

## FOOD SAFETY TRAINING NEEDED FOR ASIAN RESTAURANTS: REVIEW OF MULTIPLE HEALTH INSPECTION DATA IN KANSAS

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### ABSTRACT

The purpose of this study was to assess the frequency and types of food code violations in Asian restaurants in Kansas using health inspection data. A total of 326 restaurant inspection reports over a 12-month period from 156 Asian restaurants in 10 Kansas counties were reviewed. The results indicated that behavioral critical violations occur more often during routine health inspections than other inspections and suggested focus areas for food safety training in Asian restaurants. This study identified food handling practices that Asian restaurant managers and health inspectors should emphasize when training employees and providing performance feedback.

**Keywords:** Foodborne illness, Asian restaurants, food safety training, health inspection, food code violation

### INTRODUCTION

According to a report from the Centers for Disease Control and Prevention (CDC), the frequency of foodborne illnesses associated with ethnic food increased from 3% of total outbreaks in 1990 to 11% in 2000 (CDC, 2009). A recent CDC study estimates that, in the U.S., 9.4 million foodborne illness cases, 55,961 hospitalizations, and 1,351 deaths are caused by the 31 most prevalent foodborne pathogens each year (Scallan et al., 2011). Restaurants have been responsible for most foodborne illness outbreaks (CDC, 2011; Lynch, Painter, Woodruff, & Braden, 2006). In addition, the scale of outbreaks caused by restaurant food is much greater than those caused by home-cooked meals because the former is served to many customers (Jones & Angulo, 2006). The majority of outbreaks caused by ethnic foods were associated with Mexican, Italian, and Asian foods (Simonne, Nille, Evans, & Marshall, 2004).

A few studies have explored food handling practices in ethnic restaurants. Mauer et al. (2006) found that many food safety professionals thought ethnic restaurants had inadequate food safety training; experts identified the top three food safety violations in such restaurants as improper food temperature, cross contamination, and poor worker hygiene. Kwon, Roberts, Shanklin, Liu, and Yen (2009) found that ethnic restaurants violated more food codes per facility, both critical and non-critical, than non-ethnic restaurants. These studies address the need for food safety training programs focusing on critical behaviors that can lead to foodborne outbreaks in ethnic restaurants.

Ram, Sanghera, Abbas, and Barlow (2000) reported that only 26% of the independent restaurants operated by ethnic minorities provided food safety and personal hygiene training for their employees. These researchers reported that employers doubted the necessity of training, unless it was required by law. Rudder (2006) found that restaurant owners felt that the lack of food safety resources and

support were barriers to adopting food safety guidelines. Additional impediments to foodservice establishments providing food safety training for their employees were time constraints, employee attitudes, and language barriers (Mauer et al., 2006; Roberts et al., 2008).

Inspections are one way to ensure that foodservice establishments follow food hygiene and safety practices (Binkley, Nelson, & Almanza, 2008). Seiver and Hatfield (2002) contended that a restaurant inspection disclosure system, in which inspection scores are made public, could benefit the society by raising public awareness about food safety risks and motivating foodservice managers and employees to be more compliant with regulations. However, occasional inspection records may not fully portray the persistent challenges in individual establishments.

Therefore, this study examined health inspection data from independently owned Asian restaurants in Kansas over a 12-month period (January 1 to December 31, 2009) in order to identify persistent food handling challenges and to investigate the food safety training needs of Asian restaurant employees. Specific objectives were to identify the frequency and types of food code violations in these restaurants. The Kansas Department of Agriculture (KDA) inspects foodservice establishments at least once annually and publishes the inspection reports online. Specific food code violations are indicated in each online report.

The present study may provide Asian restaurant owners and managers with an understanding of what food handling practices related to code violations they should emphasize when training employees. At the same time, this information may help food safety professionals, including health inspectors address challenges they observe during Asian restaurant inspections.

### Asian Restaurants in America

Since the mid-19<sup>th</sup>-century, Asian cuisines such as Chinese, Vietnamese, Japanese, and Thai have gradually become an integral part of American daily life (The Food Timeline, 2010). In addition, the American population is becoming more diverse; according to the latest census report, minorities increased by 25 million in 10 years, from 86.9 million in 2000 to 111.9 million in 2010 (U.S. Census Bureau, 2012). This minority population represents approximately 37% of the U.S. population (U.S. Census Bureau, 2012). The same figure is expected to increase to 62% by 2050 (Ortman & Guarneri, 2009). With the growing ethnic population, awareness of and demand for ethnic food is increasing. Asians and Hispanics operate more ethnic restaurants in the U.S. than all other ethnic minority groups (U.S. Census Bureau, 2006a, 2006b). More specifically, Chinese food is one of America's favorite ethnic cuisines, and Chinese restaurants account for a large percentage of the ethnic restaurants in America.

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Chinese Restaurant News (2010) reported that there are twice as many Chinese restaurants as McDonald's establishments in the U.S.

### Food Handling Practices in Asian Restaurants

Liu and Jang (2008) identified the top five attributes affecting customers' intention to revisit Chinese restaurants: taste, food safety, food freshness, environmental cleanliness, and appropriate food temperature. Among these attributes, food safety was rated most important, followed by environmental cleanliness. A MORI survey for Kimberley-Clark Professional (2004) found that even among customers satisfied with food quality and price, 84% would not revisit a restaurant if they thought it was not clean. This result is consistent with Liu and Jang's study, which identified a positive association between environmental cleanliness and customers' intention to revisit Chinese restaurants. Unlike home-cooked meals, where consumers are responsible for their own food handling and preparation, consumers eating in restaurants must trust the food preparation and handling practices of chefs and other foodservice employees (Knight, Worosz, & Todd, 2007). The criterion of environmental cleanliness, although it may or may not be directly associated with foodborne illness risks, may provide a convenient way for consumers to assess the safety of Chinese restaurants.

Other studies found that, among ethnic foods, Asian, Mexican, and Italian cuisines had the highest association with foodborne outbreaks (Simonne et al., 2004). In addition, Kwon et al. (2009) found that independently operated Asian, Mexican, and Latin American ethnic restaurants had significantly more critical violations and frequent inspections than non-ethnic restaurants. The increased number of foodborne outbreaks related to ethnic foods (CDC, 2009) and poor food safety inspection results (Kwon et al., 2009) raise concerns for food handling practices, and therefore, food safety in these restaurants.

### Food Safety Inspection and Food Safety Training Needs

Most U.S. states mandate certain types of health inspection for all foodservice establishments as one way to ensure safe food handling (Binkley et al., 2008). Depending on state or local regulations, results of restaurant inspections across the U.S. are reported using letter grades, numerical scores, colored cards, or facial expressions (Filion, 2009). Publicizing inspection results encourages foodservice managers and employees to exercise compliance with food codes.

Another purpose of restaurant inspection scores is to predict the occurrence of foodborne illnesses, as in the study conducted by Irwin, Ballard, Grendon, and Kobayashi (1989). These researchers concluded that the inspection scores of restaurants with more reported outbreak cases were significantly lower than those with no reported outbreak cases.

Although inspection reports may provide insights into food safety training needs, Mauer et al. (2006) contended that food safety professionals' unfamiliarity with ethnic foods and a lack of guidelines for ethnic food safety may prevent food safety inspectors from providing constructive feedback for operators. In addition, Chinese-restaurant owners expressed concerns that health inspectors "*do not understand*" their cooking methods (Liu & Kwon, 2012). Cultural differences were identified as a contributing factor to this perceived misunderstanding, as ethnic restaurateurs were unaware of food safety risks associated with certain food handling behaviors and conditions (Liu & Kwon).

Previous research has identified some of the food safety risks associated with ethnic foods. Rudder (2006) found that there was an increased risk of *E. coli* O157 and *Clostridium botulinum* in ethnic

restaurants because business owners did not understand how they should store food and other materials. Failure to control hot food temperature (70% of violations) and lack of proper cooling (18% of violations) were rampant among retail food businesses run by ethnic minorities (Rudder).

Reviews of restaurant inspection scores have also been used to identify foodborne illness risks in restaurants. Even though there may be merits to evaluating food handling practices with such scores, isolated inspection scores may not always accurately reflect food handling practices. Restaurant inspection records capture only a snapshot of restaurant operation and do not reflect persistent challenges (Phillips, Elledge, Basara, Lynch, & Boatright, 2006). Frequent inspections have shown mixed results in terms of their relationship with sanitation compliance (Bader, Blonder, Henriksen, & Strong, 1978; Corber, Barton, Nair, & Dulberg, 1984; Kaplan, 1978; Kwon et al., 2009; Mathias, Sizto, Hazlewood, & Cocksedge, 1995; Newbold, McKeary, Hart, & Hall, 2008; Roberts et al., 2011). Kwon et al. (2009) contended that the frequency of inspections alone indicates an increased need for food safety training, as an increased number of inspections is often due to complaints and follow-up visits. Reviewing inspection records over a long period of time may reveal individual restaurants' persistent challenges in food handling practices.

## METHODOLOGY

### Study Sample and Instrument

As of 2009, there were 4,671 food and beverage service establishments in Kansas (National Restaurant Association [NRA], 2009). Approximately 3,600 of those establishments were located in the 10 counties where the population density of ethnic minorities is the greatest. Of these 3,600, over 500 establishments were identified as ethnic restaurants, and 219 of those were independently owned Asian restaurants. All 219 Asian restaurants were selected as the study sample, but inspection reports were available online for only 156 restaurants in 10 counties. The inspection data for some of the restaurants listed online were not available. The instrument developed by Kwon et al. (2009) was used to collect data from multiple inspection reports. Since the data were considered public record and no human subjects were involved in the research protocol, no approval from the institutional review board was necessary.

### Variables and Data Collection

Once the sample was identified, health inspection reports for each establishment were reviewed on the KDA website (<http://www.ksda.gov/winwam>). Each Kansas Food Code violation was recorded from every inspection report available (KDA, 2010). All 326 health inspection reports for the 156 Asian restaurants in the sample were reviewed and recorded during March and April of 2010. The individual code violations for each restaurant were recorded on the data collection form along with the number and types (e.g., routine inspection, complaint-driven inspection, follow-up inspection after poor performance on previous inspection) of health inspection reports in the previous 12-month period (January 1–December 31, 2009). A follow-up inspection was warranted when routine or other types of inspections, such as complaint-driven inspections, were not satisfactory. According to the information retrieved from KDA, a follow up inspection is carried out to "verify the correction of critical food safety issues" (KDA, 2010). After the initial data collection, the data were cross-checked to ensure the accuracy of data entry. The number of critical and non-critical food code violations and the frequency of individual code violations in each report were also recorded on the data collection form. Data were then entered into a Microsoft Access database, cross-checked again to verify correct data entry, and converted to SPSS for Windows, Version 15.0, for data analyses.

### Statistical Data Analyses

Prior to statistical analyses, individual food code violations were grouped based on categories identified by KDA. KDA categorized over 275 individual code violations into 36 groups, each of which includes a variety of food codes. KDA categories were further consolidated into 15 categories to reduce the number of variables (Kwon et al., 2009). The compute function of SPSS was used to add all violations within each category. To evaluate persistent violations and food handling challenges, multiple inspection records for the same establishments were combined using Microsoft Excel before statistical analysis. Furthermore, to make meaningful comparisons, the total number of violations per category from all restaurant inspection reports was divided by the number of inspections per establishment to calculate the average number of violations per restaurant inspection.

Descriptive statistics were calculated to summarize the data including frequencies, cross-tabulations, means and standard deviations, of continuous variables (i.e., number of inspections, critical and non-critical violations, and violations in each category). Paired-sample t-tests were conducted to determine whether differences existed in the number of critical, non-critical, and within-category violations between initial and follow-up inspections, showing whether Asian restaurants improved their food handling practices. Analyses of Variance (ANOVA) with Tukey's post hoc analyses were conducted to evaluate the differences in numbers of individual and categorical code violations between and among inspection types (i.e., routine inspection, complaint-driven inspection, and follow-up inspection). Repeated measures of Multivariate Analyses of Variance (MANOVA) were calculated to identify the differences in frequency of violations within categories. Statistical significance was determined at  $p < 0.05$ .

### RESULTS AND DISCUSSION

A total of 326 restaurant inspection reports were reviewed from 156 Asian restaurants in 10 Kansas counties. Some food handling practices were categorized as behavior-related and included hand washing occasions and methods; glove use; cooking, holding, cooling, and reheating procedures; and eating, drinking, and smoking in the kitchen. Examples of non-behavior-related practices included demonstration of knowledge; temperature of cold storage; and adequacy of hand washing facilities and supplies. The mean  $\pm$  standard deviation (SD) of critical and non-critical violations for these restaurants were  $2.92 \pm 2.59$  and  $2.05 \pm 2.55$ , respectively. Among these,  $2.66 \pm 2.41$  violations were behavior-related and  $2.30 \pm 2.77$  were non-behavior-related. Of behavior-related violations,  $1.89 \pm 1.75$  violations were considered critical. The average number of inspections during the 12-month study period (January 1–December 31, 2009) was  $2.09 \pm 1.30$  (range: 1 to 9, median 2.0).

#### Prevalence of Individual Food Code Violations and Descriptive Statistics for Compiled Inspections

The number of food code violations was computed and analyzed for each restaurant. The top violation categories were *Control of Hands as a Vehicle of Contamination* ( $2.09 \pm 1.71$ ); *Time & Temperature Control of Potentially Hazardous Food* (PHF or Time and Temperature Control for Safety [TCS] food) ( $1.56 \pm 1.41$ ); *Protection from Contamination* ( $1.55 \pm 1.82$ ); *Physical Facility Maintenance* ( $1.39 \pm 2.28$ ); and *Food & Non-Food Contact Surface Maintenance & Ware Washing Facilities* ( $1.04 \pm 1.56$ ).

To identify persistent violations, each restaurant's number of food code violations in each category per inspection was computed. This figure was calculated by dividing all violations within each category by the total number of inspections for that restaurant. *Time & Temperature Control of PHF* (TCS food) ( $0.73 \pm 0.68$ ); *Protection from Contamination* ( $0.73 \pm 0.69$ ); and *Control of Hands as a Vehicle of*

**Table 1. Mean Number of Violations per Inspection (N=326)**

Variables <sup>a</sup>	Mean number $\pm$ SD
Critical Violations	$2.92 \pm 2.59$
Non-critical Violations	$2.05 \pm 2.55$
Behavior-related Violations	$2.66 \pm 2.41$
Non-behavior-related Violations	$2.30 \pm 2.77$
Critical Behavior-related Violations	$1.89 \pm 1.75$

<sup>a</sup>Number of violations found in one health inspection report between January 1, 2009 to December 31, 2009

*Contamination* ( $0.65 \pm 0.78$ ) were violated the most. These were followed by *Physical Facility Maintenance* (e.g., hot and cold water availability; toilet, sewage, waste water, garbage, and refuse disposal) ( $0.57 \pm 0.68$ ); *Food & Non-Food Contact Surface Maintenance & Ware Washing Facilities* ( $0.46 \pm 0.55$ ); *Contamination Prevention through Pest Control, Storage & Personal Cleanliness* ( $0.36 \pm 0.60$ ); and *Safe Cooling, Thawing, Hot Holding Methods & Working Thermometer* ( $0.27 \pm 0.44$ ).

To identify food safety training priorities, the five most common categories were compared by repeated measures of MANOVA. Results showed that the numbers of violation per inspection for the top four categories were not significantly different (Table 2). However, our results indicated that *Time & Temperature Control of PHF* (TCS) was one of the most common food code categories per inspection record, despite this category's inclusion of only 7 food codes. Compared to *Physical Facility Maintenance*, which included 78 codes, the probability of getting as many violations in a category of 7 (i.e., *Time & Temperature Control of PHF* [TCS]) seems less likely. Therefore, this finding suggests that *Time & Temperature Control of PHF* (TCS) may be the category that needs the most attention to improve food handling behaviors in Asian restaurants.

ANOVA with Tukey's post hoc analyses were used to compare numbers of violations and types of inspections. The results showed significant differences among different types of inspections in the total number of violations ( $F=3.85$ ,  $p < 0.001$ ), the total number of critical violations ( $F=5.78$ ,  $p < 0.001$ ), the number of behavior-related violations ( $F=5.22$ ,  $p < 0.001$ ), and the number of critical behavior-

**Table 2. Mean Number of the Top Five Violation Categories Observed in Asian Restaurants in Kansas: Descriptive Statistics by Types of Violations per Inspection**

Violation Categories	# Of Food Codes Per Category	Mean <sup>b</sup> $\pm$ SD <sup>c</sup>
Time & Temperature Control of Potentially Hazardous Food	7	$.73 \pm .68^x$
Protection from Contamination	14	$.73 \pm .69^x$
Control of Hands as a Vehicle of Contamination	14	$.65 \pm .78$
Physical Facility Maintenance (e.g., hot & cold water availability, toilet, sewage & waste water, garbage & refuse disposal)	78	$.57 \pm .68$
Food & Non-Food Contact Surface Maintenance & Ware Washing Facilities	48	$.46 \pm .55^y$

<sup>a</sup>Statistical significance was analyzed by a repeated measures MANOVA (Degrees of Freedom=4,  $F=5.13$ ,  $p < 0.001$ ).

<sup>b</sup>Mean scores were calculated by dividing the number of violations in each category by number of inspection for each restaurant.

<sup>c</sup>SD: Standard Deviation Values with different superscripts (x or y) are significantly different ( $p < 0.05$ ) from each other analyzed by pairwise comparisons.

related violations ( $F=5.90, p<0.001$ ). In most cases, complaint-driven inspections and routine inspections had the most number of violations and were significantly different from other regulatory inspections (Table 3). There were no significant differences ( $p>0.05$ ) in numbers of non-critical violations and non-behavior-related violations among different inspection types.

The results from this study, which utilized publicly available health inspection reports, revealed evidence of food safety training needs in Asian restaurants. In Kansas, each foodservice establishment receives at least one unannounced inspection per year. If the results of the routine inspection show poor performance, follow-up inspections occur. Our data confirmed that routine inspections were performed at least once per year and that the total number of annual inspections varied (range: 1 to 9) depending on the frequency of additional inspections. In addition, our results showed that the average number of inspections per restaurant was  $2.09\pm 1.30$ , which indicated that many Asian restaurants did not pass their routine inspections and required re-inspections. This finding is consistent with Kwon et al. (2009) where ethnic restaurants had a significantly higher frequency of inspections than non-ethnic restaurants.

Researchers of this study found that increasing the frequency of routine inspections does not motivate restaurateurs to perform better. Paired-sample t-tests showed no significant differences ( $p>0.05$ ) in the number of critical, non-critical, behavior-related, and non-behavior-related violations between routine or complaint-driven inspections and their subsequent follow-up inspections. That is, assigning poor inspection scores and following up later did not necessarily improve food safety practices in Asian restaurants. This finding is consistent with Jones, Pavlin, LaFleur, Ingram, and Schaffner (2004) who found no association between inspection scores and the frequency of restaurant inspection. Corber et al. (1984) also found that increasing the number of inspections from 6 to 12 in a year did not enhance the sanitation levels of restaurants.

However, different results were reported after an intervention which identified high food safety risk establishments and increased the inspection frequency (Briley and Klaus, 1985). These researchers used

types of food served, previous inspection scores, and the number of customers to identify the total food safety risks, and then, increased the frequency of inspections for identified high-risk establishments. The results showed the score improved enough after frequent inspections that some of the high-risk establishments were reclassified as low-risk (Briley & Klaus).

In the case of Asian restaurants in Kansas, an increase in the number of inspections was not due to efforts to improve food handling practices as in previous studies. Rather, the increased number of inspections was caused by poor performance on the previous inspection or customer complaints. Future studies should address why Asian restaurants fail to perform better despite being inspected multiple times for violations.

Kwon et al. (2009) found that the most prevalent food code violations in ethnic restaurants were considered critical, which were associated with leading causes of foodborne illnesses. Failure to control time and temperature, poor personal hygiene, and cross-contamination have been identified as the most significant factors to foodborne illnesses (U.S. Food and Drug Administration [FDA], 2004). Phillips et al. (2006) analyzed recurrent food code violations in Oklahoma from 1996 to 2000. Their research showed that most repeated violations reported by the Oklahoma State Department of Health (OSDH) (Oklahoma Food Service Establishment Inspection, n.d.) and the Oklahoma City-County Health Department (OCCHD) (Oklahoma FoodService Establishment Inspection, n.d.) were related to maintaining correct food holding temperature, pest control, and personal hygiene. Findings of this study also showed that time and temperature control of PHF was the most frequently violated food code in Asian restaurants. Therefore, this violation represents a persistent problem in restaurant establishments regardless ethnic or non-ethnic restaurants.

Rudder (2006) performed a risk assessment to investigate the reasons behind failure to comply with food safety standards in retail food businesses owned by ethnic minority groups in Greater Manchester, U.K. One reason for these failures was general lack of maintenance of the restaurants' physical structures. Cultural traditions of food

**Table 3. Differences in Frequency of Violations Among Different Inspection Categories**

Inspection Categories (n)	Mean±SD	F	P
<b>No. of Total Food Code Violations</b>		<b>3.85</b>	<b>&lt;0.001</b>
Complaint-driven (n=46)	6.24±4.52 <sup>x</sup>		
Routine (n=165)	5.54±4.40 <sup>x</sup>		
Follow-up (n=60)	4.77±5.41		
Other regulatory (n=20)	1.60±2.07 <sup>y</sup>		
<b>No. of Critical Violations</b>		<b>5.78</b>	<b>&lt;0.001</b>
Complaint-driven (n=46)	3.43±2.61 <sup>x</sup>		
Routine (n=165)	3.44±2.31 <sup>x</sup>		
Follow-up (n=60)	2.68±3.11		
Other regulatory (n=20)	0.80±1.36 <sup>y</sup>		
<b>No. of Behavior-related Violations</b>		<b>5.22</b>	<b>&lt;0.001</b>
Complaint-driven (n=46)	3.15±2.13 <sup>x</sup>		
Routine (n=165)	3.13±2.32 <sup>x</sup>		
Follow-up (n=60)	2.38±2.87		
Other regulatory (n=20)	0.75±1.16 <sup>y</sup>		
<b>No. of Critical Behavior-related Violations</b>		<b>5.90</b>	<b>&lt;0.001</b>
Complaint-driven (n=46)	2.28±1.79 <sup>x</sup>		
Routine (n=165)	2.28±1.65 <sup>x</sup>		
Follow-up (n=60)	1.55±1.96		
Other regulatory (n=20)	0.45±0.76 <sup>y</sup>		

<sup>a</sup> Based on ANOVA with Tukey's post hoc analyses.

Values with different superscripts (x or y) are significantly different ( $p<0.05$ ) from each other based on Tukey's post hoc analyses.

preparation handed down through generations may also contribute to unsafe food handling in specific ethnic groups according to a nationwide survey of consumers (Kwon, Wilson, Bednar, & Kennon, 2008). The other food safety challenges found in ethnic restaurants were proper stock rotation, storage methods, hot and cold holding temperatures, and cooling methods (Rudder). Results of this study are consistent with the challenge areas identified in these studies.

Rudder (2006) also reported that there were communication barriers between inspection officers and foodservice workers, including difficulty in understanding the language used in food safety reports. Another indication that language barriers may be an issue in ethnic restaurants was high levels of violations in demonstrated knowledge on inspection reports (Kwon et al., 2009). Liu and Kwon (2012) found that owners and operators of Chinese restaurants considered health inspections and food safety training helpful for ensuring food safety at their restaurants. However, some Chinese restaurant owners and operators did not completely understand or were not able to follow the instructions after food safety inspections. Further, they identified several barriers existed including physical exhaustion in providing food safety training (Liu & Kwon).

Employees in this segment of the foodservice industry often lacked adequate knowledge about safe food handling, despite having received training. Even when employees were knowledgeable about safe food handling procedures, they often failed to apply this knowledge. Based on current and previous research findings, establishing safe food handling procedures in Asian restaurants may be challenging without continuous food safety training and motivation.

#### CONCLUSION AND MANAGERIAL IMPLICATION

The results of this study identified the five food code categories with the most violations: *Time & Temperature Control of PHF (TCS)*; *Prevention from Contamination*; *Control Hands as a Vehicle of Contamination*; *Physical Facility Maintenance*; and *Food & Non-Food Contact Surface Maintenance & Ware Washing Facilities*. Asian restaurants may need to emphasize these five areas when training employees.

Detailed inspection reports available online enabled us to identify specific violations and training needs for independent Asian restaurants located in 10 Kansas counties. Our results show that behavior-related violations, especially critical violations, occurred more often in routine health inspections than in other types of inspection such as complaint driven or follow up. Because poor food handling behaviors could be a major cause of the foodborne outbreaks that occur in ethnic foods (Simonne et al., 2004), findings from this study suggested that strategies need to be developed to nurture behavior change among the food handlers in the Asian restaurants.

Future research may be needed to identify effective ways to overcome barriers to food safety training in Asian restaurants, especially with respect to behavior-related critical violations. In order to increase Asian restaurant owners' awareness of the need for food safety training, risks associated with foodborne illness outbreaks in Asian restaurant establishments must be clearly addressed in food safety training using the languages or words that the restaurant owners could understand (Kwon et al., 2009). Because limited language skills have been identified as a barrier to providing food safety training, such training might need to be conducted by trained individuals who are bilingual. In addition, training materials should be developed in the preferred language specific to ethnic restaurants to enhance the acceptance and effectiveness (Liu & Kwon, 2012).

Moreover, it will be critical to examine the relationship between frequency of health code violations and the food safety training status. It may be also beneficial to investigate Asian restaurant owners' attitudes toward food safety. As Asian restaurant operators recognize that employee training reduces the frequency of inspection and improves health inspection results, they may be more motivated to train their employees appropriately.

Future research should also investigate employees' attitudes toward food safety training and barriers to such training in Asian and other ethnic restaurants. The ways in which employees can apply food safety knowledge to their behavior should also be explored. This study is limited in generalizability because only independent Asian restaurants located in 10 counties in Kansas were investigated. Therefore, it may not be possible to generalize the results to other geographic locations or other types of restaurants (i.e., chain, non-ethnic, or non-Asian ethnic restaurants).

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