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The effect of a handwashing intervention on preschool educator beliefs, attitudes, knowledge and self-efficacy

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Abstract

This paper describes the effect of a preschool hygiene intervention program on psychosocial measures of educators regarding handwashing and communicable pediatric disease. A cluster-randomized trial, with randomization at the level of the preschool, was run in 40 Jerusalem preschool classrooms. Eighty preschool educators participated. The program used a multipronged approach which included elements aimed at staff, children, parents, school nurses and the classroom environment. Frontal lectures by medical, epidemiological and educational experts, along with printed materials and experiential learning, were provided to staff. Responses from a validated survey instrument were used to build four scales for each respondent regarding beliefs, attitudes, self-efficacy and knowledge. The scales were built on a Likert-type 1–7 scale (1 = minimum, 7 = maximum). The effect of the intervention was tested using mixed model analysis of variance. Response was received from 92.5% of educators. Educators believed that handwashing could affect health (mean = 5.5, SD = 1.1), had high levels of self-efficacy (mean = 6.1, SD = 0.9) and had positive attitudes toward handwashing (mean = 5.7, SD = 1.2). Knowledge was affected by the intervention (intervention: mean = 6.2, SD = 0.7; control: mean = 5.8, SD = 0.8). The combination of positive attitudes toward handwashing among educators and the program's effectiveness in imparting knowledge helped to create a sustained social norm of handwashing among many children in disparate locations.

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Introduction

Simple handwashing with soap helps to protect children from the two biggest global pediatric killers: diarrhea and lower respiratory infection [1–5]. These diseases kill >3.5 million children under the age of 5 every year [6]. Diarrheal diseases, spread by the fecal–oral route, are particularly susceptible to control through handwashing with soap [3], and recent evidence has shown that respiratory infections can also be reduced through handwashing [2]. Trials of handwashing interventions in the community, aimed at improving individual handwashing behavior, have been conducted over the course of the past several decades. Recent meta-analyses of these trials and other studies have shown reductions in gastrointestinal infections ranging from ~30% [3, 7] to 47% [1], reductions in respiratory illness of 16% [2] and 21% [3] and reductions of overall risk of infection of >20% [4]. The authors of one review [1] concluded that widespread adoption of simple handwashing practices in the community

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could save a million lives annually. Despite this, handwashing practices in the community and its educational settings are often deficient [8–10].

Schools and day care centers have repeatedly been implicated in the spread of infectious disease, both among the children themselves and among their families and communities [11]. The association between school attendance and increased rates of illness was noted >50 years ago [12], and more recent studies have demonstrated an increased rate of upper respiratory infections, otitis media, lower respiratory tract infections, diarrhea, hepatitis A, cytomegalovirus, *H. influenza* and repeated infections among day care attendees [13–15].

The most drastic means of communicable disease control in schools and day care facilities is closure: this occurred, for example, during the 2003 Severe Acute Respiratory Syndrome (SARS) outbreak, when schools across the globe were closed, among them were schools in China, Singapore, Toronto and Minnesota [16–19]. Fears of avian flu spread have led to global control plans which include long-term closure of schools [20].

The improvement of hygienic practices in the preschool setting and the educational system is a far less disruptive intervention than closure and essential for routine control of communicable illnesses. Handwashing interventions in those settings have been shown to successfully reduce diarrheal illness [21–25], respiratory illness [26–28] and illness absenteeism [28–38]. Though the US Center for Disease Control recommends handwashing to students, staff and parents to prevent communicable illness [39], handwashing is often deficient [8].

Attitudes, knowledge, beliefs and self-efficacy are some of the measures which are thought to be on the causal pathway to behavior [40]. These variables have been explored in the context of handwashing primarily among health care personnel, including health care workers in intensive care units in Italy [41], healthcare workers in Denmark and Norway [42] and nurses in long-term care settings in the United States [43]. Awareness, self-efficacy and external barriers have been shown to be associated with adherence to clinical practice guidelines among physicians [44]. In the hospital setting, the physicians and nurses can actively transmit disease to their patients through poor personal hygiene.

In the early educational environment, the educators can transmit communicable disease to vulnerable young children under their care with poor hygiene and can also influence the behavior of the children themselves. It is for this reason that just as doctors and nurses are often targeted for handwashing interventions in the health care setting [45, 46], educators and caretakers are targeted for handwashing interventions in the early childcare setting [21–28, 35].

The Jerusalem Handwashing Study was a cluster-randomized intervention trial designed to change handwashing behavior and so decrease illness absenteeism among preschoolers [47]. The program dealt with various hygiene issues, with a primary emphasis on handwashing and used a multipronged approach which included elements aimed at staff, children, parents and school nurses, as well as environmental changes. A total of 1029 children and 80 preschool educators in 40 classrooms participated in the trial. The primary end points of the trial were illness absenteeism and child handwashing behavior. The effect of the intervention on those end points is described elsewhere [47–49]. The intervention improved child handwashing behavior (an ~3-fold increase in handwashing with soap was observed in the intervention group versus the control group) but did not affect illness absenteeism.

The development of the intervention program was based on the Health Belief Model and, because a large body of evidence [50] has shown that education alone is insufficient to change behavior, augmented by other approaches. These included increasing the self-efficacy of the educators, modifying the external (environmental and administrative) environment [51] through the provision of enabling factors (soap, soap dispensers, paper towels, paper towel dispensers and individual cups) and choice of a sustained intervention approach [52].

This paper examines the effects of the program on knowledge, attitudes, self-efficacy and beliefs of educators. These variables are hypothesized by the various health promotion models to be on the pathway to behavioral change: the Health Belief Model hypothesizes that knowledge will affect behavior

[51], the Theory of Reasoned Action and Theory of Planned Behavior hypothesize that beliefs influence attitudes [51] which affect behavior and Social Cognitive Theory (on which the concept of self-efficacy is based) which suggests that a personal perception of ability affects behavior.

To the best of our knowledge, this is the first time that attitudes, knowledge and beliefs regarding handwashing have been explored among preschool educators.

Methods

Design and sample

A cluster-randomized controlled trial was run to evaluate the effects of a comprehensive hygiene intervention program in preschools. The primary focus was on handwashing before lunch and after bathroom use, with a secondary emphasis on elimination of shared cups and towels. Sample size calculations were based on reducing illness absenteeism and are discussed elsewhere [48]. Forty preschools from the 3- to 4-year-old age group were recruited from those run by the state-sponsored education authority. Randomization was done at the level of the preschool, with half of the preschools being assigned to the intervention group and half to the control group. Schools were randomized within religious stream (religious or secular).

Each preschool had two staff members, a certified preschool educator and a trained assistant. Most preschools were located in independent buildings or adjacent to another preschool. A total of 1029 children and 80 preschool educators from the 40 preschools were included in the trial. At the close of the trial, the program was run in the control preschools. Thus, all participating preschools eventually received the program, in a 'phased' manner. See Fig. 1 for a pictorial description of this design. This design feature contributed considerably to the success of the trial, as it overcame the usual ethical objections to withholding the intervention from some participants and contributed to successful educator recruitment. This phased approach has been used successfully in other studies [53] and is a form of 'randomization to wait list'. Institutional Review Board approval was obtained from the Hadassah Ethics Committee. This trial is registered at ClinicalTrials.gov (Registration Number: NCT00610376).

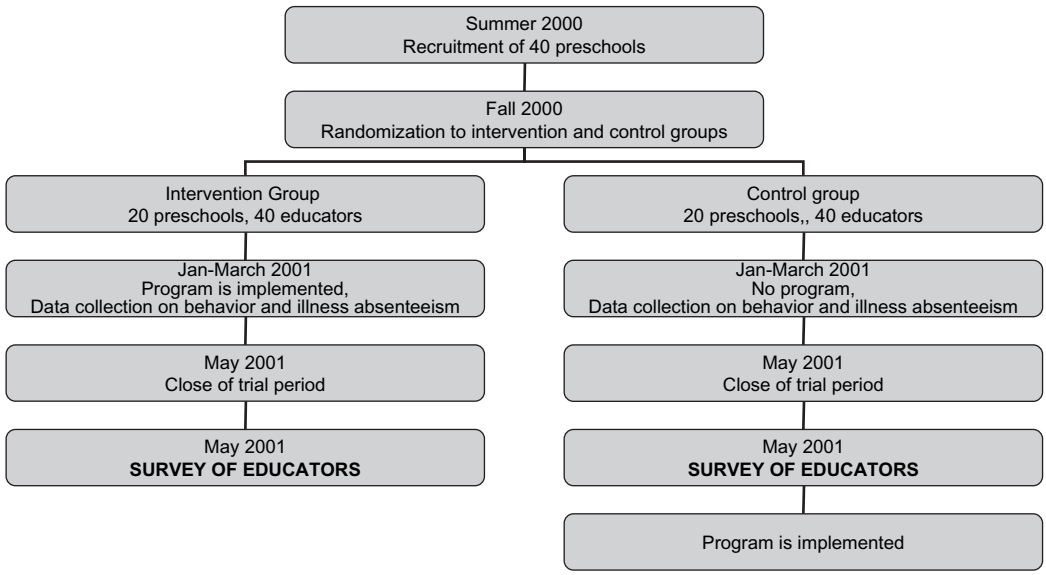

Fig. 1. Design of Jerusalem Handwashing Study.

The survey of knowledge, attitudes and beliefs was conducted in May 2001. At this time, intervention group staff members (n = 40) had already been exposed to the program, while those in the control group (n = 40) had not yet been exposed. This permits valid assessment of the intervention effect. The written questionnaire was distributed by project staff and filled out by preschool teachers and their assistants during a regularly scheduled observation visit to the preschool. Seventy-four of the 80 educators (92.5%) representing 39 of the 40 included preschools (97.5%) associated with the project filled out the questionnaire. Analysis of these data is presented in this paper.

Measures

The survey instrument, which is presented in translation in the Appendix 1, was based largely on a pre-existing instrument [54] developed to determine nurse's attitudes to handwashing among critical care nurses and their patients and was augmented by questions on knowledge adapted from a previous handwashing intervention trial [55]. Both instruments and permission to use them were received directly from the authors (C. O'Boyle, personal communication; J. Kotch, personal communication; also see [55]). The first instrument is based on concepts from the Theory of Planned Behavior, which attempts to account for motivation to perform specific behaviors. That instrument has been used and validated in many hospital settings. It was adapted for use with preschool educators and translated into Hebrew. Questions about 'your patients' directed at nurses were rewritten as questions about 'the children in your classroom'. As was done in the previous study, questions from the instrument were used to construct the scales on beliefs about outcomes, attitudes and self-efficacy. The questionnaire was tested prior to use in the study on preschool educators not involved with the program.

'Positive' scoring of individual questions indicated that a more favorable response towards handwashing was associated with a higher number. Positive and negative scoring were alternated on a non-systematic basis in the questionnaire. Questions were asked on a 1–7 Likert-type scale.

Four scales were created from the original questions. In all cases, scale construction was done after negative scales were recoded to positive ones. (That is, a value of '7' became '1', a value of '6' became '2' and so on.) Direction of scoring appears in Table I.

The beliefs about outcomes scale, with four items, concentrated on whether the respondent believed that handwashing had a protective effect against communicable illness. The attitudes scale had 14 items, seven about handwashing before lunch and seven about handwashing after bathroom use. The individual items measured the degree of inconvenience, irritation, frustration and practicality involved with getting children to wash hands at the appropriate times, as well as whether handwashing was considered optional or beneficial. The self-efficacy scale had two items and the knowledge scale six.

Intervention

The goal of the intervention was to improve hygiene: the main emphasis was on handwashing with soap before eating and after bathroom use and the secondary emphasis was on the elimination of shared cups and towels. The intervention consisted of elements aimed at the children, the staff, the environment and the parents. The preschool staff was the critical link in all elements of the program, as it was their responsibility to implement much of the program and to encourage the children, on a daily basis, to wash hands at appropriate times. There were two 3-hour training sessions for the staff. These included lectures by a pediatrician, an epidemiologist and a teacher of preschool educators; experiential learning with petri dishes and the presentation of various games, developed for the project and found in the literature, which could be used with the children.

The experiential learning approach was central to the training sessions. During the workshops, petri dishes were used to help educators understand disease transmission, particularly regarding fecal–oral contamination. Each teacher placed her hands in a petri dish three times (Fig. A1). The first time, she did this without washing hands. The second time, she washed her hands with water only and then

Table I. *Descriptive statistics for rescored individual questionnaire items by intervention group*[a]

	Score direction		Intervention group			Control group			All		
			Mean	SD	*n*	Mean	SD	*n*	Mean	SD	*n*
A		**Beliefs about outcomes**									
		If children wash hands …									
	Positive	Protect children from diarrhea	6.47	1.11	36	6.46	0.87	37	6.47	0.99	73
	Positive	Protect children from upper respiratory infection	5.69	1.53	35	5.16	1.75	38	5.41	1.66	73
	Positive	Protect self from diarrhea	6.06	1.63	35	5.16	2.23	37	5.60	2.00	72
	Positive	Protect self from upper respiratory infection	5.03	2.15	35	4.50	2.21	36	4.76	2.18	71
B1		**Feelings about children washing before lunch**									
	Negative	Inconvenient … convenient	5.69	2.13	32	5.41	2.35	34	5.55	2.23	66
	Positive	Not frustrating … frustrating	6.19	1.30	31	5.80	1.88	35	5.98	1.63	66
	Negative	Not practical … practical	5.64	2.15	33	5.21	2.13	34	5.42	2.13	67
	Negative	Troubling … reassuring	5.50	1.75	28	5.34	2.07	32	5.42	1.92	60
	Negative	Irritating … soothing	5.47	1.70	32	5.28	1.89	32	5.38	1.79	64
	Negative	Optional … necessary	5.31	2.53	36	5.31	2.22	35	5.31	2.36	71
	Positive	Beneficial … harmful	6.65	0.98	34	6.43	1.50	35	6.54	1.27	69
B2		**Feelings about children washing after bathroom use**									
	Negative	Inconvenient … convenient	4.70	2.27	33	5.24	2.34	34	4.97	2.30	67
	Positive	Not frustrating … frustrating	5.47	2.08	32	5.79	2.00	34	5.64	2.03	66
	Negative	Not practical … practical	5.30	2.26	33	5.68	1.93	34	5.49	2.09	67
	Negative	Troubling … reassuring	5.44	2.10	27	5.70	1.69	33	5.58	1.87	60
	Negative	Irritating … soothing	4.93	2.27	29	5.62	1.79	34	5.30	2.04	63
	Negative	Optional … necessary	5.03	2.61	35	5.33	2.31	36	5.18	2.45	71
	Positive	Beneficial … harmful	6.58	1.46	33	6.41	1.52	34	6.49	1.48	67
C		**Self-efficacy**									
	Positive	I can get all children to wash hands before lunch	6.39	0.84	36	6.13	1.49	38	6.26	1.22	74
	Positive	I can get all children to wash hands after bathroom use	5.83	1.03	36	6.00	1.66	38	5.92	1.38	74
D		**Knowledge**									
	Negative	Child who ritually handwashes does not need to wash with soap	6.49	1.44	35	5.64	2.02	36	6.06	1.80	71
	Negative	Trying to decrease illnesses not worthwhile	6.37	1.29	35	5.58	2.08	36	5.97	1.76	71
	Negative	Illnesses can not be minimized—they are from Heaven	6.17	1.68	36	6.46	1.38	35	6.31	1.54	71
	Negative	I can tell when child is infectious	5.71	1.62	34	5.40	2.05	35	5.55	1.84	69
	Positive	Shared towels can transmit infections	6.03	1.65	35	5.42	2.06	36	5.72	1.88	71
	Positive	Shared cups can transmit infections	6.69	0.75	36	5.76	2.03	37	6.22	1.60	73

[a]Higher numbers indicate more positive attitudes toward handwashing.

placed her hands in another petri dish. The third time, she washed her hands with soap and water, used a paper towel to dry her hands, and then put her hands in a petri dish. The teachers took the petri dishes home and watched the development of different quantities of colorful stains which indicated the presence of bacteria under different conditions.

Each preschool hosted a puppet show designed for the project. A self-reward system, games, posters and puzzles were techniques used with the children. Presentations to the children by school nurses, environmental changes (the provision of liquid soap and paper towel dispensers, cup racks and liquid soap, paper towels and individual cups) and distribution

of a home component (a video of the program and a magnet) were part of the comprehensive, multifaceted approach.

Analysis

Cronbach's alpha was calculated to assess the internal consistency of the constructed scales. Alphas in the 0.80s and 0.90s indicate high internal consistency [56]. To avoid dependencies in the dataset in the scale construction and calculation of Cronbach's alpha, an average of educator responses was calculated for each preschool. This average was based on two observations, one from the teacher and one from her assistant. In instances when only one staff member had filled out the questionnaire, that information was used.

The effect of the intervention on each of the four scales was tested using mixed model analysis of variance (ANOVA) [57] with a compound symmetry covariance structure. This model was necessary because of dependencies in the dataset resulting from using data from two staff members per preschool. All 74 observations were used for this analysis. The independent effects included were intervention group, educational sector (religious/secular) and staff member (teacher/assistant). The preschool was included as a random effect. PROC MIXED of SAS version 8.2 [58] was used. The statistical significance of the intervention effect on individual items was not calculated, due to the large number of items and the possibility of spurious results.

Pearson partial correlation coefficients were calculated to determine the relationship between the psychosocial variables while controlling for the effects of intervention group and educational sector. The unit of observation was the preschool in order to avoid dependencies in the dataset.

Information on years of experience was available for 29 of the 40 teachers (72.5%). The correlation between the psychosocial scales and years of experience was estimated for these teachers using the Pearson partial correlation coefficients while controlling for the effects of intervention group and educational sector.

Results

Educator recruitment rates were very high: at least 88% of educators approached agreed to participate in the trial. There was no dropout or loss to follow-up of educators.

Descriptive statistics for each item by intervention group and overall are presented in Table I. In Table II, values of the constructed psychosocial scales are presented, with Cronbach's alpha.

Intervention effect on beliefs

Belief in the protective effect of children's handwashing against diarrhea was quite high and nearly identical in the two intervention groups (intervention: mean = 6.47, SD = 1.11; control: mean = 6.46, SD = 0.87). The intervention group scored higher in every individual item of this scale. Belief in the protective effect of children's handwashing against upper respiratory infection was high, though not as high as belief in protection against

Table II. *Constructed psychosocial scales by intervention group*[a]

	P-value difference between groups	Cronbach's alpha	Intervention group			Control group			All		
			Mean	SD	*n* preschools	Mean	SD	*n* preschools	Mean	SD	*n* preschools
Beliefs about outcomes scale	0.0875	0.66	5.73	0.95	19	5.29	1.12	20	5.51	1.05	39
Attitudes scale	0.9187	0.93	5.60	1.15	19	5.71	1.28	20	5.65	1.21	39
Self-efficacy scale	0.9502	0.82	6.14	0.63	19	6.09	1.13	20	6.12	0.91	39
Knowledge scale	0.0343	0.60	6.24	0.73	19	5.81	0.79	20	6.02	0.79	39

[a]Higher numbers indicate more positive attitudes toward handwashing.

diarrhea, and the difference between the groups for this item was greater (intervention: mean = 5.69, SD = 1.53; control: mean = 5.16, SD = 1.75). The four items about beliefs—beliefs in the protective effect of childrens' handwashing on diarrhea and upper respiratory infection on children and staff—were combined in the beliefs about outcomes scale. The Cronbach's alpha for that scale was 0.66, indicating a medium level of internal consistency. Beliefs about outcomes were positive toward handwashing in both groups (intervention: mean = 5.73, SD = 0.95; control: mean = 5.29, SD = 1.12). The effect of the intervention on beliefs about outcomes was borderline significant [least-squares means (LSMeans) intervention group: 5.82, LSMeans control group: 5.22, $P = 0.0875$, mixed models ANOVA].

Intervention effect on attitudes

Attitudes toward handwashing were positive in both groups. In six out of seven items relating to handwashing before lunch, attitudes were more positive in the intervention group. The control group, however, had more positive attitudes toward handwashing after bathroom use. The most positive attitude occurred in both groups for the question: Is handwashing 'Beneficial … Harmful' before lunch? (intervention: mean = 6.65, SD = 0.98; control: mean = 6.43, SD = 1.50). The intervention group educators assigned the lowest grade to convenience of handwashing after bathroom use, and the control group educators assigned the lowest grade to practicality of handwashing before lunch. Mean values of the attitudes scale did not differ between the two groups (intervention: mean = 5.60, SD = 1.15; control: mean = 5.71, SD = 1.28). The Cronbach's alpha for the attitudes was 0.93, revealing a high degree of internal consistency. The effect of the intervention on attitudes was not significant (LSMeans intervention group: 5.72, LSMeans control group: 5.77, $P = 0.9187$, mixed models ANOVA).

Intervention effect on self-efficacy

High levels of self-efficacy were apparent for staff members from both groups on both of the questions, the first of which related to self-efficacy in getting children to wash hands before lunch and the second of which related to self-efficacy in getting children to wash hands after bathroom use. Scores were slightly higher in both groups for self-efficacy in getting the children to wash before lunch. The Cronbach's alpha for the combined scale was 0.82, indicating a high level of internal consistency. Self-efficacy was not significantly affected by the intervention group (LSMeans intervention group: 6.10, LSMeans control group: 6.08, $P = 0.9502$).

Intervention effect on knowledge

Knowledge was high on all items in both groups. The most positive response in the intervention group was to the item about transmissibility of infectious disease via shared cups (intervention: mean = 6.69, SD = 0.75; control: mean = 5.76, SD = 2.03). The highest response in the control group was to the item about whether it is possible for human beings to affect illness (intervention: mean = 6.17, SD = 1.68; control: mean = 6.46, SD = 1.38). The intervention group scored better than the control group on five out of six items. The score for the knowledge scale was 6.24 for the intervention group (SD = 0.73) and 5.81 for the control group (SD = 0.79). The Cronbach's alpha for this scale was 0.60, indicating a moderate level of internal consistency. Knowledge was significantly higher in the intervention group (LSMeans intervention group: 6.22, LSMeans control group: 5.66, $P = 0.0343$).

Effects of staff position and educational sector on psychosocial variables

The effect of staff position and educational sector on psychosocial variables was examined. Staff position had no effect on beliefs about outcomes, attitudes or self-efficacy ($P > 0.05$), but educators had higher levels of knowledge than did their assistants (LSMeans educators: 6.3, assistants: 5.6, $P = 0.0005$). Educational sector had no effect on beliefs about outcomes, knowledge or attitudes. Educators in the secular sector tended to have higher levels of self-efficacy than educators in the religious sector (LSMeans, secular sector: 6.4, LSMeans religious sector: 5.8, $P = 0.0682$).

Table III. *Pearson partial correlation coefficients for beliefs about outcomes, attitudes, self-efficacy and knowledge (n = 39)*

Pearson correlation coefficient, *P*-value	Beliefs about outcomes scale	Attitudes scale	Self-efficacy scale	Knowledge scale
Beliefs about outcomes scale	1.00000	−0.11855 0.4847	−0.31811 0.0550	0.19792 0.2403
Attitudes scale		1.00000	0.17830 0.2911	0.25816 0.1229
Self-efficacy scale			1.00000	0.13312 0.4322
Knowledge scale				1.00000

The relationship between educator beliefs, attitudes, knowledge and self-efficacy

Pearson partial correlation coefficients for the relationships between the psychosocial variables are presented in Table III. The correlation between beliefs about outcomes and self-efficacy ($r = -0.32$, $P = 0.0550$) was close to efficient at the $P = 0.05$ level, indicating that those preschools with educators who believed in the effectiveness of handwashing also had lower levels of self-efficacy. The direction of the correlation between knowledge and attitudes was positive (+0.258), but did not reach statistical significance.

The relationship between teachers' years of experience and psychosocial variables

Information on years of educator experience was available for 29 of the teachers (15 in the intervention group and 14 in the control group). Most teachers had many years of experience (mean = 20.5, SD = 8.0). This did not differ between the intervention groups ($P = 0.13$). Attitudes toward handwashing were more positive among less-experienced educators ($r = -0.45$, $P = 0.0221$). Correlations between knowledge and years of experience and between beliefs about outcomes and years of experience were nearly zero (−0.03, 0.06, respectively).

Discussion

This is the first controlled handwashing intervention that, to our knowledge, tested the effect of a handwashing intervention on psychosocial measures among preschool staff members. Our results showed that educators believed handwashing affects health, had positive attitudes toward handwashing, high levels of self-efficacy and high levels of knowledge. Knowledge was positively affected by the intervention and was greater among educators than among assistants and among the less-experienced teachers. The significance of the effect of the intervention on beliefs about outcomes was borderline and may have reached statistical significance if the sample size was larger. Attitudes were almost identical in the two groups.

Scores were higher in both groups for self-efficacy in getting children to wash before lunch than in getting children to wash hands after bathroom use. This confirmed our sense that it is easier to get children to wash hands in a group, as occurs before lunch, than to control their handwashing behavior after bathroom use. The higher levels of self-efficacy among secular educators than religious educators may reflect the fact that handwashing with soap in the religious sector represented a greater challenge. This may be because ritual handwashing with water alone is practiced in that sector prior to eating bread and preceding ritual handwashing with handwashing with soap is complicated for small children and time consuming for the preschool staff.

The controversy regarding the importance of knowledge in behavior change

The fact that knowledge was higher in the intervention group several months after program implementation ended [59] suggests that the information was internalized by the educators. During the training

sessions, there was at least one educator in each group who, in the context of discussing this exercise, exclaimed in surprise: 'Now I get it! NOW I understand why handwashing is important!' The strength of these assertions was surprising—as was the fact that they were repeated by an educator publicly in every group. We hypothesize that our success in changing knowledge may have been partly due to the experiential component of the teacher training workshops.

The role of knowledge in changing behavior is controversial. The Health Belief Model explicitly includes knowledge as a component on the pathway to behavior. The Theory of Reasoned Action and the Theory of Planned Behavior assume that people use available information and that this affects behavior [51]. However, empirical evidence has led to conflicting opinions of the importance of knowledge in changing behavior [60]. One previous investigator concluded that education alone is unlikely to change behavior, after discovering that the relationship between knowledge and self-reported frequency of handwashing was not significantly correlated in a study of long-term care facilities nurses [43]. On the other hand, researchers who found that Italian nurses employed in operating theaters [61] and intensive care units [42] had deficient knowledge led the authors to recommend interventions with educational as well as other components. A study of mothers' hygiene behavior in Ghana showed that knowledge was a significant factor in predicting handwashing behavior after defecation [62]. Other researchers [60] found that while food hygiene training among food handlers significantly improved food-handling practice, 61% of trained food handlers reported that they 'sometimes' or 'often' did not implement what they had learned. They noted that the relationship between training, knowledge and behavior is complex. In a subsequent article [63], those authors identified five components (attitudes, subjective norms, descriptive norms, perceived behavioral control and intention), which significantly predicted hand hygiene malpractice among food caterers, and concluded that provision of information alone is insufficient to change behavior.

The importance of attitudes

The importance of the positive attitudes of the preschool educators, and their beliefs regarding the protective potential of handwashing against communicable disease, must not be underestimated. Preschool educators, both the teacher and her assistant, are at the forefront of the ongoing battle with communicable illnesses that the community faces. Without their positive attitudes toward handwashing, such an intervention would be nearly impossible to implement. Most (at least 88%) of the educators contacted agreed to participate in the program [59], and we received over one hundred spontaneous requests to run the program elsewhere. This attests to the feasibility of implementing a handwashing intervention on a broad scale.

Attitudes toward handwashing among nurses

While psychosocial variables relating to handwashing have not been previously investigated in the population of preschool educators, they have been explored in the nursing population. Nurses and preschool educators are similarly caretakers of dependent populations, and both bear some degree of responsibility for health. Interestingly, one published study [54], of attitudes toward handwashing among nurses, reported scales' results which were remarkably similar to ours (beliefs about outcomes—preschool educators: 5.51, nurses: 5.23; attitudes—preschool educators: 5.65, nurses: 5.69; self-efficacy—preschool educators: 6.12, nurses: 6.08. Knowledge was not assessed in the nursing population). As in the current study, levels of self-efficacy were particularly high. Future researchers may benefit from rephrasing the self-efficacy questions in order to better differentiate between levels of self-efficacy. Furthermore, additional aspects of constructs which would be relevant in promoting hygiene could be explored.

Study limitations

The main limitation of this study is that information on psychosocial variables was not collected at baseline. Therefore, it is possible that observed

differences between the intervention and control groups may have been present prior to the trial. However, there are two good reasons to believe that this is not the case. First, the preschools were divided randomly into intervention and control groups, and this makes it unlikely, though not impossible, that an unequal distribution occurred. In the words of the classic textbook on controlled trials, 'Randomization tends to produce study groups comparable with respect to known and unknown risk factors, [and] removes investigator bias in the allocation of participants' [64]. Second, 10 variables which were under the control of the preschool staff were measured in each preschool at baseline: handwashing behavior before lunch and after bathroom use, type of soap, presence of soap, a soap dispenser, paper towels, paper towel dispensers, cloth towels, communal cups and individual cups. Comparison of these 10 variables at baseline, prior to the implementation of the program, showed no differences between the intervention and control groups at the $P = 0.05$ level [59]. If staff attitudes between the groups differed at baseline, one would expect to see these differences expressed in at least a few of the measured baseline variables. The randomized allocation to intervention groups, together with the lack of differences between other measured variables at baseline, provides strong evidence for the validity of the comparison between intervention groups.

Educators in both groups had very positive attitudes toward handwashing. The recruitment procedure may have influenced the attitudes of both groups of educators prior to program implementation. If this was true, the program effect would be greater than documented. Additionally, the control group may have experienced some 'leakage' during the trial itself. We tried to avoid this by choosing preschools located in independent buildings wherever possible. As previously reported, the behavior of the children in the control group did not change during the study period (handwashing before lunch, $P = 0.3916$; handwashing after bathroom use, $P = 0.3981$) [59]. It is not possible to know if contamination of attitudes took place. If it did exist, the effect on trial results would be to underestimate the true effects of the program.

Conclusions

Despite the overwhelming evidence of the importance of simple handwashing with soap for communicable disease control, attaining high levels of handwashing in many settings remains an elusive goal. Because of the centrality of early childcare centers in transmission of communicable disease in the community, preschool educators can play a crucial role in the battle against these diseases through enforcing handwashing regulations. Preschool educators in our trial exhibited very positive attitudes toward handwashing and believed that handwashing was important in disease control. The intervention successfully increased knowledge, perhaps because of the use of an experiential approach in teaching about disease transmission. The combination of positive attitudes toward handwashing among educators and the program's effectiveness in imparting knowledge helped to create a sustained social norm of handwashing among many children in disparate locations.

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Conflict of interest statement

None declared.

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Appendix 1. Items from questionnaire

A. Beliefs about outcomes

These questions were answered on the following 1–7 scale:

Reasonable	7	6	5	4	3	2	1	Unreasonable

If I insist that the children in my classroom wash their hands with soap before lunch and after bathroom use:
The children in my classroom will have fewer bouts of diarrhea
The children in my classroom will have fewer occurrences of colds and flu
This will protect me from diarrhea
This will protect me from colds and flu

B. Attitudes toward handwashing

For me to make sure that the children wash their hands before lunch is:

Inconvenient	7	6	5	4	3	2	1	Convenient
Not frustrating	7	6	5	4	3	2	1	Frustrating
Impractical	7	6	5	4	3	2	1	Practical
Troubling	7	6	5	4	3	2	1	Reassuring
Irritating	7	6	5	4	3	2	1	Soothing
Optional	7	6	5	4	3	2	1	Necessary
Beneficial	7	6	5	4	3	2	1	Harmful

For me to make sure that the children wash their hands after bathroom use is:

Inconvenient	7	6	5	4	3	2	1	Convenient
Not frustrating	7	6	5	4	3	2	1	Frustrating
Impractical	7	6	5	4	3	2	1	Practical
Troubling	7	6	5	4	3	2	1	Reassuring
Irritating	7	6	5	4	3	2	1	Soothing
Optional	7	6	5	4	3	2	1	Necessary
Beneficial	7	6	5	4	3	2	1	Harmful

C. Self-efficacy

These questions were answered on the following 1–7 scale:

Very reasonable	7	6	5	4	3	2	1	Very unreasonable

If I want to, I can get the children in my classroom to wash hands before lunch
If I want to, I can get the children in my classroom to wash hands after they use the bathroom

D. Knowledge

These questions were answered on the following 1–7 scale:

True	7	6	5	4	3	2	1	Not true

A child who ritually washes hands with water alone does not need to wash hands with soap
Communicable illnesses are a normal part of childhood and there is no reason to try to prevent them
It is not possible to reduce communicable illnesses—they come from Heaven
I can always tell if a child is infectious from the way he/she looks or behaves
It is possible to get sick from using someone else's towel
It is possible to get sick from using someone else's drinking cup

Fig. A1. Three petri dishes used as part of intervention program with preschool educators. Degree of darkness indicates concentration of bacteria. Black Hebrew script letters on petri dish covers indicate whether hands were washed prior to placing them in petri dish. Petri dish, top right (greatest concentration of bacteria): educator placed hands in petri dish without washing hands. Petri dish, top left: educator placed hands in petri dish after washing hands with water. Petri dish, bottom (least concentration of bacteria): educator placed hands in petri dish after washing hands with liquid soap and drying them with a paper towel.