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# The Impact of the COVID-19 Pandemic Response on Food Safety Violations Observed in Southern Nevada Food Establishments

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# THE IMPACT OF THE COVID-19 PANDEMIC RESPONSE ON FOOD SAFETY VIOLATIONS OBSERVED IN SOUTHERN NEVADA FOOD ESTABLISHMENTS

By

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**Abstract**

Food poisoning is a common term used to describe what is actually foodborne illness. Despite the fact these illnesses can become deadly, foodborne illnesses are endemic and common in the United States. Nonetheless, they are completely preventable simply by following proper food safety procedures. The Food and Drug Administration identified the most common foodborne pathogens responsible for most foodborne infections, as well as the five risk factor categories to target in order to decrease the risk of cases and outbreaks.

To ensure foodborne outbreaks and cases are prevented, health authorities are tasked with conducting routine inspections on permitted food establishments. In Clark County, food establishment inspections are conducted by environmental health specialists and assess food safety risk factors. Food establishments are expected to be in compliance with the Southern Nevada Health District's food regulations. A lack of compliance can result in fees, reinspections, and even closures. This entire process aims to hold food establishments accountable and reduce the risk of foodborne illness in the public.

The COVID-19 pandemic changed the way many operations functioned. Even routine human behavior was changed simply due to the fear and the unknown surrounding COVID-19. Furthermore, mandates, executive orders and emergency directives enacted by the Governor of Nevada forced businesses around the state to adapt their operations and business models. Nonetheless, in Southern Nevada, environmental health specialists continued to conduct the same routine inspections of permitted food establishments. This means there was accurate data demonstrating the food safety of food establishments in Southern Nevada prior to and after the pandemic response was initiated.

The objective of this study was to identify changes in violations observed during routine inspections of permitted food establishments within Southern Nevada after the pandemic response was initiated. To accomplish this, we analyzed inspection reports from 2019 and compared them to inspection reports from April 1st 2020 to December 31st 2020. We determined if there was a statistically significant change in the mean number of violations observed within the two analysis periods using parametric and bootstrap resampling statistics to ensure accurate results. We further analyzed the data to determine if changes were observed more often in specific violation categories.

All violation categories including total, critical, major, and good food management practices (GMP) resulted in an improvement in mean violations prior to and post-pandemic response. The largest change was observed in the total violations category, with a 0.399 improvement. The smallest change was observed in the critical violation category, with a 0.071 improvement. While all categories resulted in an improvement that was statistically significant using both parametric and bootstrap methods, all improvements were less than one violation. This calls to address the potential importance of this less than one violation improvement in regard to the impact the COVID-19 pandemic response had on food safety. While this small improvement may not be enough to determine future preparations in food safety, it is important to continue studies on this topic in order to get a better understanding of those extreme facilities that had large improvements or significant worsening of scores during this time, as well as the specific violations with the most amount of change observed.

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I feel extremely grateful to have completed this thesis project with the help and support from the following people: to all of my committee members for taking the time to be a part of this process and guiding me; to Dr. Labus who has worked as my chair but has also been a mentor to me in my academic and professional career since my undergraduate studies, and who always made sure I put forth *only* my best work; to Dr. Cross who took extra time to teach me and explain different methodologies so that my project could come to life; to the individuals at the Southern Nevada Health District's IT department who worked back and forth with me to provide me with the data I needed; to my husband, Jose Morales, who has been my greatest supporter throughout all my academic, professional, and personal endeavors and never allowed me to give up. All of you have supported me in ways I know will forever be invaluable to me.

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## Introduction

Eating a meal and beginning to feel ill not long after is a situation most people can relate to. In fact, the situation is so common that it even has its own name: food poisoning. Food poisoning is a term often used to describe a combination of gastrointestinal symptoms, but the true disease-causing agents are not commonly known. The reality of this situation is not a matter of "poisoning" at all, but rather a situation in which a pathogen infects a human body through food contamination or other risky behaviors, otherwise known as foodborne illness. Perhaps an even less known fact is that foodborne illnesses can be contagious and deadly yet are also completely preventable.

Foodborne illnesses are common and in fact are endemic. Nonetheless, these illnesses can be prevented through safe food handling practices. Due to this, commercial food establishments are heavily monitored and regulated by local authorities. Maintaining a consistent accountability with establishments selling food to customers is a way to ensure those customers are consuming safe food and reduce the risk of foodborne outbreaks; this is accomplished by conducting routine food establishment inspections.

These inspections provide a documented effort to prevent the spread of foodborne illness. However, during the COVID-19 pandemic, many processes had to adapt to new circumstances. This change in operations and in overall human behaviors likely impacted the practices in food establishments in Southern Nevada. This study aimed to identify the changes seen in violations during routine food establishment inspections prior to and after the pandemic response was initiated.

## Background

Foodborne pathogens are transmitted by consuming contaminated food or other unsafe behaviors (Jong, et. al., 2008). The five most common foodborne pathogens are *Salmonella*, *Escherichia coli* O157, *Shigella*, Norovirus and Hepatitis A (Mayrhofer, et. al., 2004). Each of these foodborne pathogens contaminate the food in different ways. For example, *Salmonella* is commonly found in raw chicken. In fact, it is estimated that 1 in every 25 packages of raw chicken in a grocery store is infected with *Salmonella* (Centers for Disease Control and Prevention, 2023). Cooking raw chicken below the recommended temperature can cause the *Salmonella* bacteria to survive on the chicken and enter a human body once it is consumed (Pas, et. al., 2012). Another example is Hepatitis A, which is transmitted via the fecal-oral route (Bidawid, et. al., 2000). Essentially, transmission occurs when an individual uses the restroom and does not wash his or her hands afterwards and or before touching and preparing food (Bidawid, et. al., 2000). This process will contaminate the food with fecal matter and thus infect a susceptible individual once he or she consumes it.

The Food and Drug Administration identified five categories that are directly linked to and commonly cause foodborne illness: poor personal hygiene of food handlers, inadequate cooking temperatures of food, improper holding temperatures of food, cross-contamination, and obtaining food from unsafe sources (Center for Food Safety and Applied Nutrition, 2022). While simple steps can be taken to address these categories and ultimately prevent these five most common foodborne pathogens, and countless others, they are not always taken.

In order to ensure these critical steps are taken, health authorities conduct routine inspections of food establishments. These inspections vary depending on each health authority, but nonetheless their ultimate goal is to identify potential risks that will lead to foodborne

illnesses and prevent them from happening (Nwako, 2017). The Southern Nevada Health District annually conducts inspections on every permitted food establishment in Clark County (Southern Nevada Health District, 2019). During this inspection, environmental health specialists look for potential risks to foodborne illness, address and correct the concern, and provide education to the people in charge of the establishment. All food establishments are required to be inspected, at minimum, once a year. However, inspection frequency is dependent on the amount of risk in the establishment's operations. The higher the risk of foodborne illness based on operations, the more frequent inspections are conducted (Southern Nevada Health District, 2019). This process ensures environmental health specialists do not spend unnecessary time on low-risk operations and prioritize more time on establishments that could be at higher risk of causing a foodborne illness case or even an outbreak.

SNHD categorizes their food establishments by risk category. The purpose of these risk categories is to assign a degree of risk based on the operations of the food establishment. Risk categories are assigned from numbers one to four. A risk category one is defined as a food establishment that conducts no open food handling and only serves prepackaged items. Examples of permits qualifying for this risk category are convenience stores (excluding the snack bars) and vending machines. Risk category two is defined as food establishments that openly handle foods but do not cool foods down. Examples of permits qualifying for this risk category are snack bars, most sandwich shops, and ice cream shops. Risk category three food establishments are defined by open food handling and cooling any temperature-controlled foods. The majority of full-service restaurants would meet the characteristics of a risk category three food establishment. The cooling process is the distinguishing factor between risk category two and three because it is a complicated, risky process. Failing to comply with either the set temperature or timing

parameters when cooling foods highly increases the risk of foodborne illness. Lastly, a risk category four is defined by a food establishment participating in high-risk, special processes. These special processes can range from cooking and cooling inside of a bag (sous vide), vacuum-sealing food, or processing food for retail sale.

SNHD has a team of environmental health specialists that are trained to conduct inspections and identify violations observed out of compliance. There are a total of 32 categories in the SNHD food establishment inspection report. See Appendix A for a complete list of the categories. Each of these categories represents a type of violation that can be found during an inspection. For example, a violation number six represents a violation of adulterated, spoiled, or damaged food. Each of these categories aims to identify potential violations that can eventually lead to foodborne illness. These categories are further broken up into three classifications: critical violations, major violations, and good food management practices (GMP). During an inspection, the environmental health specialist is tasked with marking whether each category is in compliance, out of compliance, not observed, not applicable, or repeated from the last inspection. Violations marked out of compliance can result in demerits. Critical violations are worth 5 demerits each, major violations are worth 3, and GMPs do not carry demerits. The demerits received during an inspection ultimately determine the grade the food establishment will receive. An establishment can only receive up to 10 demerits and still maintain their "A" grade. A grade of 11 to 20 demerits results in a "B" downgrade. A grade of 21 to 40 demerits results in a "C" downgrade and may require a fee to be paid. An inspection that results in 41 or more demerits results in complete closure of the establishment and a fee to be paid prior to re-opening. Closures can also occur if an environmental health specialist observes the food establishment operating under unsafe conditions; these conditions are referred to as Imminent

Health Hazards. For example, a complete lack of hot water warrants a closure of the establishment until it is repaired, even if other food safety aspects are in compliance. See Appendix B for a complete list of Imminent Health Hazards. If an inspection results in a downgrade or closure, the establishment is required to undergo and pass a new inspection, referred to as a reinspection, within 15 business days. If the establishment passes the reinspection, they obtain their "A" grade once again. Failing a reinspection can result in further fees, downgrades or closures (Southern Nevada Health District, 2023).

Apart from potentially being fined or closed down, food establishments have more reasons to pass all of their inspections. A history of failed inspections can place facilities in what is known as the Administrative Process. This is a long process of increased frequency of inspections, with a risk of potentially having their SNHD health permit permanently revoked as well as losing their right to ever obtain another SNHD health permit. The process develops in steps, beginning with a 3-4 inspection a year requirement, evolving to the requirement of staff to obtain a higher certification for food safety, to even the requirement of hiring an external food safety consultant. In short, these inspections determine not only immediate fines and closures but also long-term financial and overall business consequences (Southern Nevada Health District, 2023).

The benefit of these inspections is that they create accountability with food establishments. SNHD conducts unannounced inspections and provides a grade and potentially a fee if there are several violations to correct. This process allows for greater food safety and ultimately aims to prevent foodborne illness from occurring. Nonetheless, like many other processes, the COVID-19 pandemic and regulations impacted inspections in Southern Nevada. When the pandemic first struck Southern Nevada, government officials attempted to control the

spread by implementing new policies and procedures. The Nevada Governor's office issued mandates for social distancing guidelines, mask requirements, and ultimately ordered for non-essential businesses to be shut down and cease operations (State of Nevada, 2020). These new regulations and recommendations along with the influx of new information regarding how to prevent COVID-19 changed individual's behaviors and thus changed food establishments overall. Business owners had to adapt to new challenges such as finding ways to accommodate social distancing, running their operations with limited staff and resources and in some cases, changing their business models in order to fall under the umbrella of essential businesses.

While businesses transferred to no dine-in/curbside only services, SNHD continued to conduct inspections to ensure the safety of the food that was being given to customers. Even under the new circumstances, food establishments were required to adhere to the same level of food safety as previous years. Environmental health specialists continued to look for the same risk factors.

The Center for Disease Control and Prevention reported a 26% decline in reported foodborne illness trends across the United States during the COVID-19 pandemic (Centers for Disease Control and Prevention, 2021). However, the CDC stated that this decline may have been a result of individuals simply choosing not to obtain treatment due to fear of being in a healthcare setting during the pandemic (Centers for Disease Control and Prevention, 2021). During the midst of the COVID-19 pandemic, the public was instructed to stay home as much as possible. A combination of this instruction and simply overall fear of becoming infected in a healthcare setting made it less likely for individuals to seek treatment for non-COVID-19 related conditions. Unless an individual visits a healthcare provider and is tested and diagnosed with a

foodborne illness, that occurrence does not get reported. Thus, it is likely that foodborne illnesses were underreported, and foodborne outbreaks went completely undetected during this period.

This study provided innovative insight on food safety in Southern Nevada and in other regions across the United States. The SNHD food regulations are modeled after the FDA model food code, as are many health department regulations around the country. Thus, the results are generalizable to areas that follow this model and had similar COVID restrictions. There is a constant flow of research studying foodborne illnesses and the impact that different factors have on their incidence. However, research on foodborne illness trends is often conducted by analyzing reported illnesses, meaning a large portion of illness could be potentially unaccounted for. There is a limitation on these kinds of studies because foodborne illnesses are not always reported or even diagnosed for a variety of reasons, as previously mentioned (Newman, 2015). Rather than looking at the illnesses themselves, this study focused on looking at the risk factors that are directly linked to foodborne illness. This allowed for adequate analysis of existing data since inspection reports were set up identically before and after COVID-19 reached the region. It was important to compare this data to identify potential increases or decreases in violations under the new circumstances. This information provides the public with knowledge on potential concerns or advantages of operating during the COVID-19 pandemic circumstances.

## Objectives

The objective of this study was to compare the food safety violations seen prior to and after the COVID-19 pandemic response was initiated in Clark County. This study analyzed total violations assessed prior to and during the pandemic. The aim of this study was to assess any potential changes observed during routine inspections and identify what categories of risk factors these changes most frequently occurred in.

**Research Questions**

1) Did the COVID-19 pandemic and the new policies implemented due to it increase or decrease the number of food safety violations observed during routine inspections conducted by the Southern Nevada Health District?
2) What types of violations (critical, major or good food management practices) were observed at higher rates after the pandemic control measures were implemented in Clark County?
3) What types of violations (critical, major or good food management practices) were observed at lower rates after the pandemic control measures were implemented in Clark County?

**Hypotheses**

$H1_o$: The COVID-19 pandemic and policies did not change the mean total violations observed during routine inspections conducted by the Southern Nevada Health District.

$H1_a$: The COVID-19 pandemic and policies did change the mean total violations observed during routine inspections conducted by the Southern Nevada Health District.

H2o: The COVID-19 pandemic and policies did not change the mean total critical violations observed during routine inspections conducted by the Southern Nevada Health District.

H2a: The COVID-19 pandemic and policies did change the mean total critical violations observed during routine inspections conducted by the Southern Nevada Health District.

H3o: The COVID-19 pandemic and policies did not change the mean total major violations observed during routine inspections conducted by the Southern Nevada Health District.

H3a: The COVID-19 pandemic and policies did change the mean total major violations observed during routine inspections conducted by the Southern Nevada Health District.

H4o: The COVID-19 pandemic and policies did not change the mean total good food management violations observed during routine inspections conducted by the Southern Nevada Health District.

H4a: The COVID-19 pandemic and policies did change the mean total good food management violations observed during routine inspections conducted by the Southern Nevada Health District

## Methods

We analyzed inspection reports of routine food establishments inspections from 2019 and 2020. As previously mentioned, food establishments are often inspected more than once by SNHD environmental health specialists. These frequented food establishments were only included once for each time period during the analyzing of the reports. To ensure this, only the first routine, unannounced inspection prior and after the pandemic response initiation was analyzed. Subsequent re-inspections were excluded as they were not independent observations but rather dependent on a downgrade during the first inspection. Other routine, unannounced inspections conducted in the year were also not included. Furthermore, there were strict inclusion and exclusion criteria of food establishment inspection reports, listed below.

To determine whether there was a change before and after the COVID-19 pandemic, the included food establishment inspection reports were analyzed and compared for changes in pre-pandemic response scores versus post-pandemic response scores. Because facilities were only included if they had an inspection in 2019 AND in the analysis period of 2020, we ensured new facilities and closed facilities did not impact the overall mean of violations, because restaurant types in both periods were identical.

Pre- to post-score differences were first assessed for normality using the Shapiro-Wilk test and by examining measures of skewness and kurtosis. To test for differences from "0" (i.e., scores that were equal pre-to-post), we calculated 95% confidence intervals using both normal theory and using bootstrap resampling statistics. In this scenario, confidence intervals not containing the value "0" would be considered statistically significant at the $\alpha = 0.05$ level. To account for potential departures from normality, n = 10,000 resamples were utilized to calculate bootstrap intervals.

**Inclusion and Exclusion Criteria**

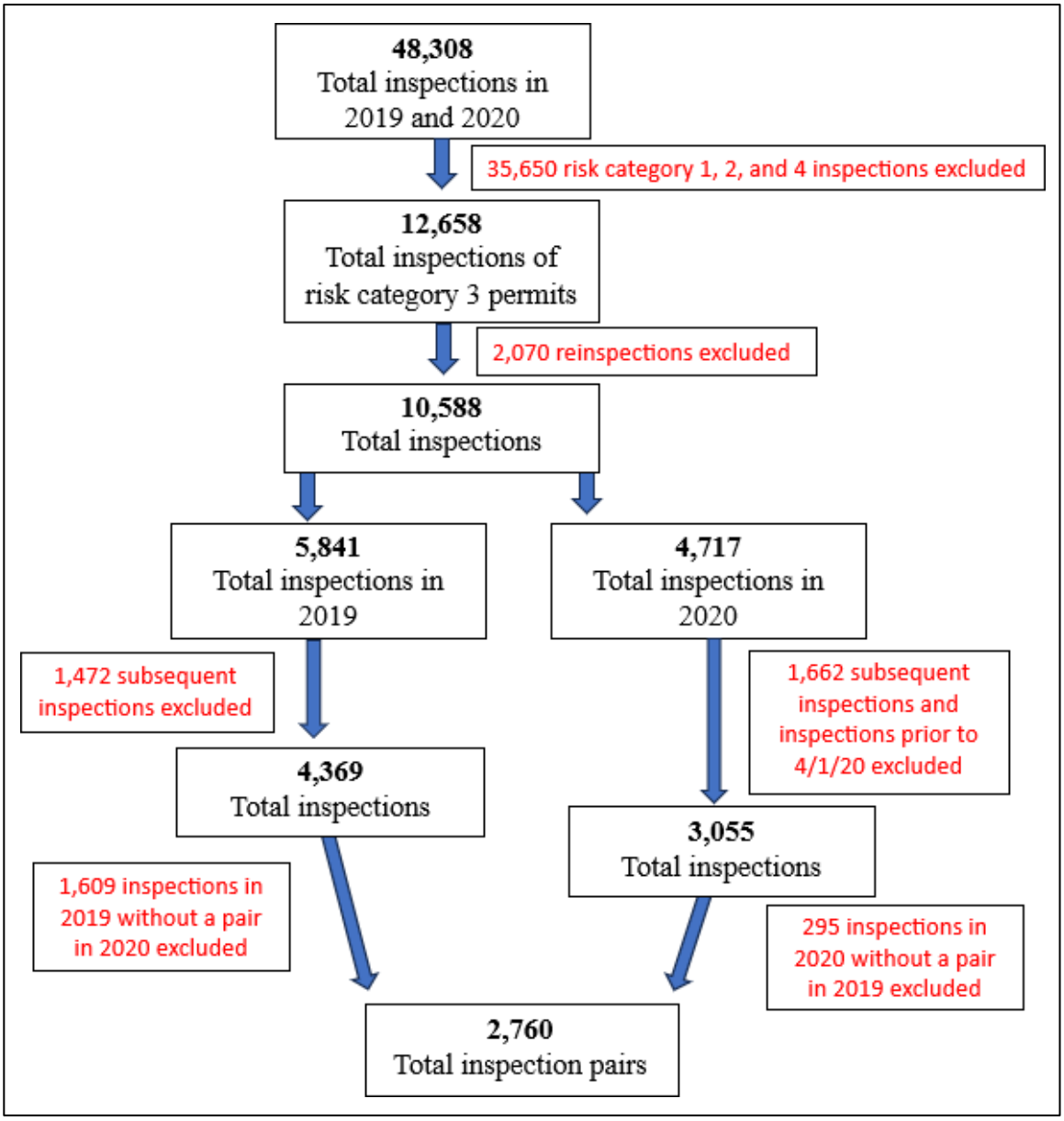
In order to accurately depict the changes observed between food establishment inspections, there were specific inclusion and exclusion criteria for inspection reports. To ensure accuracy of comparison between food establishments, only restaurants categorized as a risk category three were analyzed. Any food establishments that were categorized as a risk category 1, 2, or 4 were excluded. This ensured data from food establishments with similar risk were assessed. A risk category 1 or 2 establishment would have had several violation categories marked as "not observed" or "not applicable" simply due to the operations conducted. This means that these establishments were less likely to have any changes because their operations were low-risk and limited in 2019 and in 2020, regardless of the pandemic. Risk category 4 establishments had highly specialized processes that were not applicable to other establishments. This meant that comparing only risk category 3 establishments gave the best, accurate overview of violations prior to and after the pandemic reached Clark County. Inclusion criteria for establishments were risk category 3 establishments as well as an inspection conducted in 2019 and another inspection conducted from April 1st to December 31st of 2020. Providing a timeframe of April 1st to December 31st of 2020 ensured results did not include establishments that had inspections prior to the initiation of the COVID-19 response. Furthermore, if a facility did not obtain a routine inspection in the year 2019 or the analysis period of 2020, the establishment was excluded. Lastly, as previously mentioned, all reinspections or secondary inspections were excluded.

## Results

There were 48,308 inspections conducted in 2019 and 2020. After removing inspections of risk categories one, two, and four, 12,658 inspections remained. After removing reinspections, 10,588 inspections remained; of these, a total of 5,841 and 4,717 inspections were conducted in 2019 and 2020 respectively. After removing subsequent inspections for each establishment, a total of 4,369 remained in 2019. After removing inspections conducted prior to April 1st, 2020, as well as subsequent inspections of each establishment, a total of 3,035 inspections remained in the 2020 analysis period. Finally, after removing establishments that had inspections in 2019 but not in the analysis period of 2020 or vice versa, 2,760 inspections remained in each year with an overall total of 5,520 inspections analyzed for this study. Each of the 2,760 facilities had a pre and post pandemic response violation score. A full breakdown of inspections is shown below in **Figure 1.**

Figure 1

Flow Chart Breakdown of Inspections



In all cases, data did not meet the assumption of normality using the Shapiro-Wilk test. However, only two (i.e., total violations and major violations) had kurtosis measures that were out of a desired range of +2 (**Table 1**). Therefore, data were examined using both normal theory and using bootstrap resampling to account for potential violations of normality.

**Table 1.** Statistics for assessing normality of violation type.

| Violation Type | Skewness | Kurtosis | SW Test Statistic | p-value |
|---|---|---|---|---|
| Total | 0.153 | 2.296 | 0.963 | < 0.001 |
| Critical | 0.120 | 1.419 | 0.915 | < 0.001 |
| Major | -0.014 | 2.401 | 0.947 | < 0.001 |
| GMP | 0.027 | 0.605 | 0.960 | < 0.001 |

Descriptive statistics demonstrated a mean difference pre-to-post pandemic range of a low of 0.071 (critical violations) to a high of 0.399 (total violations). Both parametric and bootstrap methods were significant in all cases (**Table 2**).

*Hypothesis 1 Results*

The mean change in total violations from 2019 to 2020 was an increase by 0.399. The greatest noted decrease in an individual facility score from 2019 to 2020 was -18 violations while the greatest increase in scores was 15. A total of 1,277 facilities improved their scores, 515 facilities maintained their scores, and 968 facilities decreased their scores (**Table 3**).

*Hypothesis 2 Results*

The mean change in Critical violations was an increase by 0.071. The greatest noted decrease in an individual facility score from 2019 to 2020 was -5 violations while the greatest increase in scores was 5. A total of 834 facilities improved their scores, 1,213 facilities maintained their scores, and 713 facilities decreased their scores (**Table 3**).

*Hypothesis 3 Results*

The mean change in Major violations was an increase by 0.200. The greatest noted decrease in an individual facility score from 2019 to 2020 was -10 violations while the greatest increase in scores was 9. A total of 1,096 facilities improved their scores, 847 facilities maintained their scores, and 817 facilities decreased their scores (**Table 3**).

*Hypothesis 4 Results*

The mean change in Good Food Management Practice violations was an increase by 0.127. The greatest noted decrease in an individual facility score from 2019 to 2020 was -7 violations while the greatest increase in scores was 6. A total of 1,029 facilities improved their scores, 857 facilities maintained their scores, and 874 facilities decreased their scores (**Table 3**).

All categories (total, critical, major, and good food management practices) demonstrated a change from pre-pandemic response scores to post-pandemic response scores. All changes, based on parametric and bootstrap methods, demonstrated statistical significance. All null hypotheses were rejected.

**Table 2.** Descriptive statistics and 95% confidence intervals for each violation type.

| **Violation Type** | **Descriptive Statistics** | | | | | **95% Confidence Interval** | |
|---|---|---|---|---|---|---|---|
| | **Mean** | **SD** | **Median** | **Min** | **Max** | **Normal** | **Bootstrap** |
| Total | 0.399 | 3.0549 | 0 | -18 | 15 | (0.2849, 0.5129) | (0.2855, 0.5138) |
| Critical | 0.071 | 1.0978 | 0 | -5 | 5 | (0.0297, 0.1116) | (0.0290, 0.1127) |
| Major | 0.200 | 1.7646 | 0 | -10 | 9 | (0.1338, 0.2655) | (0.1348, 0.2652) |
| GMP | 0.127 | 1.5397 | 0 | -7 | 6 | (0.0697, 0.1846) | (0.0688, 0.1851) |

**Table 3.** Distribution of change in number of violations from 2019 to 2020.

| | **Decreased Score (-)** | **Maintained Score (0)** | **Increased Score (+)** |
|---|---|---|---|
| All Violations | 968 (35%) | 515 (18.7%) | 1277 (46.3%) |
| Critical | 713 (25.8%) | 1213 (44%) | 834 (30.2%) |
| Major | 817 (29.6%) | 847 (30.7%) | 1096 (39.7%) |
| GMP | 874 (31.7%) | 857 (31%) | 1029 (37.3%) |

**Figure 2** demonstrates the distribution of change in number of violations from 2019 to 2020. Facilities with decreased scores meant they had more violations in the respective violation category during their 2020 inspection compared to their 2019 inspection. Facilities with maintained scores had the same number of violations in their 2019 inspection as their 2020 inspection. Finally, facilities with increased scores had less violations in their 2020 inspection compared to their 2019 inspection. Each violation type resulted in a different distribution of change. The category of all violations demonstrated to have the highest number of facilities with improved scores, and the lowest number of facilities with maintained scores. Critical violations had the highest number of facilities with maintained scores and the lowest number of facilities with decreased scores. Major violations had the highest number of facilities with increased scores, and the lowest number of facilities with decreased scores. Finally, GMP violations had the highest number of facilities with increased scores and the lowest number of facilities with maintained scores.

Figure 2

Distribution of Change in Number of Violations from 2019 to 2020

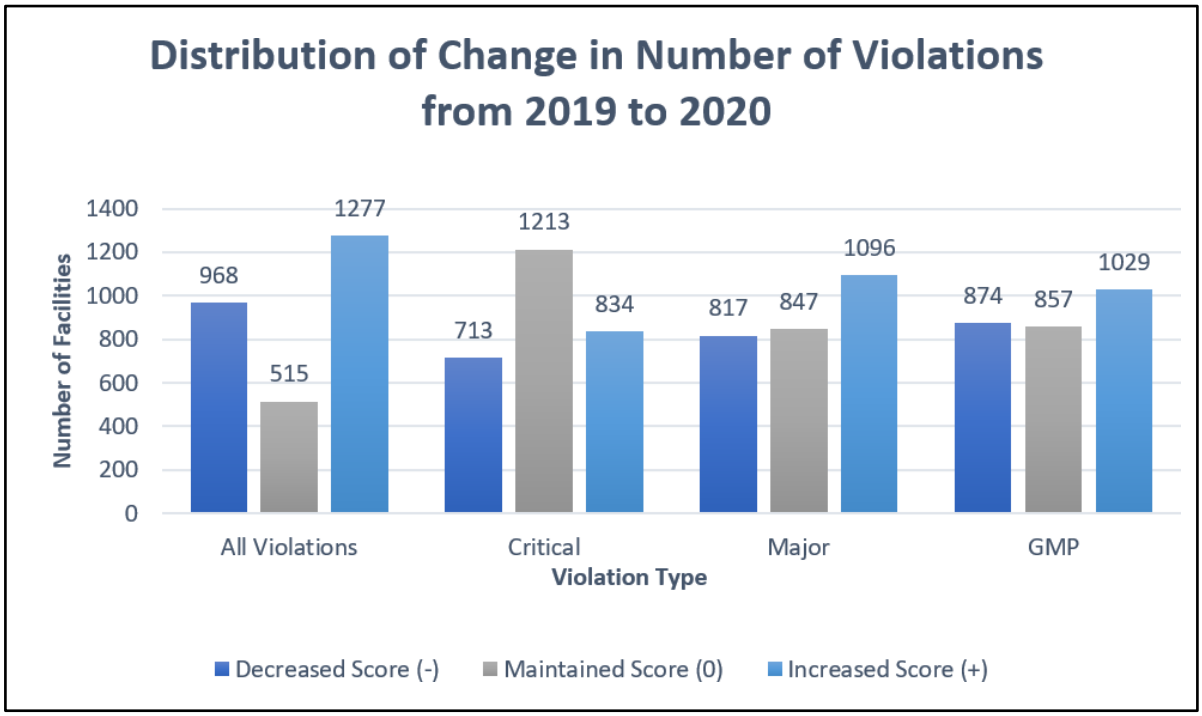



**Table 4** demonstrates the number of facilities that had zero violations observed in each category during their 2019 inspection. These facilities can be categorized as the number of facilities that were only able to maintain their scores or worsen their scores in 2020.

**Table 4.** Number of facilities with zero violations observed during their 2019 inspection by violation type.

| Violation Type | Facilities With Zero Violations in 2019 | % |
|---|---|---|
| All Violations | 191 | 0.7 |
| Critical | 1399 | 50.7 |
| Major | 640 | 23.2 |
| GMP | 756 | 27.3 |

While the results demonstrated a statistically significant, but minimal, increase in pre-to-post pandemic scores, there were other potentially important findings. For example, in the all violations category, there were nine establishments that worsened their score by 10 or more violations observed. Of these establishments, there were six violations that were observed out of compliance in every or nearly every 2020 inspection. Contamination violations, hand sink violations, and sanitation violations were observed in 100% (n=9) of those nine inspections with the worst change. Handwashing, employee/customer contamination and facility maintenance violations were observed in 89% (n=8) of those nine inspections with the worst change (**Table 5**). On the contrary, there were 23 establishments that had an improved score of 10 or more violations observed. Thus, once again, more establishments improved scores rather than worsened.

**Table 5.** Frequency of most common violations among establishments with worst scores.

| Violation Number | Violation Description | % of Observed Among the 9 |
|---|---|---|
| 2 | Hand washing as required, no bare hand w/ RTE foods. Foodhandler health restrictions as required | 89% (n=8) |
| 11 | Food protected from potential contamination during storage and preparation. | 100% (n=9) |
| 13 | Food protected from potential contamination by employees and consumers. | 89% (n=8) |
| 14 | Kitchenware & FCS of equip. properly washed, rinsed, san. & air dried. San solution as required. | 89% (n=8) |
| 15 | Handwashing facilities adequate in number, stocked, accessible, and limited to handwashing only. | 100% (n=9) |
| 32 | Facility maintained (floors, walls, ceilings, plumbing, lighting, ventilation, etc.). | 100% (n=9) |

## Discussion

The COVID-19 pandemic response changed many processes for restaurant owners. Nonetheless, they continued to be held to the same standards as they were previously held to. The regulations and inspections for food establishments were maintained equal. Due to this, this study aimed to identify if the external COVID-19 policies and regulations had an impact in the total mean number of violations seen prior to and after implementation.

Total violations, critical violations, major violations, and good food management practices violations were all analyzed to determine if a change occurred. In all instances, a positive change was observed from pre-to-post pandemic scores. This means that in all instances, there were less violations observed after the pandemic response was initiated.

Nonetheless, the level of change differed among the four categories. The category with the highest level of improvement was in total violations, with a 0.399 improvement in scores. However, this category accounted for all violations as equal, as we were simply examining the total number of violations. This means that if a facility received four GMP violations in 2019, and one critical violation in 2020, they scored as +3 which presented as an improved score. However, this does not constitute an actual improvement in food safety because the level of risk associated with any GMP violation is much lower than with a critical violation. Thus, the total violations category does not account for food safety risk.

The lowest level of improvement was observed in critical violations, with a 0.071 improvement in scores. As previously mentioned, critical violations are the ones that carry the most amount of risk, and thus are worth the most amount of demerits. If a facility obtains a single critical violation during an inspection, they can only obtain one more critical or major violation before failing their inspection. This is because one critical violation is worth 5 demerits,

and a facility can only obtain 10 demerits and still maintain their "A" grade. Due to this fact, it is logical that the least amount of change was seen in critical violations. If a facility had a significantly worse score in critical violations, this would mean the 2020 inspection resulted in a downgrade.

Nonetheless, all categories showed an improvement that was statistically significant. The important portion to mention from these results is that none of the categories demonstrated a large improvement, or even full point-worth (i.e. one violation) of improvement. This calls to address the relevancy of the results. Having less than a single violation worth of improvement across all categories means that of all the analyzed inspections, this noted improvement would likely not have even resulted in an improvement in the overall inspection graded score. While improvement was noted, a less than one point improvement across all categories may not prove to have a large importance when discussing whether or not the COVID-19 pandemic response truly improved food safety inspection results.

Apart from the improvement of scores, it is also important to note the overall distribution of change in number of violations by category. When analyzing total violation changes, the majority of facilities improved their scores while the lowest number maintained scores. This could be due for a number of reasons but may possibly be due to the previously mentioned concern of only accounting for the total number of violations and not the risk associated with the violation. This would explain why there were few facilities that maintained their score and more that either improved or worsened their scores. Furthermore, it is important to note that if a facility received zero violations on their 2019 inspection, their score would be 0. This would mean that a facility would be unable to improve, as they scored the best possible score. Their only options would be to worsen or maintain their score. As shown in **Table 4**, approximately

50% of all facilities had no critical violations observed during their 2019 inspection; therefore 50% of all facilities could only maintain or decrease their scores in 2020.

Critical violations demonstrated the highest facilities with maintained scores and the least amount of facilities with decreased scores. As previously stated, if a facility worsened their critical violation score by -3, that change in it of itself would warrant a downgrade as a -3 translates to 15 demerits (B downgrade). Nonetheless, the difference between increased scores and decreased scores for critical violations was only 4.4%. This means that when examining critical violations, there was very minimal change.

Major violations had the highest number of facilities with increased scores. Decreased and maintained scores were nearly equal, with only 1.1% more facilities demonstrating a maintained score. This means that major violations had the most relevant increase in score. While their scores only increased by 0.2, the distribution of these changes were more heavily distributed on improved scores rather than worsening or maintained scores.

Lastly, GMPs demonstrated having the highest number of facilities with increased scores and the lowest number of maintained scores. However, the difference between decreased scores and maintained scores for GMPs was less than 1%. Once again, the change of 0.127 improvement, while minimal, was likely the most accurate depiction of improvement. Nonetheless, because these violations are considered maintenance, low risk violations, the impact on food safety was even more minimal.

Ultimately, results showed that there was a minimal yet statistically significant improvement among all categories of violations. This means that statistically speaking, there were less violations seen in 2020 compared to 2019. However, this improvement could be a result of other factors. A part of the inspection process is to educate establishments on the

violations that were observed out of compliance, with the expectation that establishments will learn from the noted violations and improve during the next inspection. Thus, a level of improvement from one inspection to another is not only the intention but also expected. The COVID-19 pandemic interrupted and changed many processes, but not the food safety inspection process. Due to this, the data from prior and post-pandemic inspections shows the pandemic did not negatively impact the safety of the food distributed in Southern Nevada food establishments. To further investigate this topic and identify potential specific violations that were negatively impacted by the pandemic, a further analysis of each violation (1-32) could be conducted to obtain directional changes.

**Limitations**

There were several limitations to this study. The first and most evident limitation is that inspections are conducted by different environmental health specialists. Due to this, there is the natural potential for human error. One environmental health specialist may be more likely to observe and note violations than another. However, to aid this, SNHD trains each environmental health specialist and maintains their training through the process of standardization. When a new environmental health specialist is hired, they are required to go through a six-month long training where they are tasked with observing core trainers conduct inspections, then jointly conducting inspections with core trainers, and finally being signed off to do independent inspections. Trainees are required to reach a certain number of successful inspections in each risk category prior to sign off. This ensures all environmental health specialists can conduct a full inspection up to regulation standards regardless of the operations existing. There are certain skills that are assessed in order to be signed off to be independent. Trainers observe for ability to identify violations, correct violations, multi-task, maintain awareness of active operations surrounding the inspector, and overall, the ability to conduct an inspection from start to finish independently.

Once an environmental health specialist is signed off to be independent, there are several measures that are taken to ensure they continue to maintain their skills. Not only do environmental health specialists frequently inspect in pairs of their peers, but they are also required to inspect alongside their supervisors on a quarterly basis. This ensures there is adequate oversight over each inspector on a regular basis. Furthermore, on a more formal basis, environmental health specialists are required to go through a process known as standardization every three years. Standardization is a process where each environmental health specialist is paired with a training officer and a supervisor, other than their own, and is observed conducting

multiple inspections on different establishments. If there is an excess of discrepancies between what the environmental health specialist observed out of compliance and what the training officer or supervisor observed, the environmental health specialist must undergo a new training process and pass standardization to ensure they can meet the standard of inspections (Southern Nevada Health District, 2023). This entire process aims to ensure that variability between different environmental health specialists is minimal.

Another limitation is that overall business structures changed during the COVID-19 pandemic. According to the National Restaurant Association, the COVID-19 pandemic impacted the restaurant industry so severely that establishments reported being unable to maintain the same operations due to limited staff and lack of food supply or increase in food cost (National Restaurant Association, 2022). Due to this, it is likely that establishments lessened their operations during the COVID-19 pandemic. Thus, while we compared the same establishment's pre-to-post pandemic scores, we cannot ensure that the establishments continued to perform the same operations pre-to-post pandemic.

## Conclusion

Food safety is an important topic for the health of the community. When public emergencies occur, it is important to create, adapt, or maintain structures that will enable the community to continue to thrive. The COVID-19 pandemic created an emergency environment where individuals and businesses quickly had to learn to adapt. At this time, the focus was highly emphasized on respiratory illnesses and symptoms. Nonetheless, with substantial changes, the rest of our operations continued to progress. Consequently, other illnesses continued to progress as well. While the focus may shift to whichever disease has rising incidence at the time, the goal as public health professionals is always to decrease morbidity of any illness. It is crucial to study the impact that emergency situations, mandates, and regulations have on other illnesses.

Foodborne illnesses specifically will always pose a risk simply because of the mode of transmission. Even in emergency situations, everyone will continue to consume food and beverages. These pathogens are naturally occurring in our food and thus we will always be at risk if proper behaviors are not maintained. The advantage of this form of foodborne illness research is that food establishments are heavily regulated by the Southern Nevada Health District. This means that data was available for any point before or after the pandemic. These reports were not impacted by a lack of seeking care as seen in foodborne illness reporting. Instead, they were conducted, at minimum, annually and provided insight on real-world risk factors contributing to foodborne illness.

The results demonstrated that there was an overall improvement in the mean number of violations prior to and after the pandemic response was initiated. This improvement ranged from 0.071 to 0.399. While this improvement is statistically significant, it is less than one, or one violation. This means that the relevance of this improvement in regard to determining whether

the COVID-19 pandemic response truly impacted food safety may be minimal. Furthermore, the distribution of change among the violation categories demonstrated that the most relevant change was the 0.20 improvement observed in major violations. While the improvement is so minimal, it is an accurate depiction of improvement in food safety because major violations measure safety over maintenance. The idea that this 0.20 improvement in major violations would warrant an action for the future is unlikely. Nonetheless, the study did provide information on the violations observed after the COVID-19 pandemic response was initiated. It also identified violations in the extremely worsened facilities that provided insight on potential issues that were observed after the COVID-19 pandemic response. While this information is only relevant to a small number of the 2,760 facilities that were analyzed, it could provide useful information on food safety gaps.

While the overall importance in determining the significant changes observed during the COVID-19 pandemic may not be large enough to guide future preparations, the extremes of these results may provide useful insight. Nonetheless, further analysis of this topic is recommended in order to further address directional changes of each violation. Ensuring to address food safety in emergency situations will reduce the number of foodborne illness cases and outbreaks around the country.

## Appendices

*Appendix A - Critical, Major, and Good Food Management Practice Violations*

| | |
|---|---|
| **SECTION 1 - The Critical Violations listed below are to be assessed 5 demerits for each violation** | |
| 1 | Verifiable time as a control with approved procedure when in use. Operational plan, waiver or variance approved and followed when required. Operating within the parameters of the health permit. |
| 2 | Handwashing (as required, when required, proper glove use, no bare hand contact of ready to eat foods). Foodhandler health restrictions as required. |
| 3 | Commercially manufactured food from approved source with required labels. Parasite destruction as required. Potentially hazardous foods/time temperature control for safety (PHF/TCS) received at proper temperature. |
| 4 | Hot and cold running water from approved source as required. |
| 5 | Imminently dangerous cross connection or backflow. Waste water and sewage disposed into public sewer or approved facility. |
| 6 | Food wholesome; not spoiled, contaminated, or adulterated. |
| 7 | PHF/TCSs cooked and reheated to proper temperatures. |
| 8 | PHF/TCSs properly cooled. |
| 9 | PHF/TCSs at proper temperatures during storage, display, service, transport, and holding. |
| **SECTION 2 - The Major Violations listed below are to be assessed 3 demerits for each violation** | |
| 10 | Food and warewashing equipment approved, properly designed, constructed and installed. |
| 11 | Food protected from potential contamination during storage and preparation. |
| 12 | Food protected from potential contamination by chemicals. Toxic items properly labeled, stored and used. |
| 13 | Food protected from potential contamination by employees and consumers. |
| 14 | Kitchenware and food contact surfaces of equipment properly washed, rinsed, sanitized and air dried. Equipment for warewashing operated and maintained. Sanitizer solution provided and maintained as required. |
| 15 | Handwashing facilities adequate in number, stocked, accessible, and limited to handwashing only. |
| 16 | Effective pest control measures. Animals restricted as required. |
| 17 | Hot and cold holding equipment present; properly designed, maintained and operated. |
| 18 | Accurate thermometers (stem & hot/cold holding) provided and used. |
| 19 | PHF/TCSs properly thawed. Fruits and vegetables washed prior to preparation or service. |
| 20 | Single use items not reused or misused. |
| 21 | Person in charge available and knowledgeable/management certification. Foodhandler card as required. Facility has an effective employee health policy. |
| 22 | Backflow prevention devices and methods in place and maintained. |
| 23 | Grade card and required signs posted conspicuously. Consumer advisory as required. Records/logs maintained and available when required. NCIAA compliant. PHFs labeled and dated as required. Food sold for offsite consumption labeled properly. |
| **SECTION 3 - Good Food Management Practices to Prevent Unsanitary Conditions** | |
| 24 | Acceptable personal hygiene practices, clean outer garments, proper hair restraints used. Living quarters and child care completely separated from food service. |
| 25 | Non-PHF and food storage containers properly labeled and dated as required. Food stored off the floor when required. Non-PHF/TCS not spoiled and within shelf-life. Proper retail storage of chemicals. |
| 26 | Facilities for washing and sanitizing kitchenware approved, adequate, properly constructed, maintained and operated. |
| 27 | Appropriate sanitizer test kits provided and used. Equipment and ware washing thermometer(s) are required. Wiping cloths and linens stored and used properly. |
| 28 | Small wares and portable appliances approved, properly designed, in good repair. |
| 29 | Utensils, equipment, and single serve items properly handled, stored, and dispensed. |
| 30 | Nonfood contact surfaces and equipment properly constructed, installed, maintained and clean. |
| 31 | Restrooms, mop sink, and custodial areas maintained and clean. Premises maintained free of litter, unnecessary equipment, or personal effects. Trash areas adequate, pest proof, and clean. |
| 32 | Facility in sound condition and maintained (floors, walls, ceilings, plumbing, lighting, ventilation, etc.). |

(Southern Nevada Health District, 2013)

*Appendix B - Imminent Health Hazards*

| Imminent Health Hazards-Notify SNHD and Cease Operations as Directed | |
|---|---|
| A | Interruption of electrical service |
| B | No potable water or hot water |
| C | Gross unsanitary occurrences or conditions including pest infestation |
| D | Sewage or liquid waste not disposed of in an approved manner |
| E | Lack of adequate refrigeration |
| F | Lack of adequate employee toilets and handwashing facilities |
| G | Misuse of poisonous or toxic materials |
| H | Suspected foodborne illness outbreak |
| I | Emergency such as fire and/or flood |
| J | Other condition or circumstance that may endanger public health |

(Southern Nevada Health District, 2013)

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