

Effects of the COVID-19 Pandemic on Restaurant Food Safety: Trends in Hygiene and Sanitation Related Violations

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Abstract

Background

Restaurants and other food service establishments are of major concern to public health as they can be sources of illnesses and disease outbreaks. Many of the measures that were put forth by public health to reduce COVID-19 transmission, would also have been beneficial to the overall food safety of restaurants. On the contrary, psychological stress, staff shortages and revenue losses may have had a negative impact on food safety practices in restaurants. This study aims to determine if the COVID-19 pandemic had a measurable impact on post-pandemic food safety in restaurants.

Methods

Restaurant inspection data from 2019 (pre-pandemic) and 2022 (post-pandemic) from the Fraser Health Region was used to analyze proportions of specific hygiene and sanitation related violations, hazard scores of those violations and overall hazard scores of restaurants. Geographic distribution of violations across the Fraser Health Region was also analyzed using the data.

Results

Proportion of violations related to 'inadequate facilities/equipment for sanitation' significantly declined in the year 2022 following the pandemic. Significant increase in proportion of violations related to 'adequate handwashing stations not available for employees' observed in the year 2022. Restaurants in Fraser East region saw a significant decline in violations related to 'equipment/facilities/hot & cold water for sanitary maintenance not adequate', and a notable increase in violations related to 'adequate handwashing stations not available for employees'. A significant increase in the mean hazard scores of 'violations for equipment/facilities/hot & cold water for sanitary maintenance not adequate', and 'adequate handwashing stations not available for employees' was observed in the post-pandemic year, 2022. An increase in the mean overall hazard score of restaurants was observed in 2022 as compared to 2019.

Conclusion

Results of this study show that the COVID-19 did have a measurable impact on restaurant hygiene and sanitation practices. The difference in violations between Fraser East and the other regions of Fraser Health needs to be further explored to determine the factors behind the discrepancy. Findings from this research have practical implications for Fraser Health and other health authorities to evaluate the effectiveness of their food safety programs during a major public health emergency such as the COVID-19 pandemic. Health authorities gather a lot of data from routine, complaint, and follow-up inspections and these can be used to evaluate the effectiveness of their inspections over the years.

Keywords: *food safety, restaurants, inspections, hygiene, sanitation, COVID-19*

Introduction

On March 11, 2020, after more than 118,000 cases in 114 countries, COVID-19 was declared a global pandemic by the World Health Organization. (1) The consequent actions of governments and policy makers ultimately decided the trajectory of the pandemic and how it impacted all aspects of daily life. The various industries and sectors impacted can generally be divided into 4 main categories: Health, Environment, Financial, and Social. (2) One such industry that was impacted by the pandemic was the restaurant and food service industry. It is estimated that by the end of 2020, the restaurant industry globally lost approximately a quarter of a trillion dollars, over 100 000 food service

establishments were forced to shut down, and close to eight million employees were laid off. (3) In British Columbia, key public health messaging surrounding restaurant operations to reduce the spread of COVID-19 included measures such as practicing personal hygiene (e.g., hand hygiene), social distancing, face masks, quarantining if sick, cleaning and disinfecting frequently used surfaces, and engineering new interventions including curbside pickups, online menus, and contactless payments. (4)

Restaurants and other food service establishments are of major concern to public health as they can be sources of illnesses and disease outbreaks. In the context of the pandemic, it can be argued that many of the measures that were put

forth by public health to reduce COVID-19 transmission, would also have been beneficial to the overall food safety of restaurants. On the other hand, psychological stress, staff shortages and revenue losses may have had a negative impact on food safety practices in restaurants. To better understand the effect of COVID-19 on post-pandemic food safety in restaurants, this study aims to analyze restaurant inspection reports from 2019 (pre-pandemic) and compare it to reports from 2022 (post-pandemic) using data from Fraser Health. Indicators such as number of critical and non-critical violations, hygiene and sanitation related violations were used as a proxy to assess food safety of restaurants pre- and post-pandemic.

Literature Review

Food Safety and Interventions

Foodborne illness is a major contributor to morbidity and the overall cost to healthcare in Canada. It is estimated that each year 4 million Canadians get sick from foodborne pathogens. (5) Each incidence of foodborne illness has economic and productivity costs associated with it. The corresponding cost associated with foodborne illnesses each

year is estimated to be between \$12 billion and \$14 billion Canadian dollars. (6) Food service establishments are a major source of foodborne illness in developed countries as many people enjoy eating outside of their homes. Before the pandemic, Canadians bought almost 2 meals per week from food service establishments, and 16% of Canadians stated that eating out was part of their everyday lives. (7) To protect the health of the public and reduce the economic burden from foodborne illnesses, health authorities across Canada have implemented various food safety interventions. These include food safety training and education programs, hazard analysis and critical control point plans, health inspections and enforcement, foodborne illness investigations, food sampling, and other engineering interventions. (8)

Evaluating a food protection program is crucial in determining its effectiveness. However, it is often very difficult to evaluate the impact of various food safety measures on overall public health outcome. Overall, evidence suggests that kitchen manager training and restaurant disclosure systems seem to promote food safety

culture while food handler training policies do not result in significant improvement in food inspection compliance. (8)

When a food safety intervention is put into place, two major categories of indicators are often used to measure the effectiveness of said intervention. These categories are based on hygiene performance and public health outcome. (8) Indicators using public health outcomes aim to measure changes in foodborne outbreaks, reported foodborne illness cases, changes in attitude or behavior in food safety, self reported perceived changes in food hygiene by consumer, and changes in levels of foodborne pathogens. (8) These measurements require data from surveillance systems, field observations and microbiological sampling. Measuring the impact of the pandemic on overall public health outcomes is out of the scope for this study. However, measuring food safety effectiveness based on hygiene performance can be accomplished using inspection reports, which are readily available from online public databases.

Routine Inspections

Routine inspection is one of the most frequently used interventions in evaluating a food service establishment's compliance with regulations. (9) An advantage of using routine inspection to evaluate food safety is that it can indicate hygiene performance using quantitative data such as number and types of violations. When routine inspections are accompanied with educational interventions such as verbal advice, significant improvement in personal hygiene are seen. (10) In the context of the pandemic, education on handwashing and general sanitation was in the limelight, which would suggest an overall benefit to food safety of restaurants. Restaurant inspection frequency is another factor that can be seen as influencing the food safety compliance of restaurants. However, the evidence for increased frequency of inspections in lowering food safety risk remains unclear.

Impacts of COVID-19

There is a lack of literature surrounding the impact of COVID-19 on post-pandemic public health outcomes and hygiene performance in the food service industry. A

study published in the BCIT Environmental Public Health Journal investigated inspection frequency and inspection violations during COVID-19 in Vancouver Island Health Authority. The author analyzed inspection data from January 2019 to December 2021 and found that the number of inspections decreased with each subsequent year. Accounting for the decrease in inspections, the ratio of inspections to number of violations was measured. While the total number of violations decreased, the number of critical violations were significantly higher in 2021 and the number of non-critical violations decreased. (11)

The COVID-19 pandemic also influenced psychological well being of employees which could possibly explain some of the non-compliance. According to one study, employees who were still working during the COVID-19 pandemic had higher levels of psychological distress and substance abuse. (12) Restaurant workers and operators faced stressful circumstances while working during the pandemic. On one hand, they were fearful of contracting the virus, while on the other hand, financial burdens and revenue losses due to the pandemic

explained why some food service establishments struggled to meet regulatory compliance.

Purpose of the Study

The purpose of this research was to determine the effect of the COVID-19 pandemic on trends in sanitation and hygiene related violations in restaurants in the Fraser Health region. Specifically, the study analyzed the number and severity of sanitation and hygiene related violations by comparing restaurant inspection data from 2019 and 2022.

Methods and Materials

Materials

Restaurant inspection data from HealthSpace Cloud was provided by the Fraser Health Authority, in British Columbia. The inspection data was in a Microsoft Excel file and was stored on a computer with Windows 11 Operating System. Microsoft Excel was used to organize the data, as well as generate descriptive statistical tables and graphs. Inferential statistical analysis of the inspection data was performed using NCSS 2022 statistical analysis software, (13).

Methods

The methods used for this research included requesting specific restaurant inspection data from Fraser Health Authority in British Columbia. Inspection data was requested for *routine inspections* only of the FE1 type (restaurant) establishments. Two excel files with matching datasets were acquired. First dataset contained FE1 routine inspection data from 2019 and the second dataset contained FE1 routine inspection data from 2022. The type of data included restaurant name, city name, date of inspection, and presence or absence of several violations including hygiene and sanitation related violations, their hazard scores and total hazard scores of restaurants.

The following violation codes were the focus of the study and are based on the Fraser Health Food Premises Inspection Report & Violation Checklist (Appendix A):

Sanitation Related Violations

- Violation Code 302 – Equipment/utensils/food contact surfaces not properly washed and sanitized.
- Violation Code 303 – Equipment/facilities/hot & cold

water for sanitary maintenance not adequate.

Hygiene Related Violations

- Violation Code 401 – Adequate handwashing stations not available for employees.
- Violation Code 402 – Employee does not wash hands properly or at adequate frequency.

Results

Descriptive Statistics

The proportion of each violation code observed as a percentage of the total number of violations observed each year was graphed (Figure 1). The proportion of violation code 302 (inadequate sanitation of equipment/food contact surfaces) stayed relatively the same. Whereas a slight decrease in proportion of violation code 402 (improper handwashing) was observed in 2022. There was a reduction in proportion of violation code 303 (inadequate equipment/facilities for sanitation) and an increase in violation code 401 (Inadequate handwashing stations) in 2022 compared to 2019. Average hazard score of violation codes 302, 303, 401, 402 and the overall hazard score of restaurants during routine inspections in 2019 vs 2022 is graphed (Figure 2). There was an increase

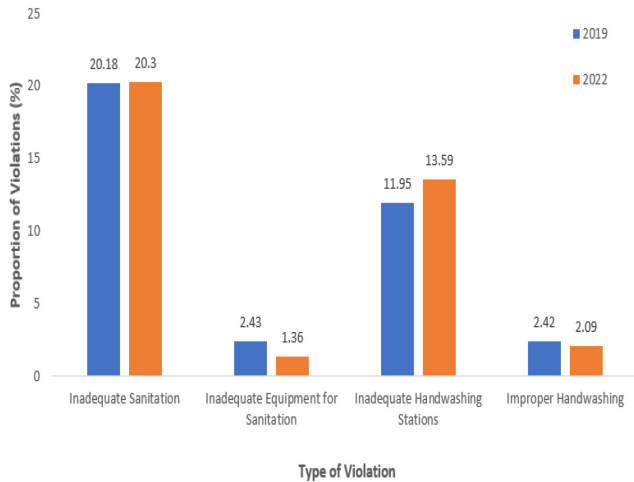


Figure 1: Proportion of sanitation and hygiene related violations during routine restaurant inspections in the Fraser Health Region in 2019 and 2022

in the overall hazard scores of restaurants in 2022 compared to 2019. An increase in average hazard score of violation code 303 (inadequate equipment/facilities for sanitation) was observed in 2022 compared to 2019.

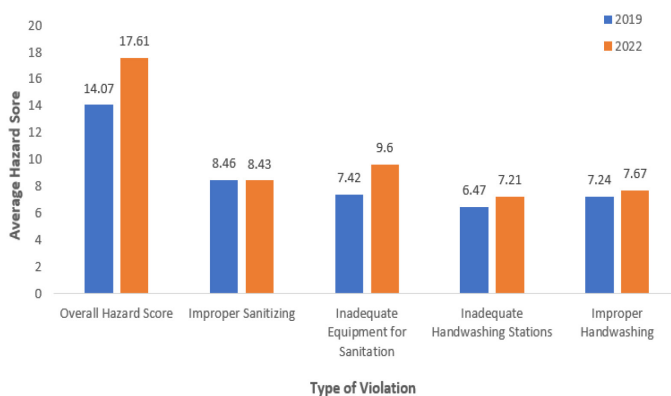


Figure 2: Average Hazard Score of Various Types of Violations during Routine Restaurant Inspections in the Fraser Health Region in 2019 and 2022.

Slight increase in average hazard score was observed for violation codes 401 (inadequate handwashing stations) and 402 (improper handwashing) in 2022. Average hazard score of violation code 302 (inadequate sanitation of equipment/food contact surfaces) was relatively the same for both years.

The proportion of violation codes observed in a region was calculated as a percentage of the total violations observed in that region for a given year and compared using pie charts (figure 3).

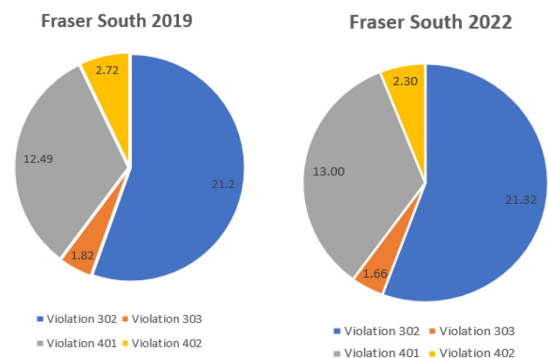


Figure 3: Proportions of violations related to hygiene and sanitation as a percentage of total violations in Fraser South region in 2019 and 2022.

A slight decrease in the proportion of violation code 303 (inadequate equipment for sanitation) and 402 (improper handwashing) was observed in the Fraser South region in the year 2022 compared to 2019. In Fraser North, a decrease in the

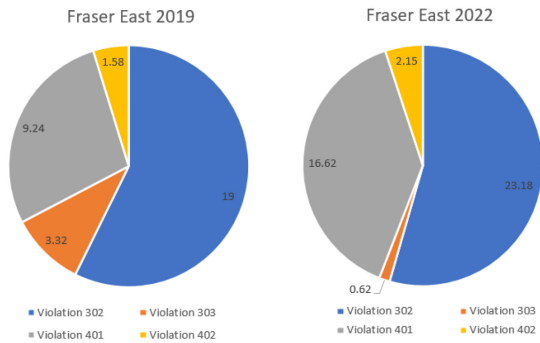


Figure 4: Proportions of violations related to hygiene and sanitation as a percentage of total violations in Fraser East region in 2019 and 2022.

proportion of violation code 303 (inadequate equipment/facilities for sanitation) and an increase in the proportion of violation code 401 (inadequate handwashing stations) was observed in the year 2022 (Figure 4).

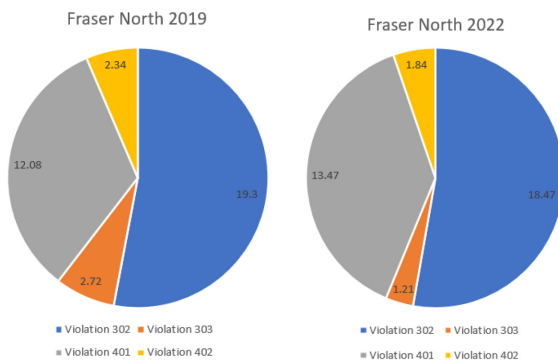


Figure 5: Proportions of violations related to hygiene and sanitation as a percentage of total violations in Fraser North region in 2019 and 2022.

In Fraser East, there was a significant decrease in proportion of violation code 303 (inadequate equipment for sanitation) in the year 2022 compared to 2019 (Figure 5). Whereas significant increase in proportion of violation code 401

(inadequate handwashing stations) was observed.

Inferential Statistics

Results for the Pearson’s Chi Square test and independent samples T-test are summarized in Table 4. Key takeaways include a statistically significant association between the year of inspection and the proportion of violation codes 302 (inadequate sanitation of equipment/food contact surfaces) and 401 (inadequate handwashing stations). Mean overall hazard score of restaurants was significantly higher in 2022 compared to 2019. In addition, violation codes 303 (inadequate equipment/facilities for sanitation) and 401 (inadequate handwashing stations) had significantly higher hazard scores in 2022 compared to 2019 (Table 4).

Discussion

The main objective of this study was to determine if the COVID-19 pandemic had a measurable impact on the hygiene and sanitation practices in restaurants. The negative impacts of the pandemic were seen as revenue losses, restaurant closures, staff shortages, and psychological stress. (3,12) On the other hand, it could be argued

that key public health messaging surrounding enhanced hand hygiene, sanitation and cleanliness would have resulted in improved food safety outcomes in restaurants in areas of hygiene and sanitation. The results from this study show that the proportion of violations for code 303, 'inadequate facilities/equipment for sanitation' significantly declined in the year 2022 following the pandemic. It is possible that the pandemic increased the awareness of having an adequate supply of sanitation facilities and equipment amongst operators, as evidenced by a decrease in the number of violations in this category. Interestingly, this increase in adequate supply of sanitation facilities did not translate to an increase in the actual practice of properly washing and sanitizing equipment & food contact surfaces. This suggests that while the means to achieve sanitation improved, the behavior of washing and sanitizing remained similar to the pre-pandemic year, 2019. This is evident from the results which saw no significant difference in the number of violations for code 302, "Equipment/Utensils/food contact surfaces not properly washed and sanitized [s. 17(2)]".

The study however, found a significant increase in proportion of violation code 401, "Adequate handwashing stations not available for employees [s. 21 (4)]" in 2022 (post pandemic). Inadequate facilities for handwashing are an indicator of a lack of proper hand hygiene practices in the workplace. If we look at some of the barriers, identified by Arendt et al., (14) that affect personal hygiene practices in workplaces; lack of knowledge and availability of resources should not have played a big factor in the hygiene practices in the post-pandemic year, 2022. It is possible that due to the psychological stress and staff shortages from the pandemic, (12) a shift in the workplace culture surrounding hand hygiene practices occurred. In the post-pandemic era, it is possible that some operators may have prioritized generating profits for their businesses over ensuring food safety measures, including hand hygiene, which is a crucial factor in preventing the spread of diseases. This study also sought to evaluate the geographic distribution of violations across the Fraser Health Region. The results indicate that the restaurants in Fraser East region saw a significant decline in violation

Table 1: Summary of inferential statistics

#	H ₀ and H _a	Test Used	Results and Interpretation
1	H ₀ : There is no association between the year of inspection and the proportion of inspections with violation code 302 (inadequate sanitation of equipment/food contact surfaces) H _a : There is an association between the year of inspection and the proportion of inspections with violation code 302 (inadequate sanitation of equipment/food contact surfaces)	Pearson's Chi Square	P=0.83964. Hence, do not reject H ₀ and conclude that there is no statistically significant association between the year of inspection and the proportions of inspections with violation code 302 (inadequate sanitation of equipment/food contact surfaces).
2	H ₀ : There is no association between the year of inspection and the proportion of inspections with violation code 303 (inadequate equipment/facilities for sanitation) H _a : There is an association between the year of inspection and the proportion of inspections with violation code 303 (inadequate equipment/facilities for sanitation)	Pearson's Chi Square	P=0.0000. Hence, reject H ₀ and conclude that there is a statistically significant association between the year of inspection and the proportion of violation code 303 (inadequate equipment/facilities for sanitation). There was a significant decrease in violation code 303 in 2022 (post-pandemic)
3	H ₀ : There is no association between the year of inspection and the proportion of inspections with violation code 401 (inadequate handwashing stations) H _a : There is an association between the year of inspection and the proportion of inspections with violation code 401 (inadequate handwashing stations)	Pearson's Chi Square	P=0.00082. Hence, reject H ₀ and conclude that there is a statistically significant association between the year of inspection and the proportion of violation code 401 (inadequate handwashing stations). There was a significant increase in violation code 401 in 2022 (post-pandemic)
4	H ₀ : There is no association between the year of inspection and the proportion of inspections with violation code 402 (improper handwashing) H _a : There is an association between the year of inspection and the proportion of inspections with violation code 402 (improper handwashing)	Pearson's Chi Square	P=0.13494. Hence, do not reject H ₀ and conclude that there is no statistically significant association between the year of inspection and the proportions of inspections with violation code 402 (improper handwashing).
5	H ₀ : Mean overall hazard score of restaurants during routine inspections in 2019 = Mean overall hazard score of restaurants during routine inspections in 2022 H _a : Mean overall hazard score of restaurants during routine inspections in 2019 ≠ Mean overall hazard score of restaurants in 2022	Independent Samples T-Test (Mann-Whitney U)	P=0.00000. Hence, reject H ₀ and conclude that the mean overall hazard score of restaurants during routine inspections in 2019 is statistically different than mean overall hazard score of restaurants in 2022. Mean overall hazard score of restaurants was significantly higher in 2022 (post-pandemic). Power = 100% at alpha of 0.05. Therefore, the test is powerful enough to detect differences in the sample when there is a difference in the larger population.
6	H ₀ : Mean hazard score of violation code 303 (inadequate equipment/facilities for sanitation) in restaurants during routine inspections in 2019 = Mean hazard score of violation code 303 (inadequate equipment/facilities for sanitation) in restaurants during routine inspections in 2022 H _a : Mean hazard score of violation code 303 (inadequate equipment/facilities for sanitation) in restaurants during routine inspections in 2019 ≠ Mean hazard score of violation code 303 (inadequate equipment/facilities for sanitation) in restaurants during routine inspections in 2022	Independent Samples T-Test (Mann-Whitney U)	P=0.00031. Hence, reject H ₀ and conclude that mean hazard score of violation code 303 (inadequate equipment/facilities for sanitation) in restaurants during routine inspection in 2019 is statistically different from mean hazard score of violation code 303 in restaurant during routine inspection in 2022. Mean hazard score of violation code 303 is significantly higher in 2022. Power = 95% at alpha of 0.05. Therefore, the test is powerful enough to detect differences in the sample when there is a difference in the larger population.
7	H ₀ : Mean hazard score of violation code 401 (inadequate handwashing stations) in restaurants during routine inspections in 2019 = Mean hazard score of violation code 401 (inadequate handwashing stations) in restaurants during routine inspections in 2022 H _a : Mean hazard score of violation code 401 (inadequate handwashing stations) in restaurants during routine inspections in 2019 ≠ Mean hazard score of violation code 401 (inadequate handwashing stations) in restaurants during routine inspections in 2022	Independent Samples T-Test (Mann-Whitney U)	P=0.00009. Hence, reject H ₀ and conclude that mean hazard score of violation code 401 (inadequate handwashing stations) in restaurants during routine inspection in 2019 is statistically different from mean hazard score of violation code 401 in restaurant during routine inspection in 2022. Mean hazard score of violation code 401 is significantly higher in 2022. Power = 97% at alpha of 0.05. Therefore, the test is powerful enough to detect differences in the sample when there is a difference in the larger population.
8	H ₀ : Mean hazard score of violation code 402 (improper handwashing) in restaurants during routine inspections in 2019 = Mean hazard score of violation code 402 (improper handwashing) in restaurants during routine inspections in 2022 H _a : Mean hazard score of violation code 402 (improper handwashing) in restaurants during routine inspections in 2019 ≠ Mean hazard score of violation code 402 (improper handwashing) in restaurants during routine inspections in 2022	Independent Samples T-Test (Mann-Whitney U)	P=0.37547. Hence, fail to reject H ₀ and conclude that the mean hazard score of violation code 402 (improper handwashing) in restaurants during routine inspection in 2019 is not statistically different from mean hazard score of violation code 402 in 2022. Power = 13% at alpha of 0.05. Therefore, β = 0.87, indicating that the test is not powerful enough to detect a difference.

code 303 “Equipment/facilities/hot & cold water for sanitary maintenance not adequate” but a notable increase in violation code 401 “Adequate handwashing stations not available for employees”. These findings need further examination to determine the specific reasons behind the increase or decrease in numbers of violations over a given period. Factors affecting violations may include potential changes of operation, staff turnovers, and a shift in workplace culture.

We found a statistically significant increase in the mean hazard scores of violation codes 303 (Equipment/facilities/hot & cold water for sanitary maintenance not adequate) and 401 (Adequate handwashing stations not available for employees) across FHA in the post-pandemic year, 2022 (Table 1). Assigning hazard scores is a method of classifying the severity of a violation. An increase in the severity of critical violations suggests two possibilities; existing critical violations became more severe or new critical violations emerged in previously non-violating restaurants. The results also indicate an increase in the mean overall hazard score of restaurants in 2022 as compared to 2019. Overall hazard score

may be considered when prioritizing restaurants and the level of food safety intervention they may require.

Limitations

The primary limitations of this study concern the interpretation of results. Although the study achieved statistical significance in identifying both an increase and decrease in violations post-pandemic, the exact cause of the increase or decrease in certain violations could not be determined from this study as there could be various social, political, or economic factors that played a role during or right after the pandemic. Hazard scores are another point of discussion in terms of limitations of the study. Although our results showed a statistically significant increase in the overall hazard scores, what that means in terms of actual increased food safety risk remains unclear.

Knowledge Translation

Findings from this research have practical implications for Fraser Health and other health authorities to evaluate the effectiveness of their food safety programs during a major public health emergency such as the COVID-19 pandemic. Health

authorities gather a lot of data from routine, complaint, and follow-up inspections and these can be used to evaluate the effectiveness of their inspections over the years. Trends in specific food safety violations can be used to modify the intervention programs to better meet the needs of the food services community.

Future Research

The following are recommended ideas for future research.

1. Evaluating the effectiveness of routine inspections by looking at routine inspection data from the last 10 years.
2. Surveying EHOs regarding their experiences, opinions, and trends of violations seen during and after the COVID-19 pandemic.

Conclusion

The findings of this study show that the COVID-19 did have an impact on restaurant hygiene and sanitation practices to a certain extent. A decrease in violations related to 'equipment/facilities/hot & cold water for sanitary maintenance not adequate' was seen in 2022. This could be attributed to the increased sensitivity to supply shortages

experienced during the pandemic and operators being extra cautious to ensure their facilities remain adequately supplied. The increase in violations related to 'Adequate handwashing stations not available to employees' could be attributed to a shift in workplace culture surrounding hand hygiene; operators having gone through the stress of the pandemic and staff shortages may have overlooked a big part of food safety i.e., hand hygiene. The difference in violations between Fraser East and the other regions of Fraser Health needs to be further explored to determine the factors behind the discrepancy.

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Competing Interest

The authors declare that they have no competing interests while conducting this study.

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