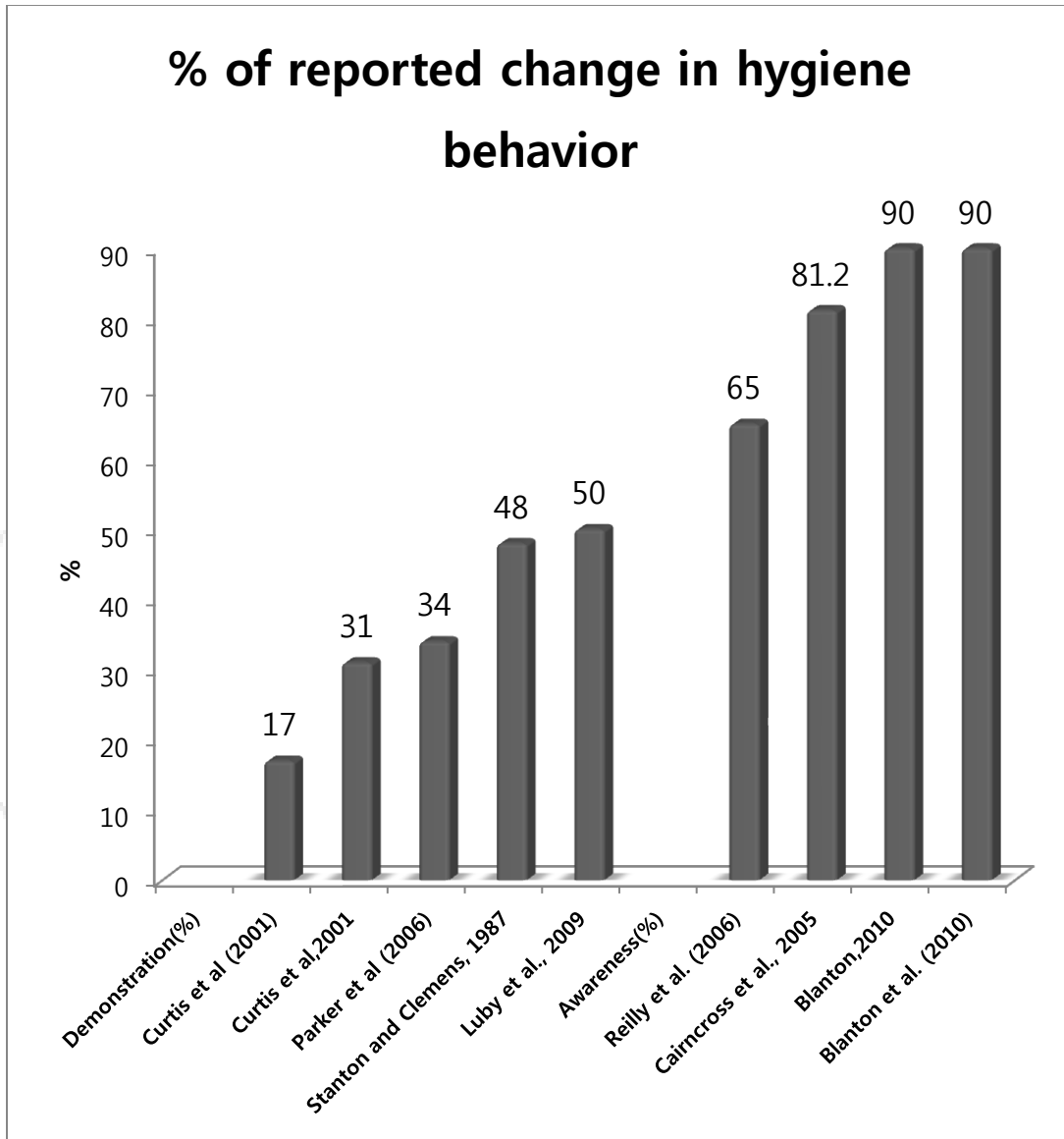
**Table1: Studies included in the review**

No.	Author	Study Location (year)	Urban /Rural	Sample Size	Focus groups	Study Design	Duration	Intervention Methodology (tools)	Outcome Measures *	Results	Statistical Significance	Sustainability
1	Biran et al., 2009,	Andhra Pradesh, India (2009)	Rural	10 villages, 30 households per village	Children aged 8-13 and mothers	Cluster randomized control trial	2 months of intervention 4 months follow up	visited each village 4x in 8 weeks; tools: demonstrations, presentations, stencils, health camps emphasizing hygienic practices	1	Observed handwashing with soap – intervention : -1%, 95% CI - 2%/+0.3% control: +0.4%, 95% CI - 1%/+2%	No	Very low uptake, hence
2	Stanton and Clemens, 1987	Dhaka, Bangladesh (1985)	Urban Slums	51 slum communities (25 trial, 26 control)	Mothers	Randomized control trial (P)	3 months, 6 month follow up	8 week intensive educational intervention emphasizing hygienic practices	1, 3	mother's handwashing before giving food (p<0.05)– intervention : 49% control: 33%	Yes	Sustainable
3	Cairncross et al., 2005	Kerala, India (2000)	Rural	10 villages, 345 households	Gen population	Control trial (P)	3-12 months in each village (varied)	3 year hygiene and education project by SEUF <sup>#</sup> ; provision of latrines and health education (classes, video slide shows, street plays, competitions)	2	demonstration of handwashing method taught— intervention : 81.2% control: 10%	Yes	Only if they are merged into the health system
4	Alam et al., 1989,	Teknaf, Bangladesh (1983)	Rural	3 rural communities (1 intervention, 2 control)	Gen population	Control trial (P)	2 months	Given hand pumps and 2 month blocks of health education (home visits, group discussions, demonstrations)	1,3	Measured indirectly by comparing distribution of hygiene practices in trial/control areas: p<0.0001	Yes	Sustainable
5	Luby et al., 2009	Karachi, Pakistan (2002)	Urban Slums	36 low-income neighborhoods (600 households trial, 306 households control)	Mothers and children	Randomized control trial (P)	1 year, 18 months after the intervention	Given soap and hygiene education (weekly household visits to give information, demonstrations)	2,3	Demonstration of handwashing method taught (p=0.002) — intervention : 50% control: 23%	Yes	Sustainable, if govt intervenes

\* 1= structured observation, 2= demonstration of hand washing, 3= disease incidence 4=awareness increase, P=Prospective

# Here sustainability implies the uptake of behavior without external intervention.

**Figure 2: Comparing the reported change through demonstration vs. awareness**



Studies have also faltered to assess the sustainability of hygiene behavior change.<sup>[12]</sup> Few interventions to influence hand washing have had measurable effects.<sup>[13]</sup> Hygiene behavior persisted for years which implies that hygiene promotion is one of the most cost-effective health interventions.<sup>[14]</sup> Whether handwashing in poor communities can reduce the risk of ARIs is under research, but this Mills–Reinicke phenomenon ; that water supplies improve hand hygiene and reduce child mortality not only from diarrhea but also from respiratory

infections have been accepted in the west<sup>[15]</sup> Luby et al. in 2009 conclude that although intervention households showed better hand washing technique after 2 years without intervention, their soap purchases and diarrhea experience was not significantly different from controls. In 2001, Curtis et al. found only three papers published with satisfactory evidence of behavior change and impact of health from 1987 and



commented that its not unusual that policy-makers question whether it is appropriate to use scarce resources for health promotion in developing countries.

There should be more rigorous and preferably quasi-experimental design, and be better documented, so that findings can be validated and studies replicated.<sup>[16]</sup>

The authors advocates that only methods like structural observation and demonstration should be used as measurement of outcomes when there is a behavioral interventional study regarding hand washing. There should be further inbuilt mechanisms in the public health systems in developing country so that practices could be intervened over time to bring in a positive change.

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