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The effects of food safety education on adolescents' hand hygiene behavior: an analysis of stages of change

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Abstract

The hand hygiene behavior of 400 middle school students (grades 1-3) in Seoul and Gyeonggi-Do was studied to determine how stages of change were affected by food safety education, focusing on hand hygiene and general food safety. Subjects were 51.3% male and 44.3% of study subjects were first graders of middle school. Approximately 40% of subjects were at the stage of action, 42.7% were at the stage of contemplation, and 16.4% were at pre-contemplation. The most important factor that influenced proper hand washing was self efficacy ($P < 0.001$). Proper hand washing was also correlated significantly with positive belief ($P < 0.01$) and stages of change ($P < 0.01$). After food safety education by high-school mentors, middle-school students who were in the stages of pre-contemplation (11.1%) and contemplation (88.9%) showed significant progression toward the action stage ($P < 0.001$). Proper hand washing ($P < 0.01$) and food safety knowledge ($P < 0.05$) were also significantly increased after educational intervention.

Key Words: Hand-washing, middle school students, behavior, self-efficacy, stages of change

Introduction

Hand washing is a simple and cost effective means of reducing the incidence of food-borne disease. Hand washing can reduce the spread of infections obtained by external contact, eliminating between 12% and 40% of all gastrointestinal diseases and over 20% of all infections [1-5]. Hand washing with soap is especially effective, with washing with only water killing fewer germs [5,6]. However, Luby *et al*. [6] showed that incidences of disease were not significantly different between households that were given plain soap and those given antibacterial soap.

Hand washing is especially important for children and adolescents, as these groups are the most susceptible to infections gained from unwashed hands [4]. Although many young people are aware of the importance of proper hand hygiene, education focusing on proper hand washing practices in schools is often deficient.

Nutrition education is more likely to be effective when it focuses on behavior and action rather than only knowledge and is systematically linked to educational theory [7]. Several theories have been adapted to nutrition education to encourage behavioral changes. Among these, the health belief model [8] and the stages of change model [9] have been popularly applied to nutrition intervention. The health belief model [8] predicts behavioral changes by focusing on the importance of knowledge, perceived benefits and barriers while stages of change model (trans-theoretical model (TTM)) [9] is more focused on decisional balance and self-efficacy in predicting behavior changes.

For effective education, it is important to identify the subject's educational background, readiness to make change, and awareness of the problem. The stages of change model, developed by Prochaska and DiClemente [9], was initially used to change smoking or alcohol addiction behaviors [10], but its use has been diversified to improve various nutritional and heath related behaviors. The original stages of change model divides subjects into six stages: pre-contemplation, contemplation, preparation, action, maintenance and termination [9]. Restrictions due to the subjects' age and the nature of the research led this work to divide subjects into the three most distinct stages of this process: pre-contemplation, contemplation, and action. Pre-contemplation involves either very little or no awareness of the subject matter

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and no intention to take actions to change the current lifestyle. In the contemplation stage there is awareness of the subject's current lifestyle and individuals plan to take action over the next six months. The action stage includes people who are currently taking action in the particular area of concern.

There have been some studies into changing fruit and vegetable consumption behavior using the stages of change model [11-14], but the model has not yet been applied to hand hygiene behavior, which this work aimed to analyze so as to provide a basis for more thorough and more systemic hygiene education. The primary purpose of this study was to examine the current stages of change level of subjects' hand washing behavior, and assess which important factors influence behavioral changes, such as self-efficacy, beliefs, and food safety knowledge. The second purpose of this study was to determine the effect of food safety education on the stages of change for hand hygiene behavior and food safety knowledge.

Subjects and Methods

Subjects

For the first purpose of study, a survey was conducted with 400 first to third grade middle-school students from two schools in Seoul and Gyeonggi-do from July 2010 to December 2010. For the effective education intervention study, 26 subjects, all of whom were in the first grade of middle school, had similar academic achievements, and were in the contemplation/ pre-contemplation stage, were selected. Subjects who attended the same dormitory school were chosen because that the selected school had middle and high school attendants (mentors and mentees) and allowed for convenient and time-efficient gathering of subjects for educational provision.

Survey study

The survey included items about the subjects and their parents' demographic characteristics, questions about food safety and hand washing knowledge and behavior, and items related with behavioral changes.

Proper hand washing score

The proper hand washing score was the sum of two scores (Cronbach's $\alpha = 0.75$) on 5 point scales where 1 = never and 5 = always. The items asked whether students washed hands after going to the bathroom or before eating and whether they washed hands for at least 30 seconds up to the wrist with soap.

Determining the stages of change

A questionnaire from previous work that measured stages of change was modified for this study [15-17]. One item was used to determine the stage of change, with subjects being asked to choose one of three statements: I do not consider hand hygiene practices to be important for health (scored as pre-contemplation); I agree that hand hygiene behavior is very important for health, and although I do not currently practice it well now, I will in the near future (contemplation and preparation); I realize that hand hygiene behavior is very important for health, and I have been practicing it for at least six months.

Self-efficacy

One item was used to determine self-efficacy [18]: "I can wash my hands after going to the bathroom even when I am in a real hurry". Self-efficacy was measured on a 5-point scale where 1 = not at all sure, and 5 = extremely sure.

Positive and negative beliefs

Items regarding positive and negative beliefs were based on how subjects made decisions relating to hand hygiene practices [19]. Items for positive belief included perception of importance of washing and hands and health benefits. Negative beliefs included barriers such as time, dry skin problems, and inconvenience. These items were measured by using a 5 point Likert scale (1 = not at all important in deciding whether to wash hands and 5 = extremely important in decision making) (Cronbach's $\alpha = 0.60$)

Food safety knowledge questionnaires

The ten questions assessing food safety knowledge (O/X response) included hand washing related questions, food safety, nutrition labeling, food poisoning, and food selection items [17]. A correct answer received a score of 1 and a wrong answer scored 0, resulting in possible total scores ranging from 0-10.The reliability of the food safety knowledge and practice questions was validated using Cronbach's α (Cronbach's $\alpha = 0.84$).

Intervention study

After determining the stages of change level of hand hygiene behavior, subjects in the pre-contemplation / contemplation stages, i.e. those who knew of the importance of hand washing but failed to behave accordingly, were recruited to receive appropriate educational intervention based on the techniques and processes associated with the stages of change model [9,10].

Education intervention was conducted between the 1st to 30th of September 2010, and was designed to increase participants' food safety behavior, especially focusing on hand hygiene behavior and practice. The contents of the education materials were developed by professors specializing in nutrition and education, and high school mentors were trained in using these

materials to educate subjects. The educators reviewed the contents through middle school students, and finally these contents were re-checked for revision by a professional. The contents of education comprised three lessons and one lab experiment. Lessons focused on teaching the importance of good hand hygiene, hand hygiene and food poisoning and food safety in general (such as unsafe foods and nutrition labeling) for thirty minute periods, followed by a review through discussions and quizzes. Discussion included how to overcome barriers to action, increase self-efficacy and improve skills for practicing proper hand washing.

Data analysis

Data were analyzed using SPSS 12.0 (SPSS, Inc,, Chicago, IL, USA), after data coding and cleaning. Subjects' general characteristics were expressed as either means with standard deviations for numerical variables or as frequencies and percentages for categorized variables. Significant differences between stages of change and numerical variables were tested by an analysis of variance, and within group differences were identified by Duncan's *post-hoc* test. The mean differences between male and female were determined by independent t-test. The education effect before and after were tested by paired t-test. Variable differences with categorized scores were analyzed by χ^2-tests. Regression analysis was conducted; the dependent variable was proper hand washing behavior and the independent variables included self-efficacy, beliefs, stages of change, food safety knowledge, gender, and age.

Results

Subjects were 51.3% male and 48.7% female with a mean age of 14.7 years (Table 1). 44.3% were first graders and 42.7% were second graders. Table 2 shows that 33.1% of the subjects had high scores for proper hand washing and 20.4% had low scores. No significant differences were observed between males and females. In terms of readiness to change hand hygiene behavior, 40.9% of the subjects were at the stage of action, 42.7% were at the stage of contemplation, and 16.4% were at the stage of pre-contemplation. Significantly more female subjects were at the stage of action than were male subjects (48.7% v. 33.7%, $P < 0.01$).

Table 1. General characteristics of subjects (n = 384)

		Total
Age (yrs)		14.7 ± 0.7[1)]
Weight (kg)		52.4 ± 10.3
Height (cm)		163.1 ± 7.5
Grade (middle school)	1th	170 (44.3)[2)]
	2th	164 (42.7)
	3th	50 (13.0)
Sex	Male	197 (51.3)
	Female	187 (48.7)

[1)] Mean ± SD
[2)] N (%)

Table 2. Proper hand-washing and stages of change scores in subjects N (%)

	Male	Female	Total	*P*-value
Proper hand-washing scores				
Low (2-5)	43 (21.7)	36 (19.7)	79 (20.4)	
Medium (6-7)	90 (45.5)	90 (47.6)	180 (46.5)	0.802
High (8-10)	65 (32.8)	63 (33.3)	128 (33.1)	
Total	198 (51.2)	189 (48.8)	387 (100)	
Stages of change				
Pre-contemplation	39 (19.3)	25 (13.2)	64 (16.4)	
Contemplation	95 (47.0)	72 (38.1)	167 (42.7)	0.009
Action	68 (33.7)	92 (48.7)	160 (40.9)	
Total	202 (51.7)	189 (48.3)	391 (100.0)	

P-value by χ^2-test

Table 3. Parental influence on proper hand-washing

	Hand-washing score	*P* value[2)]
Parental emphasis on hand-washing		
None (n = 3)	4.00 ± 2.00[1)a]	0.000
Little (n = 25)	5.72 ± 1.88[b]	
Moderate (n = 62)	6.53 ± 1.71[c]	
Some (n = 163)	6.80 ± 1.55[c]	
Much (n = 135)	7.05 ± 1.71[d]	
Mother's job status		
Stay-home (n = 189)	6.82 ± 1.66	0.776
Part-time job (n = 130)	6.71 ± 1.62	
Full-time Job (n = 69)	6.68 ± 1.94	
Mother's education		
high School (n = 91)	6.65 ± 1.83	
2-yr college (n = 87)	6.74 ± 1.81	0.538
4-yr college (n = 142)	6.71 ± 1.54	
> University (n = 63)	7.05 ± 1.68	

[1)] Mean ± SD
[2)] *P*-value by ANOVA
Numbers with different letter superscripts in the same row are significantly different (Duncan's test).

Food safety instruction at home from the subjects' mothers was significantly associated with proper hand washing ($P < 0.001$, Table 3); that is, subjects whose mothers stressed food safety at home had higher scores of hand-washing while subjects who received no instruction from their mothers had a poor average score. No association between maternal job status or education and proper hand washing scores were shown.

The most influential factors on proper hand washing behavior are listed in Table 4. These accounted for a 30% influence on behavior ($R^2 = 0.329$). The most important factor that influenced proper hand washing was self-efficacy ($P < 0.001$). Proper hand washing scores were also correlated significantly with positive belief ($P < 0.01$) and stages of change ($P < 0.01$). Subjects' age, sex and food safety knowledge showed no significant effects on their proper hand washing scores.

Table 4. Influences of psychological variables on scores of proper hand washing by regression analysis

Variables	Non-standarized constant B	Standardized constant		t	Significance
		SE	beta		
Self-efficacy	0.446	0.097	0.255	4.590	0.000***
Positive belief	0.127	0.041	0.168	3.129	0.002**
Negative belief	0.020	0.045	0.026	0.443	0.658
Stages of change	0.383	0.129	0.163	2.978	0.003**
Knowledge scores	-0.051	0.037	-0.072	-10.388	0.166
Grade	-0.073	0.126	-0.029	-0.580	0.562
Sex	-0.194	0.176	-0.057	-1.105	0.270

dependent variable: score of proper hand washing
** $P < 0.01$
*** $P < 0.001$

Table 5. The effect of food safety education on stages of change N (%)

		Before	After	*P*-value
Stages of change	Pre-contemplation	2 (11.1)	0 (0)	
	Contemplation	24 (88.9)	14 (51.9)	0.000
	Action	0 (0)	12 (48.1)	

P-value by χ^2-test

Table 6. The effect of food safety education on hand hygiene behavior, beliefs, self-efficacy and food safety knowledge scores

	Before	After	*P*-value
Hand washing score	6.21 ± 1.51	9.37 ± 2.01	0.000***
Belief (Positive)	9.45 ± 1.77	10.50 ± 1.88	0.023*
Belief (Negative)	8.54 ± 1.22	9.08 ± 1.59	0.152
Knowledge score	6.51 ± 1.97	7.97 ± 1.93	0.018*
Self-efficacy	4.42 ± 0.50	4.60 ± 0.50	0.425

1) Mean ± SD
* $P < 0.05$ by paired t-test
*** $P < 0.001$

Table 7. Change in food safety knowledge before and after education

Questions	Before	After	*P*-value*
Norovirus and health	0.15 ± 0.37[1)]	0.46 ± 0.50	0.018*
Food bone disease	0.70 ± 0.19	0.77 ± 0.25	0.615
Nutritional labeling	0.79 ± 0.61	0.85 ± 0.54	0.574
Hand washing and diseases	0.81 ± 0.50	0.87 ± 0.50	0.068
Key times to wash hands	0.73 ± 0.49	0.90 ± 0.36	0.041*
Safe food- selection	0.69 ± 0.47	0.73 ± 0.45	0.746
Proper food storage	0.80 ± 0.50	0.87 ± 0.49	0.490
Hand washing technique	0.73 ± 0.49	0.96 ± 0.15	0.021*
Expiration date of foods	0.46 ± 0.27	0.56 ± 0.19	0.067
The meaning of HACCP	0.65 ± 0.377	1.00 ± 0.00	0.043*

1) Mean ± SD
* $P < 0.05$ by paired t-test

After the educational intervention, subjects at the stage of pre-contemplation (11.11%) and contemplation (88.9%) significantly moved towards the action stage ($P < 0.001$, Table 5). Scores of proper hand washing were also significantly increased from 6.21 to 9.37 ($P < 0.001$) after education (Table 6). Positive beliefs about food safety significantly increased ($P < 0.05$).; negative beliefs did not. The mean scores of food safety knowledge after education were statistically significant, when compared to scores pre-intervention ($P < 0.05$).

Among the questions of food safety knowledge (Table 7), the knowledge scores for questions about nutrition labeling in foods and food handling/storage remained low even after food safety education while the scores for all questions that asked about hand washing improved significantly. Responses to two questions regarding general food safety knowledge, specifically about the norovirus ($P < 0.05$) and HACCP ($P < 0.05$), were significantly different after intervention.

Discussion

Food poisoning from school meals accounts for over 60 to 80% of all instances of food poisoning in Korea [20], thus food safety education in school is very important. The stage of change model was shown to be a suitable theoretical base for assessing behavioral changes for hand hygiene [9,21]. The advantage of this model is that it identifies the current stage of subjects and assigns education accordingly.

There has been little work relating stages of changes theory to adolescent hand hygiene behavior [16] or the effect of education intervention, i.e. work that applies stages of change theory to this behavior. As results of this baseline study, 40.9% of subjects were found to be at the stage of action, 42.7% were at the stage of contemplation, and 16.4% were at the stage of pre-contemplation. Most importantly, proper hand washing scores showed a clear positive relationship with the stages of changes.

Attitudes, knowledge, beliefs and self-efficacy are some of the measures that are thought to be on the causal pathway to behavioral change, and several studies have reported that these psychological factors are associated with proper hand hygiene practice among health care personnel [22-26]. In this study, self-efficacy was shown to be the most important factor influencing proper hand washing practice scores, which means that if a student has a high degree of self efficacy about hand hygiene, he has a greater ability to positively change his behavior [27]. The results of this research agreed with previous work that has shown the relationships between self-efficacy and the stages of change [14,27,28].

After receiving four sessions of food safety education that was focused on hand hygiene education including one lab experiment for proper hand washing, students in the pre-contemplation and contemplation stages advanced to later stages, specifically the action stage. Proper hand washing scores (Table 6) and knowledge regarding hand hygiene (Table 7) was significantly increased after intervention. Several studies into children's hand hygiene have shown that those who received educational intervention had lower rates of catching hand hygiene-related diseases, such as intestinal diseases, flu, and diarrhea [28-33].

This research also shows that health education by senior-mentor students can effectively change the behavior of younger students. Previous studies have shown that nutrition and health

education for teenagers has positive results when carried out by peers [34-36] because peers better understand their fellow students' level and environment [33]. Studies on peer education have primarily focused on teenagers and topics such as sex education, smoking, drug addiction, and drinking [34-36]. This study may be seen as involving a type of peer education, but it can also be classified as mentor-mentee education [37-40] because high-school seniors taught middle school students and thus teachers and students were not in the same age groups.

Lastly to account for the discrepancy between the significant improvement of hand hygiene knowledge and the relatively low improvement in food safety knowledge after education intervention, the following explanation can be given: although teen mentors were well-instructed in the subject matter by a nutritional expert, there may be some differences between the conveyance of knowledge by professionals and by non-professionals. Such differences could be assessed by conducting further studies in which both teachers and older students deliver the same education material. The limitation of this study is that education intervention was conducted with limited number of subjects who were attending a dormitory school, unlike most of other schools in Korea, and who had high academic ability. Thus the result of this study cannot be generalized to students at large.

Nevertheless, based on the results of this study, which shows great improvements in hand hygiene behavior and knowledge, this type of mentor-mentee or peer education appears to be suitable for conveying not complicated yet essential knowledge/information to subjects, but not for disseminating more specialized or expert knowledge.

In conclusion, the fundamentals of food safety lie in hand washing and while most middle school students knew the importance of proper hand washing, over 60% fail to practice it. This indicates the importance of food safety education in schools. This research in particular focused on the results of educational intervention applying stages of change theory, and such an educational approach was shown to be effective in changing middle students' hand hygiene behavior. Furthermore, in areas in which expert education is difficult to administer, this type of mentor-mentee education within the school may greatly assist in improving awareness of hand hygiene and ultimately teenagers' overall health.

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