

## HACCP Performance of Employees in School Foodservice Operations and the Related Variables

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### Abstract

The purpose of this study was to assess current food-handling practices of employees in school foodservice settings, as well as their knowledge levels, and identify relationships between knowledge, practices, and influencing variables. The survey was conducted for dietitians and employees in the school foodservice industry in Gyeongsangbuk-do province. A total of 270 and 570 questionnaires for dietitians and employees, respectively, were distributed by mail. Response rates were 62 % (N=171) and 66 % (N=376) from dietitians and employees, respectively. Data was analyzed using SPSS Windows (version 10.0). Descriptive statistics were used to summarize data. Pearson correlations were applied to test for relationships between knowledge and practice of HACCP principles. Stepwise regression analysis was performed to examine the influence of knowledge, current education guidelines, demographic information (working experience, academic background, and certification for food and cooking), and school characteristics (food production system, service style, and number of meals). School foodservice employees were found to have a significant amount of food safety knowledge ( $67.5 \pm 1.8$  out of 100 possible points). Proper food handling practices were not always being followed in many schools. The relationship between their knowledge, current HACCP education training, and food handling practices was not significant. These results suggested the present situation of HACCP trainings performed by dietitians were inadequate for many school foodservice operations. The number of meals in school was an independent predictor of the employees' food-handling practices. These results suggest that an effective education program should integrate endeavors that take account of social and environmental influences on food safety to support the improvement of food-handling practices and the implementation of a HACCP program. Furthermore, dietitians should continue to provide consulting, training, and technical assistance to schools on HACCP implementation.

**Key words:** HACCP performance, education, school foodservice

### INTRODUCTION

The Ministry of Education & Human Resources Development of Korea (MEHRDK) reported in 2004 that school foodservice programs served more than 7.2 million students at 10, 586 schools (1). In Gyeongbuk Province, Korea, 384,049 students (92% of the total students in the province) were served through the school lunch program (1). Although school children's expectations of high-quality food products have increased and, appealing to this customer is not easy today, they are still a high risk group for foodborne illness with compromised immune systems (2). For foodservice operations serving this group, ensuring food safety is critical.

Food safety is an important part of providing school children with acceptable and nutritious meals (3). There

is evidence that improvements are needed in the area of food safety in school's foodservice, and that few schools have implemented Hazard Analysis Critical Control Point (HACCP) programs (4). Although the implementation of HACCP programs in foodservices has not been widespread because it has not yet been mandated, the important role of food safety is well established and food safety issues have been documented in school foodservices (5). However, employee motivation and commitment factors were referred to as high barriers to the implementation of HACCP, as identified by both registered dietitians and dietary managers (6). An understanding of HACCP and the related prerequisite programs, as well as a commitment from employees, must be established to make the HACCP program successful

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(7). Hwang et al. (7) found that the limited use of HACCP programs and the number of schools having no employees certified in food safety indicate that school foodservice directors may face challenges in implementing this program. In their study of school foodservice in Iowa, Youn and Sneed (8) found that HACCP programs and food safety practices were more likely to be implemented in larger school districts than in smaller districts, and education was a significant factor for food safety practices. According to Lee et al. (9), difficulties in implementing the HACCP program in the retail foodservice included limited food safety education/training programs. Chong and Kwak (10) reported that employees' inadequate knowledge and training in HACCP were obstacles in the implementation of HACCP in foodservice establishments. Thus, the success of a HACCP program depends on the education and training of employees regarding their role in maintaining food safety. Through a training process, trainees should gain knowledge, modify their attitudes, and subsequently change their behaviors towards food handling. The food safety awareness program developed by Korea Health Industry Development Institute (KHIDI) using HACCP principles has been widely administrated to food service operations in Korea (11). However, the effectiveness of food safety education program depends on how well employees carry out assigned tasks. Ehiri et al. (12) did not investigate the effectiveness of food safety training courses for improving the knowledge of crucial aspects of food safety. In contrast, another study (13) evaluated whether HACCP-based training was effective in improving both the food safety knowledge and food safety behavior of hospital foodservice employees.

As a safeguard against the increased risk of foodborne illness, safe food handling practices are imperative in school foodservice operations. Little research has documented the relationship between food safety practices and knowledge and the influencing variables on food-handling practices. The purpose of this study was to assess current food-handling practices and the knowledge of employees in Gyeongbuk province school foodservice settings, to provide baseline data for developing educational programs to ease of the implementation of the HACCP program. Furthermore, the researchers investigated relationships and variables that predict food-handling practices. Knowledge gaps and inadequacies in employees' performance will be scrutinized, and it will also help determine where they need further training.

## METHODS

### Questionnaires

The research methodology was developed in two

phases for school foodservice settings: (1) a survey for dietitians, and (2) a survey for employees. The dietitian's survey focused on identifying a comprehensive criteria for current food safety education training with a 20-food safety guideline about HACCP education principles provided by MEHRDK, and 3 questions about the frequencies and type of education and the evaluation method. Responses to each of the food safety guideline question were given on a 5-point scale by the dietitians (1=little or not, 2=seldom, 3=somewhat, 4=widely, 5=always).

The questionnaire for employees contained three sections: knowledge about HACCP principles, their practices for performing HACCP principles, and demographic data. The knowledge and practice statements were based on the guideline by school foodservice requirement HACCP plan provided by MEHRDK (1). Knowledge and practice statements were categorized into seven constructs based on the principle of Critical Control Points (CCP). A cumulative knowledge score was obtained by assigning four points to each correct response and zero point to each incorrect response. The maximum cumulative knowledge score was 100 points. Thirty-seven practice items on the scale were scored from 1 to 5 (1=never, 2=seldom, 3=neutral, 4=sometimes, 5=always/daily). A pilot test was conducted with 35 employees in foodservice operations to evaluate the clarity of instructions and statements. The questionnaire was modified to improve the reliability and the clarity of wording based on the results of the pilot study.

### Survey administration

Two hundred and seventy school foodservice facilities from all 486 schools in Gyeongsangbukdo province were included in the study sample. The questionnaire, a cover letter that explained the purpose of the study and encouraged participation, and a postage-paid return envelope were mailed to the study participants. A total of 270 questionnaires were distributed to dietitians and 171 questionnaires were returned for a response rate of 62% (171/270). From the total sample of 570 employees, a response rate of 66% (376/570) was obtained. The administration of the surveys was conducted over 4 weeks from March 29 to April 29, 2005.

### Data analysis

Statistical analyses were performed using SPSS 10.0 for Windows (Version 11.5, 2004, SPSS, Inc., Chicago, IL). In the first stage, descriptive analysis was conducted on all measurement items and the overall characteristics of participating students were determined. The Pearson correlation was applied to test for relationships between current education training and practices and between

knowledge and practices about HACCP principles. Step-wise regression analysis was performed to examine the influence of knowledge, current education guidelines, employee characteristics (working experience, academic background, and certification on food-handling practices), and school characteristics (food production system, service style, and number of meals). The level of statistical significance was  $p < 0.05$ .

## RESULTS

### Demographic information and characteristics of participating schools

Demographic information related to the characteristics of schools, dietitians and employees are presented in Table 1 and Table 2. Of the 171 schools participating in this study, 125 had an on-site production system and 144 had a cafeteria service. On average, estimated 600 ~ 900 meals were produced daily. Approximately 89.5% of school districts had one employee per 51 ~ 150 students.

**Table 1.** Descriptive characteristics of participating schools

Variables	N (%)
School level	
Elementary schools	102 (59.6)
Middle schools	32 (18.7)
High schools	19 (11.1)
Special schools	18 (10.6)
Location	
Urban areas	81 (47.4)
Rural areas	90 (52.6)
Type of school foundation	
Public	154 (90.0)
Private	17 (10.0)
Food production system	
On site production kitchen	125 (73.1)
Commissary food production/ Co-management	46 (26.9)
Service style	
Cafeteria service	144 (84.2)
Classroom service	25 (14.6)
Combination of cafeteria & classroom services	2 (1.2)
Number of meals per day	
< 300	52 (30.4)
300 ~ 299	36 (21.1)
600 ~ 899	30 (17.5)
900 ~ 1199	23 (13.5)
≥ 1200	30 (17.5)
Number of meals per one employee	
< 50	12 (7.0)
50 ~ 99	93 (54.4)
100 ~ 149	60 (35.1)
150 ~ 199	4 (2.3)
≥ 200	2 (1.2)

The majority of dietitians in these school districts were female (97.7%), had received a university diploma (66.1 %), and had 6 or more years of school foodservice management experience (80.1%). Most employees in charge of school foodservice were female (98.4%) and were between the ages of 30 and 49 years old (89.1%). Most had received a high school diploma (63.3%) and 65.4% had certification related to food and cooking.

### Current food safety education training for employees

Eight categories, which included 20 guidelines to implement HACCP principles provided by MEHRDK, were used to complete the dietitian survey. The respondents were asked to indicate how much they engaged each guideline in their current food safety education

**Table 2.** Demographic information of participating dietitians and employees

	Variables	N (%)
Dietitians	Gender	
	Male	4 (2.3)
	Female	167 (97.7)
	Age (y)	
	< 30	17 (9.9)
	30 ~ 34	50 (29.2)
	35 ~ 39	74 (43.3)
	≥ 40	30 (17.5)
	Working period (y)	
	< 5	34 (19.9)
	5 ~ 10	44 (25.7)
	11 ~ 15	79 (46.2)
	≥ 16	14 (8.2)
Employees	Education level	
	2 years college	17 (9.9)
	4 years university or equivalent	124 (72.5)
	Graduate school or equivalent	30 (17.5)
	Gender	
	Male	2 (0.5)
	Female	374 (99.5)
	Age (y)	
	< 30	2 (0.5)
	30 ~ 39	57 (15.2)
	40 ~ 49	278 (73.9)
	≥ 50	39 (10.4)
	Working period (y)	
	< 5	154 (41.0)
	5 ~ 10	163 (43.4)
	11 ~ 15	56 (14.9)
	≥ 16	3 (0.8)
	Education level	
	Less than high school diploma	101 (26.9)
	High school diploma	238 (63.3)
	2 years college	26 (6.9)
	4 years university or equivalent	9 (2.4)
	No response	2 (0.5)
	Certification related to food and cooking	
	Yes	246 (65.4)
	No	128 (34.0)
	No response	2 (0.5)

**Table 3.** HACCP guideline in current education training demonstrated by dietitians in school foodservice operations

	Education statements	Mean $\pm$ SD	Total Mean $\pm$ SD
Introduction of HACCP	Definition and principles of HACCP	3.36 $\pm$ 0.65	3.41 $\pm$ 0.56
	Identification of food needed critical control	3.39 $\pm$ 0.67	
	Identification of foodborne illness	3.48 $\pm$ 0.70	
CCP2	Food process control of PHF	3.55 $\pm$ 0.77	3.55 $\pm$ 0.77
CCP4	Proper food handling after receiving	3.63 $\pm$ 0.74	3.84 $\pm$ 0.57
	Temperature control of refrigerators and freezers	4.05 $\pm$ 0.69	
	Proper food storage in refrigerators and freezers	3.92 $\pm$ 0.70	
CCP5	Pre-cooking methods	3.75 $\pm$ 0.74	3.92 $\pm$ 0.70
	Cleaning and sanitation of fresh fruit and vegetables	4.09 $\pm$ 0.66	
CCP6	Inner temperature control of prepared foods	3.71 $\pm$ 0.88	3.53 $\pm$ 0.65
	Temperature control of prepared foods before serving	3.44 $\pm$ 0.84	
	Principles of time/temperature zone	3.45 $\pm$ 0.78	
	Control of cross-contamination	3.52 $\pm$ 0.76	
CCP7	Sanitation of equipment and utensils during serving	3.64 $\pm$ 0.79	3.55 $\pm$ 0.72
	Time/temperature control during serving	3.46 $\pm$ 0.81	
CCP8	Cleaning and sanitation of food contact surface	3.73 $\pm$ 0.70	3.79 $\pm$ 0.61
	Proper control of ware washing facilities	3.96 $\pm$ 0.79	
	Proper sanitizer concentration and usage	3.69 $\pm$ 0.80	
Miscellaneous items	Personal health and hygiene control	4.15 $\pm$ 0.70	4.22 $\pm$ 0.63
	Saving sample of prepared food for analyses	4.29 $\pm$ 0.71	

training for employees and the results are shown in Table 3. Most guideline were widely used (mean score from 3.36 to 3.96), especially *saving samples of prepared food for analyses* (4.29  $\pm$  0.71), *proper personal hygiene practices* (4.15  $\pm$  0.70), and *sanitation of fresh fruit and vegetables* (4.09  $\pm$  0.66) were always used by the dietitians. These findings indicated that dietitians were very engaged in food safety education for their employees and performed well in their efforts to educate employees in food safety principles as they followed school food safety inspection requirements from MEHRDK.

In the practice education training, 69.6% of dietitians usually used written material as an educational tool (Table 4). Over 30% of dietitians reported that they conducted educational training more than 4 times per month. The advantages of a proper training program in any foodservice operation include a reduction in outbreaks of foodborne illness and an increase in customer satisfaction. Therefore, dietitians' responsibility should be to continue establishing and conducting effective training programs for the improvement of food safety.

#### Assessment of food safety knowledge and food handling practices

The food safety knowledge of employees was high. The mean knowledge score was 67.5  $\pm$  1.8 (100 possible points) (Table 5). The food safety knowledge questions most frequently answered incorrectly were related to *understanding the difference between the critical control*

**Table 4.** HACCP educational position in school foodservice operations of Gyeongsangbukdo province

	Variables	N (%)
Frequency of education training per month (times)	1	56 (32)
	2	49 (29)
	3	12 (8.4)
	4	54 (31.6)
Educational module	Oral presentation	47 (27.5)
	Written manuscripts	119 (69.6)
	Demonstration	4 (2.3)
	Video and slide	1 (0.6)
Test methods	Drawing up checklist	12 (7)
	Observation	41 (24)
	Oral test	18 (10.5)
	Written examination	92 (53.3)
	No tests	8 (4.7)

*area and the regular area in the kitchen* (10.1% correct rate), *proper sanitation methods for meal trays* (17.0% correct rate), and *proper chopping board sanitation method* (29.8% correct rate). Half of the participants incorrectly responded to questions about *how to properly check the inner temperature of food* (40.78% correct rate), *proper cleaning and sanitation of their hands* (41.8% correct rate), *time controlling of PHF* (42.0% correct rate), *the optimum temperature of refrigerators and freezers* (43.4% correct rate), *proper sanitation and cleaning method* (47.1 correct rate), and *proper food storage in refrigerators and freezers* (49.2% correct rate). Questions about *the identification of foods re-*

**Table 5.** Food safety knowledge of employees in school foodservice operations

Knowledge statements		Correct N (%)	Incorrect N (%)
Total		73.6%	26.4%
CCP2	Time control of PHF	158 (42.0)	218 (58.0)
	Identification of PHF	249 (74.2)	97 (25.8)
CCP4	Proper temperature zone of refrigerators and freezers	163 (43.4)	213 (56.6)
	Proper food storage in refrigerators and freezers	284 (75.5)	92 (24.5)
	Proper food handling from refrigerators and freezers	185 (49.2)	191 (50.8)
CCP5	Identification of food needed for sanitation	363 (96.5)	13 (3.5)
	Proper cleaning and sanitation methods	177 (47.1)	199 (52.9)
	Proper sanitizer concentration and immersing time	357 (94.9)	19 (5.1)
CCP6	Safe food handling of prepared foods	270 (71.8)	106 (28.2)
	Safety control at rescheduling in food processing	343 (91.2)	33 (8.8)
	Comprehension of regular area and clean area in kitchen	38 (10.1)	338 (89.9)
	Principles of adequate cooking	305 (81.1)	71 (18.9)
	Prevention method of cross-contamination	295 (78.5)	81 (21.5)
	Proper control of inner temperature in solid food	153 (40.7)	223 (59.3)
	Proper control of inner temperature in liquid food	333 (88.6)	43 (11.4)
CCP7	Control the prepared food before serving	363 (96.5)	13 (3.5)
	Steps of food flow from cooking to serving	266 (70.7)	110 (29.3)
CCP8	Dry and clean tray	339 (90.2)	37 (9.8)
	Cleaning and sanitation of chopping boards	64 (17.0)	312 (83.0)
	Cleaning and sanitation of trays	112 (29.8)	264 (70.2)
Miscellaneous items	Proper usage and sanitation of knives and scissors	367 (97.6)	9 (2.4)
	Standard hand washing and sanitation	157 (41.8)	219 (58.2)
	Personal health control	303 (80.6)	73 (19.4)
	Saving sample of prepared food for analyses	308 (81.9)	68 (18.1)
	Pest control	339 (90.2)	37 (9.8)

quiring sanitation, sanitizer concentration and immersion time, controlling preparation of meals, and the proper usage of knives and scissors were answered correctly by 94% to 97% of participants. Results from this study are consistent with previous studies evaluating food-handling practices in schools (14,15). Although food safety knowledge scores were high, these results found that some school foodservice employees did not know specific numeric data, such as temperature, time, ppm, and amount; thus knowledge of food safety is another problem. Not understanding the difference between a regular area and a clean area was identified as the most serious concern in school foodservice. According to Yoon's (16) study that the kitchen facilities' space was too small for the implementation of HACCP programs and unsatisfactory for compartmentalizing clean areas in schools, dietitians need to focus on educating employees about clean area controls.

Both proper and inappropriate food-handling practices were followed in school foodservice. The mean frequency of using correct food handling behavior was  $3.55 \pm 0.48$  on a 5-point scale, with 1 being 'never' and 5 being 'always' (Table 6). Proper food-handling practices were not consistently followed in many school food-

service operations. Most food service operations were not keeping records of checklists at each critical control points. Each step of CCP2, CCP5, CCP6, CCP7, and CCP8 was not being recorded by most of the employees. The recording of control points and critical control points was not prevalent in this study sample. Operations that are documenting practices as part of prerequisite programs are more likely to build effective HACCP systems (17). Miscellaneous items, which included personal hygiene and saving samples of prepared food for analyses, were the practices that scored most highly ( $3.89 \pm 0.60$ ). These results were consistent with several previous studies (18), in which personal hygiene practice showed high employee compliance in CCP inspections. Although food-handling practices also had high compliance, they were not always consistent with accepted standards. Many food safety practices, such as *regular checking of the temperature of refrigerators and freezers* (CCP4), *adjusting sanitizer concentration* (CCP5), *standard operating time/temperature zone* (CCP6), *documenting time/temperature of food in the classroom* (CCP7), and *proper volunteers' hygiene* are not done regularly. Kim (19) also found that cooking temperatures were not taken and temperature logs were not maintained in a small sample

**Table 6.** Food safety practices of employees in school foodservice operations

	Practice statements	Mean $\pm$ SD
	Total	3.55 $\pm$ 0.48
CCP2	A linear food product and traffic flow	3.88 $\pm$ 0.72
	Documenting corrective actions	2.94 $\pm$ 0.97
	Keeping records	2.65 $\pm$ 1.04
CCP4	Keeping records	4.04 $\pm$ 0.78
	Little crossing of paths between steps	3.80 $\pm$ 0.71
	Storing prepared foods tightly wrapped	3.98 $\pm$ 0.78
	Labeling all items for storage with the production date	3.39 $\pm$ 0.96
	Regular checking in the temperature of refrigerators and freezers	3.18 $\pm$ 1.03
CCP5	Standard operating the sanitation of vegetables	4.12 $\pm$ 0.67
	Standard operating optimum chloride concentration and immersion time	3.75 $\pm$ 0.78
	Checking in chloride concentration by paper test	3.81 $\pm$ 0.81
	Adjusting concentration	3.34 $\pm$ 0.86
	Keeping records	2.70 $\pm$ 1.09
CCP6	Safe food handling for prevention of cross-contamination	3.60 $\pm$ 0.70
	Proper handling of knives, gloves, and scissors	4.08 $\pm$ 0.70
	Checking in the inner food temperature	3.78 $\pm$ 0.74
	Checking in the temperature on 3 places per a batch	3.53 $\pm$ 0.88
	Standard operating the time/temperature zone	3.36 $\pm$ 0.93
	Keeping records	2.60 $\pm$ 1.07
	Hand sanitation at each steps	3.71 $\pm$ 0.75
CCP7	Proper hot food handling	3.05 $\pm$ 1.02
	Proper food container handling	3.88 $\pm$ 0.86
	Documenting the time and temperature of food at cafeteria	3.48 $\pm$ 0.93
	Documenting the time and temperature of food at classroom	2.85 $\pm$ 1.08
	Clean and neat clothes	4.01 $\pm$ 0.83
	Keeping records	2.75 $\pm$ 1.11
CCP8	Standard operation of the sanitizer concentration	3.60 $\pm$ 0.74
	Checking in the temperature of the tray	3.62 $\pm$ 0.90
	Preparation a sanitizer once a day	4.03 $\pm$ 0.79
	Keeping records	2.74 $\pm$ 1.11
Miscellaneous items	Proper hand washing and sanitation	3.95 $\pm$ 0.77
	Restriction with infections	3.94 $\pm$ 0.77
	Reporting personnel with health problems	3.94 $\pm$ 0.82
	Proper volunteer hygiene	3.40 $\pm$ 0.93
	Saving samples of prepared foods for analyses	4.11 $\pm$ 0.62

of foodservice operations.

#### **Relationships between knowledge and practices and variables influencing food-handling practices**

The model testing the relationships between the food safety knowledge and food-handling practices, and between present education trainings and food-handling practices were not significant (Data were not shown). It suggested that the present situation of HACCP trainings performed by dietitians was inadequate for many school foodservice operations.

Multiple linear regression analysis was performed to examine how knowledge, employee characteristics, and school characteristics influence food-handling practices of employees in school foodservice operations (Table 7). Composite scale items of knowledge scores, current educational training, working experience, educational

level, certification related to food and cooking, food production system, service style, and number of meals were used in the stepwise regression analysis. Knowledge and current educational training about HACCP principles were not predictors of food-handling practices. Also, practice scores did not differ based on employee characteristics (working experience, academic background and certification) and school characteristics (food production system and service style). Only the number of meals per day in school foodservice facilities was found to influence food-handling practices of employees. Schools with a larger number of meal servings had higher food-handling practice scores than those serving a smaller number of meals. Dietitians of small schools need to explore ways that they can operate HACCP programs more effectively.

**Table 7.** Multiple regression analysis for variables predicting employees' safe food-handling practice

Variable	B <sup>1)</sup>	SE B <sup>2)</sup>	B <sup>3)</sup>	R <sup>2</sup>
Dependent Variable: Food handling practices				0.31
Number of meals per day in school foodservice*	0.967	0.142	0.555	

For the regression analysis, composite items of knowledge, current education training, working experience of employees, academic background of employees, and employees' certification on food-handling practices, school food production system, service style, and number of meals were used.

<sup>1)</sup>Unstandardized coefficients, <sup>2)</sup>Standard error of unstandardized coefficients, <sup>3)</sup>Standardized coefficients.

\*p < 0.05.

Food safety education should be the first priority for the implementation of HACCP principles and training programs (8). Dietetics practitioners employed in school foodservice operations need to develop a food safety program that gives positive feedback to employees following safe food handling practices and evaluate current education and training programs (8). Furthermore, dietitians should consider the content and quality of educational training as well as the effects of when and how they train employees on performance (12). Further, this study finding supposes some of the limits inherent in current food safety education training as an isolated domain which only purposed to provide mere knowledge and information to training participants and did not reflect school districts' characteristics. This suggests a need for the adoption of endeavors which take account of social and environmental influences on food safety training, and thus assures that food safety training is considered not as an isolated domain, but as part of an overall infrastructure for effective HACCP implementation.

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