

Critical Food Safety Violations in Surrey: Relationship to Community Median Household Income and Restaurant Type

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ABSTRACT

Background: Foodborne illness affects 4 million (1 in 8) Canadians each year, with at least 50% of these illnesses linked to restaurants. Environmental Health Officers (EHOs) conduct routine, demand, and follow-up restaurant inspections to safeguard the public. Critical violations (CVs) must be corrected during inspection because they have a high probability of causing a foodborne illness. Examples of CVs include: previously served food not being discarded, and infrequent handwashing from employees. Previous research has shown that individuals of low socioeconomic status are more susceptible to foodborne illness. According to Statistics Canada, the poverty rate in Surrey, British Columbia, is 14.8%, which is slightly higher than the national rate of 14.2%. Unfortunately, there is limited research that assesses the safety of food service establishments in different socioeconomic neighbourhoods. This study examined the relationship between the number of CVs in chain and independent restaurants and median household income in three communities within Surrey.

Methods: Secondary data was used for this study. The researcher collected publicly accessible restaurant inspection reports from the Fraser Health website. Three communities (Whalley, Fleetwood, South Surrey) within Surrey were selected for comparison according to their median household income (from City of Surrey Community Demographic Profiles webpage). Whalley and South Surrey had the lowest and highest median household income, respectively. Fleetwood was chosen based on its proximity to the median household income for Surrey. The researcher then recorded the name and restaurant type within these communities using Zomato. 25 chain and 25 independent restaurants were randomly selected in each community. In total, 150 restaurants were analyzed. The number of CVs, violation code, and hazard rating were compared between January 2016 and December 2017.

Results: Independent restaurants were found to have more CVs than chain restaurants in all communities. There was an association between the number of CVs observed in both types of restaurants and the restaurant's hazard rating. The p-values for chain restaurants in Whalley, Fleetwood, and South Surrey are: 0.00, 0.00006, and 0.00, respectively. Meanwhile the p-values for independent restaurants in all three communities are 0.00. In general, independent restaurants had more moderate or high hazard ratings than chain restaurants. The top four CVs found in all communities were related to poor sanitation of equipment, improper storage of cold potentially hazardous foods, and lack of adequate handwashing stations. Finally, a negative correlation was observed between the number of CVs in both restaurant types and the neighbourhood median household income (p-value for chain and independent restaurants = 0.0186 and 0.0073, respectively).

Conclusion: The findings indicate that communities with lower median household income had more CVs. Further research is needed to analyze this relationship. In addition, chain restaurants have fewer CVs than independent restaurants possibly due to their internal food safety monitoring systems. Therefore, independent restaurants may benefit from more education because this pattern has been observed in the past. Finally, an educational intervention is potentially necessary for restaurant operators in Surrey to reduce the top four CVs, thereby improving the restaurants' hazard rating.

Keywords: Critical Violations, Restaurant Inspections, Restaurant Type, Chain Restaurants, Independent Restaurants, Food Safety, Foodborne illness, Median Household Income, Fraser Health Authority

INTRODUCTION

In 2015, Canadians households spent on average \$2502 per year on food purchased from restaurants (Statistics Canada, 2017). At the same time, Canadians are reducing meal cooking times for the sake of convenience.

Unfortunately, consumers cannot access restaurant kitchens to view how their food is prepared (Fraser Health Authority (FHA), 2017). Thus, they have no choice but to trust that food handlers are complying with food safety guidelines.

According to Health Canada, at least 50% of foodborne illnesses can be traced back to restaurants and other food service establishments (Griffith-Greene, 2014). Therefore, Environmental Health Officers (EHOs) play an important role in protecting public health through conducting over 16,000 inspections of food establishments each year within the Fraser Health region (Fraser Health Authority (FHA), 2017). Critical violations (CVs) are problematic because these violations are highly likely to cause illness, which poses a significant risk to the public (Fraser Health Authority (FHA), 2017). EHOs tend to spend more time in restaurants with more critical violations because they have to educate operators and take appropriate action if necessary to protect the public. Previous research has suggested that food retailers in low income neighbourhoods struggle with proper sanitation and refrigeration practices (Quinlan, 2013). The percentage of individuals who reside in low-income households in Surrey exceeds the national average, thus raising the question of whether or not food safety compliance is a socioeconomically related issue (Chan, 2017).

LITERATURE REVIEW

Foodborne Illness

Approximately 4 million (1 in 8) Canadians are affected by foodborne illnesses annually (Health Canada, 2016). The economic burden of foodborne illness is about \$100 million per year (Health Canada, 2016). Among the 4 million Canadians affected, 1.6 million and 2.4 million cases are due to "known pathogens" and "unknown pathogens", respectively. This has led to over 11,500 hospitalizations and 238 deaths

annually (Thomas et al., 2013). In British Columbia (BC), there are over 550,000 cases of foodborne illnesses each year. Among the foodborne illnesses, 90% are caused by five pathogens: Norovirus, *Campylobacter*, *Clostridium perfringens*, *Yersinia enterocolitica*, and *Salmonella* (BC Center for Disease Control, 2017). Unfortunately, foodborne illnesses are often underreported in Canada.

Although foodborne illness outbreaks can occur anywhere, there have been consistent findings of a positive correlation between dining out in restaurants and risk of foodborne illness (Jones & Angulo, 2006). Restaurants produce high volumes of food, which increase the probability that an improper food handling practice may result in more illnesses, compared to other settings such as at home (Jones & Angulo, 2006).

The Importance of Food Safety

One dominant factor that consumers consider when deciding which restaurant to eat at is food safety (Harris, Knight, & Worosz, 2006; Harris, DiPietro, Murphy, & Rivera, 2014; Worsfold, 2006). Among the respondents surveyed by Michigan State University, consumers are willing to spend an extra 5% if the risk of contracting a foodborne illness could be decreased by 50% (Harris et al., 2006). Respondents with a lower income have higher concerns about food safety compared to their counterparts (Harris et al, 2006). One possible reason is that low income individuals are working paycheck-to-paycheck and cannot afford to take time off work to recuperate from a foodborne disease.

Unfortunately, the relationship behind food safety, restaurant inspection scores, and socioeconomic differences is poorly understood. There are conflicting results among studies. For example, a positive correlation was observed between foodborne illnesses and residents with a low socioeconomic status in Italy and the United States (Darcey & Quinlan, 2011). US surveillance systems such as the National Notifiable Diseases Surveillance System discovered that salmonellosis and shigellosis incidences were associated with poverty stricken areas. Similarly, Italian children in "low social

classes" tended to contract *Salmonella* (Darcey & Quinlan, 2011). However, Darcey and Quinlan's (2011) research contradicted the findings from Italy and the National Notifiable Surveillance System. Instead, they found that medium-high socioeconomic neighbourhoods in Philadelphia had the highest percentage of restaurants with no CVs per inspection. Surprisingly, restaurants with the highest and lowest mean level of CVs per inspection belonged to high socioeconomic neighbourhoods and low-medium socioeconomic neighbourhoods, respectively (Darcey & Quinlan, 2011). As chain restaurants have excellent quality control procedures, it is possible that this is due to low socioeconomic neighbourhoods having more chain restaurants than high socioeconomic neighbourhoods.

Chain versus Independent Restaurants

There is no current consensus on the definition of a chain restaurant. For example, Harris, DiPietro, Murphy, and Rivera (2014) defined chain restaurants as having a minimum of 7 identical restaurants globally. Meanwhile, Leinwand, Glanz, Keenan, and Branas (2017) stated that a restaurant must have at least 15 identical restaurants worldwide to be considered a chain restaurant. Furthermore, chain restaurants not only have the same menus and décor (Harris et al., 2014), but also serve food that requires minimal preparation time (Leinwand et al., 2017). Examples of chain restaurants found in BC include: McDonalds, White Spot, and Earls. On the other hand, independent restaurants offer a unique and complex menu with an ambience different from other restaurants. In addition, these restaurants prepare foods using raw ingredients, making food preparation more complicated and time-consuming (Leinwand et al., 2017)

Maintaining food safety and quality is a priority for chain restaurants in order to maintain their reputation. Chain restaurants have standardized food preparation protocols that include corporate food safety plans and internal food safety monitoring systems (Harris et al., 2014; Leinwand et al., 2017). For example, a significant number of chain restaurant employees used a thermometer to check the

cooking temperature of food compared to employees working at independent restaurants (Green et al., 2005). In addition, chain restaurants collaborate with third party auditors and company representatives to check for any food safety and quality system issues at the supplier facilities (Gale, 2006). Thus, food handling practices should be consistent in all chain restaurants regardless of the restaurant location.

Studies have been conducted in the United States and Canada to determine the relationship between CVs among chain and independent restaurants. However, there are conflicting results. American literature reported fewer critical violations in chain restaurants compared to independent restaurants in Florida and Louisiana. Independent restaurants were 1.64 times more likely than chain restaurants to receive critical violations in Louisiana (Liu & Lee, 2017). Similarly, all districts in Florida reported significantly higher mean levels of critical violations in independent restaurants compared to their counterparts (Harris et al., 2014). On the other hand, about one in four inspections at national chain restaurants in Canada have at least one major violation such as a fly infestation and failure to keep food at safe temperatures (Griffith-Greene, 2014). Furthermore, these violations were not corrected after consecutive inspections. In addition, a study conducted by (Cseke et al., 2014) reported no significant difference in the number of CVs for non-ethnic chain and independent ethnic restaurants within the Fraser Health region of British Columbia. Nevertheless, employees in both chain and independent restaurants must be vigilant in adhering to food safety guidelines to reduce the likelihood of causing a foodborne illness.

Disclosing Restaurant Inspection Reports

According to previous literature cited by Chan (2012), "public disclosure of inspection information helps foster a culture of food safety by encouraging dialogue about food safety issues among both consumers, various levels of government and the foodservice industry". In fact, 90% of consumers who regularly visit restaurants believe they have the right to view

restaurant inspection reports (Worsfold, 2006). By knowing if regulatory requirements at restaurants are being met, consumers can use their judgment to decide if they should order food from the restaurant (Fraser Health Authority (FHA), 2017). However, public disclosure is concerning for restaurant owners because it can influence the consumers' restaurant decision making process. Hence, restaurant operators will make an effort to adhere to the legislation requirements as public disclosure of restaurant inspection reports will impact their business. Nonetheless, interpreting a restaurant inspection report may be challenging for the general public because they lack extensive background knowledge about food safety compared to EHOs (Chatha, Heacock, & Chiodo, 2009).

Restaurant inspection reports can be disclosed either at the premises or online. For example, a placard system is used in Toronto and Seattle, where restaurant operators are required to post their food safety inspection notice in a conspicuous location (Besharah & Heacock, 2015). However, Toronto and Seattle have different food safety rating systems. In Toronto's DineSafe inspection system, there are three placards issued for restaurants: green indicates pass, yellow indicates conditional pass, and red indicates closed (Besharah & Heacock, 2015). The type of notice issued to restaurants depends on the number of minor, significant, and crucial infractions found during an inspection. On the other hand, Seattle's restaurants are assigned one of four food safety ratings: i) needs to improve, ii) okay, iii) good, and iv) excellent (Seattle & King County, 2017). The rating category is determined by the number of red critical violations observed over the past four recent inspections. Meanwhile, in BC, restaurant inspection reports are found online. That being said, only routine and follow-up inspections are posted on the Fraser Health Authority website because Fraser Health must comply with the Freedom of Information Legislation (Fraser Health Authority (FHA), 2017).

Unfortunately, there have been conflicting results on the effectiveness and the public's perception of posting restaurant inspection

reports online in BC. Two similar studies were carried out using a survey methodology. Chatha et al., (2009) conducted a person-to-person interview at a seniors' home in New Westminster and Ladner Library while Chan (2012) distributed a survey online. Although Chatha et al (2009) found that all surveyed individuals knew that restaurant inspection information was available online and easily accessible, Chan's (2012) surveyed participants did not. In fact, only 51% of individuals Chan (2012) surveyed were aware that restaurant inspection information was disclosed online. Furthermore, individuals in their 20s or over age 50 were less aware about online restaurant inspection reports compared individuals aged 30 to 49 (Chan, 2012). Based on these results, it is difficult to conclude whether BC Health Authorities have been effective in communicating their findings on restaurant inspections to the public.

Fraser Health

In BC, EHOs are authorized to inspect food premises under the BC Public Health Act to ensure that operators are complying with the Food Premises Regulation and the Food Services Code (Fraser Health Authority (FHA), 2017). The type of inspections EHOs complete are routine, follow-up, and complaint inspections. There are five regional health authorities in BC that EHOs may work in: Vancouver Coastal Health, Fraser Health, Interior Health, Vancouver Island Health, and Northern Health. EHOs working for Fraser Health are responsible for inspecting restaurants in cities including but are limited to: Burnaby, Surrey, New Westminster and Abbotsford.

All five health authorities design their own Food Premises Inspection Reports for EHOs to use. For Fraser Health, the restaurant inspection reports are categorized into five sections: i) Construction and Approvals, ii) Control of Food Hazards, iii) Maintenance and Sanitation, iv) Hygiene and Communicable Diseases, and v) Education and Training (Cseke et al., 2014). Within each section are critical or non-critical violations that contravene the Food Premises Regulations (Figure 1). CVs must be corrected immediately because failing to do so may contribute to foodborne illness. Examples of

critical violations include: poor hand hygiene, improper cooling and heating practices, and an ill employee who is handling food or utensils. Non-CVs do not require immediate correction, but must be addressed to control environmental conditions. Examples of non-CVs include: conditions that harbour pests, improper storage of chemicals, and reusing single use utensils and containers. Each violation is rated as low, medium, or high risk and is assigned a number. Afterwards, the EHO totals the violation scores to determine if the food premises overall has a low, moderate, or high hazard rating (Cseke et al., 2014).

Role of an Environmental Health Officers (EHOs)

EHOs have the authority to conduct announced and unannounced restaurant inspections. Follow-up inspections, on the other hand, are scheduled to ensure that the restaurant operator has corrected any violations that were found during the routine inspection (Fraser Health Authority (FHA), 2017). However, there is limited research on the relationship between the number of critical violations in chain and independent restaurants and their neighbourhood's socio-demographic characteristics. In Surrey, 14.8% of its residents live in poverty, which exceeds the national rate of 14.2% (Chan, 2017). This research study would raise the EHOs' awareness about the type of neighbourhoods and restaurants that may require more attention and time during inspections. Therefore, the purpose of this research study was to compare the number of CVs between chain restaurants and independent restaurants, and to determine if there is a correlation with the restaurants' neighbourhoods' median household income.

METHODS

The researcher selected three communities within the city of Surrey in British Columbia according to median household income. Whalley and South Surrey had the lowest and highest median household income respectively. Meanwhile, Fleetwood was selected based on its close proximity to the overall median household income of Surrey. The researcher used Zomato to collect the name and restaurant type of restaurants in British Columbia's Lower

Mainland. Zomato is a website that provides users with background information about the restaurant such as location, type of cuisine, and reviews (Zomato, 2017). Search parameters were used to include only restaurants in Whalley, Fleetwood, and South Surrey. It was assumed that the restaurant address provided in Zomato reflects the location of the community on the City of Surrey website.

For this research study a chain restaurant is defined as a food premise with a minimum of ten identical establishments across Canada and/or globally. Meanwhile, independent restaurants are defined as food premises that are independently owned. Therefore, restaurants outside of the municipality, convenience stores, food trucks, and food carts were excluded from the study. After generating a list of chain and independent restaurants for each residential neighbourhood using Excel, the researcher cross-referenced each restaurant name and type on a separate day to ensure results are accurate. Once this was complete, Microsoft Excel was used to randomize the order to prevent selection bias. The first 25 chain and 25 independent restaurants on the randomized list for each residential neighbourhood was selected for further analysis. In total, restaurant inspection reports from 150 restaurants were analyzed.

Next, HealthSpace was used to record the number and type of CVs in randomly selected restaurants in the three communities between January 2016 and December 2017. In addition, the restaurant's hazard rating for each inspection was recorded. These were accessible to the public. HealthSpace is Fraser Health Authority's online database for storing restaurant inspection reports (Fraser Health Authority (FHA), (2018)). Routine inspection reports were used while follow-up and complaint inspection reports were excluded. All data were entered into Microsoft Excel

RESULTS

DESCRIPTIVE STATISTICS

This research study was conducted using secondary analysis of quantitative and qualitative data. The median household income for Whalley, Fleetwood, and South Surrey is

found in Table 1. Microsoft Excel 2007 was used to calculate the mean number of CVs in chain and independent restaurants for each community. This is summarized in Table 2.

Table 1: Median Household Income for 3 communities in Surrey (City of Surrey, n.d.)

Name of Community in Surrey	Median Household Income (2011)
Whalley	\$68,569
Fleetwood	\$80,800
South Surrey	\$96,838

Table 2: Mean Number of CVs in Chain and Independent Restaurants in Surrey between January 2016 and December 2017

Name of Community in Surrey	Mean Number of CVs per inspection in Chain Restaurants	Mean Number of CVs per inspection in Independent Restaurants
Whalley	0.751	1.13
Fleetwood	0.561	0.975
South Surrey	0.383	0.654

Comparison of Number of Critical Violations and Hazard Rating for Restaurant Type

The majority of chain and independent restaurant inspection reports had 0 or 1 critical violations with a low hazard rating. Furthermore, there were two or fewer restaurant inspection reports in all communities with four or more CVs per inspection. A summary of CVs and hazard rating for each restaurant inspection report is found in Tables 3, 4, 5, 6, 7, 8.

Table 3: Hazard Rating of Chain Restaurant Inspection Reports and Number of CVs in Whalley

Hazard Rating	Number of Critical Violations			Total
	0 – 1	2 -3	≥ 4	
Low	72	10	0	82
Moderate	1	11	0	12
High	0	1	2	3
Total	73	22	2	97

Table 4: Hazard Rating of Independent Restaurant Inspection Reports and Number of CVs in Whalley

Hazard Rating	Number of Critical Violations			Total
	0 – 1	2 -3	≥ 4	
Low	44	5	0	49
Moderate	12	23	0	35
High	5	12	2	19
Total	61	40	2	103

Table 5: Hazard Rating of Chain Restaurant Inspection Reports and Number of CVs in Fleetwood

Hazard Rating	Number of Critical Violations			Total
	0 – 1	2 -3	≥ 4	
Low	74	8	0	82
Moderate	5	7	0	12
High	1	1	0	2

Total	80	16	0	96
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Table 6: Hazard Rating of Independent Restaurant Inspection Reports and Number of CVs in Fleetwood

Hazard Rating	Number of Critical Violations			Total
	0 – 1	2 -3	≥ 4	
Low	54	11	0	65
Moderate	9	7	0	16
High	4	16	2	22
Total	67	34	2	103

Table 7: Hazard Rating of Chain Restaurant Inspection Reports and Number of CVs in South Surrey

Hazard Rating	Number of Critical Violations			Total
	0 – 1	2 -3	≥ 4	
Low	90	3	0	93
Moderate	3	4	0	7
High	0	0	0	0
Total	93	7	0	100

Table 8: Hazard Rating of Independent Restaurant Inspection Reports and Number of CVs in South Surrey

Hazard Rating	Number of Critical Violations			Total
	0 – 1	2 -3	≥ 4	
Low	71	4	0	75
Moderate	9	9	1	19
High	2	5	1	8
Total	82	18	2	102

Frequency of Critical Violation committed by restaurant type in all communities

Violation Code 302 was the top CV committed by both chain and independent restaurants in all communities. Other top CVs found for both restaurant types in all communities were Violation Codes 205, 301, and 401 (Figures 1, 2, 3). None of the restaurants committed Violation Codes 202, 207, and 405 (Figures 1, 2, 3)

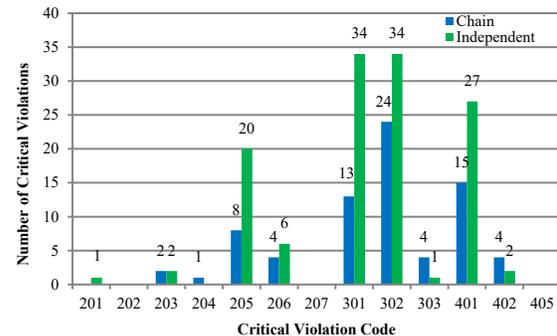


Figure 1. Frequency of CVs in Whalley

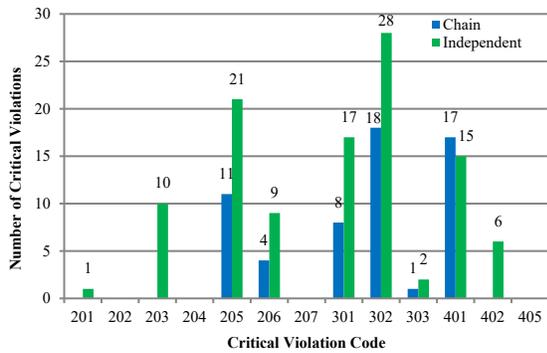


Figure 2. Frequency of CVs in Fleetwood

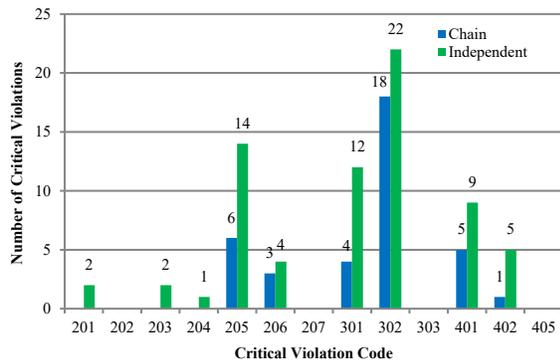


Figure 3. Frequency of CVs in South Surrey

Code definitions:

Control of Food Hazards

- 201 – Food contaminated or unfit for human consumption
- 202 – Food not processed in a manner that makes it safe to eat
- 203 – Food not cooled in an acceptable manner
- 204 – Food not cooked or reheated in a manner that makes safe to eat
- 205 – Cold potentially hazardous food stored/displayed above 4°C
- 206 – Hot potentially hazardous food stored/displayed below 60°C
- 207 – Previously served food not discarded

Maintenance and Sanitation

- 301 – Equipment/utensils/food contact surfaces not maintained in sanitary condition
- 302 – Equipment/utensils/food contact surfaces not properly washed and sanitized
- 303 – Equipment/facilities/hot & cold water for sanitary maintenance not adequate

Hygiene and Communicable Disease

- 401 – Adequate handwashing stations not available for employees
- 402 – Employee does not wash hands properly or at adequate frequency
- 405 – Ill staff not excluded from contact with food or food equipment/utensils

INFERENCE STATISTICS

NCSS was used to analyze inferential statistics. Three statistical tests were used. MANOVA was performed to compare the mean level of CVs between restaurant type and community. Next, a correlation/regression analysis was selected to assess the relationship between critical violations in restaurant type (chain and independent) and community's median household income. Finally, a chi-square test was conducted to determine if an association exists between the number of CVs and hazard rating for both restaurant types in each community.

Comparison of Critical Violations between Chain and Independent Restaurants

H ₀	There is <u>no</u> difference in the mean number of CVs based on restaurant type and community
H _a	There is a difference in the mean number of CVs based on restaurant type and community

When comparing between the mean number of CVs and restaurant type, the p-value was 0.0003, indicating a statistically significant difference in CVs between chain and independent restaurants. Independent restaurants had significantly more CVs than chain restaurants. Meanwhile, among mean level of CVs and community, the p-value was 0.002, indicating a statistically significant difference between CVs and community. Whalley had significantly more CVs than the other two communities. These findings were lower than $\alpha=0.05$ and thus, the null hypothesis was rejected.

However, there is no interaction between restaurant type and community on mean number of CVs as shown in Figure 4. The p-value is 0.838.

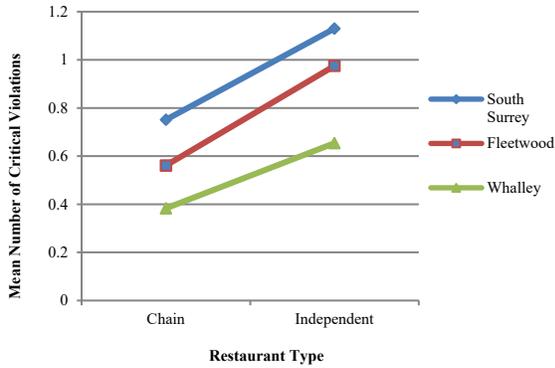


Figure 4. Mean Number of CVs based on restaurant type and community

Relationship between mean level of CVs in restaurant type and community's median household income

H ₀	There is no correlation between the mean number of CVs in <u>chain</u> restaurants and the restaurant community's median household income
H _a	There is a correlation between the mean number of CVs in <u>chain</u> restaurants and the restaurant community's median household income

The equation is Mean Number of CVs = - 0.0132* (Median Household Income (Thousands) in Surrey) + 1.6471. The slope had a p-value of 0.0186, therefore the null hypothesis was rejected. Meanwhile, the correlation coefficient was -0.2711, indicating a fair relationship. For every \$10,000 increase in median household income in Surrey, the number of critical violations per inspection decreased by 0.132 (Figure 5).

H ₀	There is no correlation between the mean number of CVs in <u>independent</u> restaurants and the restaurant community's median household income
H _a	There is a correlation between the mean number of CVs in <u>independent</u> restaurants and the restaurant community's median household income

The equation is Mean Number of CVs = - 0.0169* (Median Household Income (Thousands) in Surrey) + 2.3069. A negative correlation was observed between the number of CVs in independent restaurants and median

household income. The correlation coefficient was -0.3073, showing a fair relationship between these two variables. The slope had a p-value of 0.0073, thus, the null hypothesis was rejected and the results were statistically significant. For every \$10,000 increase in median household income in Surrey, the number of critical violations decreased by 0.169 (Figure 6).

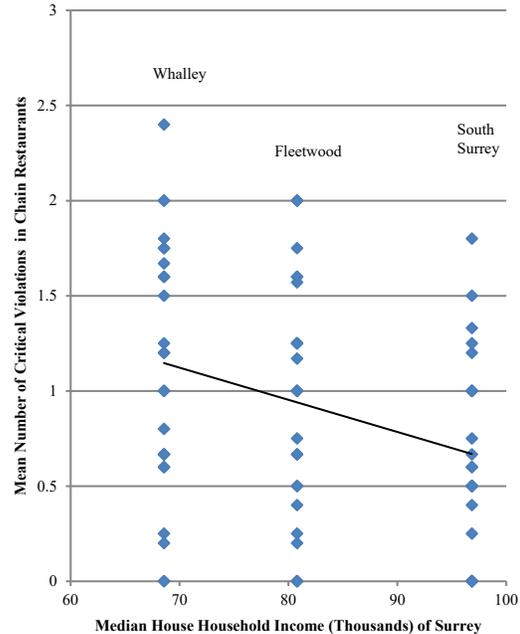


Figure 5. The mean number of CVs in chain restaurants based on median household income level

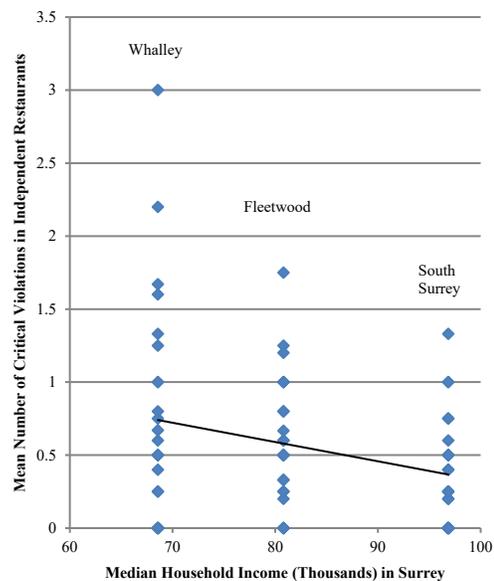


Figure 6. The mean number of CVs in independent restaurants based on median household income level

Comparison of Number of Critical Violations and Hazard Rating for Restaurant Type

H ₀	There is no association between the number of critical violations observed in <u>chain</u> restaurants and the restaurant's hazard rating
H _a	There is an association between the number of critical violations observed in <u>chain</u> restaurants and the restaurant's hazard rating

For Fleetwood, the p-value is 0.00006 while Whalley and South Surrey both have a p-value of 0.00, thus, the null hypothesis was rejected. This indicates an association between the number of CVs observed in chain restaurants and the restaurant's hazard rating in all three communities. Chain restaurants with a low number of CVs appear to have a low hazard rating.

H ₀	There is no association between the number of critical violations observed in <u>independent</u> restaurants and the restaurant's hazard rating
H _a	There is an association between the number of critical violations observed in <u>independent</u> restaurants and the restaurant's hazard rating

For Whalley, Fleetwood, and South Surrey, the p-values are 0.00, as such, the null hypothesis was rejected. This concludes that there is an association between the number of CVs observed in independent restaurants and the restaurant's hazard rating in all three communities. Independent restaurants with a low number of CVs appear to have a low hazard rating.

DISCUSSION

Chain versus Independent Restaurants

There were statistically significantly fewer CVs in chain restaurants compared to independent restaurants for each community. These findings were consistent with American literature. Harris et al. (2014) and Liu & Lee's (2017) studies reported that independent restaurants had more CVs than chain restaurants. This is not surprising because chain restaurants have quality

control programs and internal food safety monitoring systems to ensure that food is prepared and served in a safe manner (Harris et al., 2014). However, the researcher's findings refuted Cseke et al.'s (2014) research study. His research reported no significant findings in the number of CVs between non-ethnic chain and independent ethnic restaurants. One possible reason for this is due to changes in management and policies as well as variability in the EHOs' inspection style (Cseke et al, 2014).

Critical Violation Code

There are 13 CVs listed on the Food Premises Inspection Report that a restaurant operator could commit if they do not control for food hazards and/or maintain their food premises in a safe and sanitary condition. The top four CV codes found in all communities were 205, 301, 302, and 401. These CV codes are defined as:

- 205 – Cold potentially hazardous food stored/displayed above 4°C
- 301 – Equipment/utensils/food contact surfaces not maintained in sanitary condition
- 302 – Equipment/utensils/food contact surfaces not properly washed and sanitized
- 401 – Handwashing stations not available for employees

Among these critical violations, Violation Code 302 was the top critical violation committed in chain and independent restaurants in all three communities. In other words, inadequate concentration of sanitizer in the dishwasher and wiping cloths are a frequent occurrence during routine restaurant inspection (M. MacLeod, personal communication, March 8, 2018). For the other three critical violations, the frequency was dependent on the community and type of restaurant.

These findings corroborated Cseke et al.'s (2014) study. His research also found Violation Code 302 to be the most common critical violation among the 150 restaurants sampled. Similarly, the other three critical violations restaurants committed according to frequency were: 205, 301, and 401 (Cseke et al., 2014). The current study revealed that the majority of restaurant

operators fail to ensure that cold potentially hazardous foods are not temperature abused. In addition, restaurant operators struggle to provide adequate handwashing stations while keeping their facilities and equipment in a sanitary condition. The internal validity of these results is high because the census data on Surrey and online restaurant inspection reports collected were not done for the purpose of this research study, but for public awareness.

Hazard Rating and Number of Critical Violations observed in Chain and Independent Restaurants

There was a statistically significant association between the number of CVs observed in restaurants and the restaurant's hazard rating. Most chain and independent restaurant inspection reports with one or fewer critical violations had a low hazard rating. However, Whalley had the lowest number of independent restaurant inspection reports that had a low hazard rating and one or fewer CVs. Several chain and independent restaurant inspection reports that had fewer than two CVs had a moderate or high hazard rating. Independent restaurants had more restaurant inspection reports with two to three CVs compared to chain restaurants in all communities. Among this category, Whalley had the highest number of restaurant inspection reports where the majority of these restaurants were assessed a moderate hazard rating. Nevertheless, there were less than three restaurant inspection reports that had four or more critical violations observed in all communities.

Similarly, Cseke et al.'s (2014) study analyzed the hazard rating, which stated that most of the chain non-ethnic, independent ethnic, and independent non-ethnic restaurants had a low hazard rating. Not surprisingly, chain non-ethnic restaurants had the highest percentage out of the three categories with a low hazard rating. However, Cseke et al. (2014) did not compare the hazard rating with number of critical violations. Nevertheless, this study has demonstrated that non-critical violations possibly contribute to the moderate or high hazard rating of chain and independent restaurants.

Mean number of Critical Violations observed in Chain and Independent Restaurants and Restaurant Community's Median Household Income

Whalley had the lowest median income while South Surrey had the highest median income. A negative correlation was observed between the mean number of CVs in restaurants and median household income of the community. This negative correlation was also observed when comparing independent versus chain restaurants by community.

This contradicted Darcey & Quinlan's (2011) research, where restaurants with the highest mean level of critical violations were from high socioeconomic neighbourhoods within Philadelphia. As chain restaurants have standardized protocols at the supplier and the food preparation level, it is possible that low socioeconomic neighbourhoods have a higher density of chain restaurants compared to high socioeconomic neighbourhoods in Philadelphia (Gale, 2006; Leinwand et al., 2017).

Unfortunately, the current study only analyzed 50 restaurants in each of the three communities. Nonetheless, these restaurants were randomly selected where routine restaurant inspection reports were collected in a recent timeframe, between January 2016 and December 2017. Possible reasons for poorer food safety compliance in Whalley include lack of budget, knowledge, understanding and motivation.

KNOWLEDGE TRANSLATION

Despite possible changes to management and policy over the past four years, Violation Codes 205, 301, 302, and 401 are a recurring issue in chain and independent restaurants within the Fraser Health region. Therefore, EHOs should focus on lowering these CVs to improve the hazard rating of restaurants. To address this, it is recommended that EHOs provide information sheets during routine inspections for restaurant operators to review sanitation, safe storage of cold foods, and hygiene practices. These information sheets should be available in multiple languages to prevent communication barriers.

In addition, EHOs could consider increasing the frequency of routine inspections for independent restaurants because they have more critical violations than chain restaurants in all communities. Specifically, more resources could be devoted to lower income areas. There are possible reasons why chain and independent restaurants in Whalley have more CVs than other communities. Whalley is known for its high theft and crime rate, which potentially forces restaurant operators to spend more money on security to protect their food premises (M. MacLeod, personal communication, March 8, 2018). As a result, these restaurant operators might have a smaller budget when addressing food safety related issues.

LIMITATIONS

Despite efforts to reduce selection bias and improve inter-rater reliability, there were a few limitations that negatively impacted the validity and reliability of this research study.

EHOs' Evaluative Approach

EHOs working in Fraser Health use a standardized Food Premises Hazard Rating Checklist when conducting a routine restaurant inspection. However, there will be variability in the EHOs' evaluative approach when deciding whether a critical violation should be classified as low, medium, or high risk. The level of classification affects the violation score and hazard rating of the restaurant. Furthermore, there may have been two or more EHOs inspecting the restaurants between January 2016 to December 2017. This lowers the reliability of the results. Unfortunately, restaurant inspection reports in the Fraser Health Authority do not disclose the names of the EHOs who evaluated the restaurants.

Restaurant Operators' Background

It is possible that CVs are not related to community median household income. Restaurant operators may come from another city in Metro Vancouver, where their income differs from the community's median income. For example, it is possible that affluent operators own a restaurant in a low income community. This potentially reduces the internal validity of the study.

Regardless, all operators should be knowledgeable in proper food safe practices. In BC, all operators are required to be FOODSAFE certified.

Small Sample Size

There were only 25 chain and 25 independent restaurants collected for each community. Unfortunately, the sample size could not be increased because there were only a total of 25 chain restaurants in Fleetwood.

Time Constraints

Due to time constraints, the researcher only focused on three communities within one city within the Fraser Health region. Consequently, the results of this study may not be generalized to the entire British Columbian population. Each health authority has a different system when conducting routine inspections. The external validity would improve if cities under a different health authority were included in this research study.

FUTURE RESEARCH

To reduce knowledge gaps based on the results from this research study, future research should look at:

- Conducting a similar study in a different city in Metro Vancouver
- Conducting an in-depth analysis of common practices and reasons restaurant operators committing Violation Codes 205, 301, 302, and 401
- Analyzing non-CVs and their impact on the restaurant's hazard rating

CONCLUSION

Foodborne illnesses affect approximately 4 million Canadians every year (Health Canada, 2016). The economic impact is \$100 million annually (BC Center for Disease Control, 2016). Unfortunately, restaurants and other food service establishments are responsible for at least 50% of foodborne illnesses each year (Griffith-Greene, 2014). Thus, it is imperative for EHOs to educate restaurant operators on the importance of food safety because CVs have a high likelihood of causing a foodborne illness (Fraser Health Authority, 2018).

The findings of this research study reveal that independent restaurants have more critical violations than chain restaurants in all three communities. EHOs could consider allocating more resources and increasing the frequency of routine inspections in Whalley because it has the highest number of CVs in both types of restaurants compared to other communities. In addition, a statistically significant association was observed between the number of CVs observed in both types of restaurants and the restaurant's hazard rating. Within all communities, independent restaurants were found to have more moderate or high hazard ratings than chain restaurants. Nonetheless, non-critical violations likely contribute to the restaurant's moderate or high hazard rating, especially when less than two CVs were observed. Finally, an educational intervention could be considered to lower CV codes 205, 301, 302, and 401 to reduce the possibility of a future foodborne outbreak.

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ABBREVIATIONS

CVs	Critical Violations
EHOs	Environmental Health Officers

COMPETING INTERESTS

The authors declare that they have no competing interests.

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