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RESEARCH PAPER

Assessing Food Safety Practices in the Era of COVID-19: A Cross-Sectional Analysis of Restaurant, Retail, and Hotel Sectors in Muscat Governorate, Oman

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تقييم ممارسات سلامة الغذاء في عصر كوفيد19-: تحليل مقطعي لقطاعات المطاعم والتجزئة والفنادق في محافظة مسقط، عمان

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Abstract. This study evaluated the adherence of food retailers, restaurants and hotels in Muscat Governorate to the precautionary measures to control the spread of COVID-19. This study found that only 18% of hotels implemented a Food System Management System (FSMS) while no restaurant or retailer implemented any FSMS. The majority of food retailers (89%) and restaurants (96%) did not conduct COVID-19 measures assessment while the assessment was conducted by 53% of caterers. All caterers assessed visitors/suppliers on COVID-19 symptoms and 94% of them kept details in a record book, followed by 96 and 76 %, respectively in retailers and restaurants. Safety distancing measure, signs, barriers and one-way system were implemented by different food establishments at different percentages. Covid-19 pandemic resulted in several changes in the food hygiene-related practices, such as hands sanitizing, wearing gloves and wearing masks. In conclusion, the overall adherence level of the food establishments toward health and symptoms monitoring, physical distancing, and face mask wearing was relatively high. The Era resulted in the introduction of hygienic practices that have been always recommended in the food service sector.

Keywords: Food safety, COVID-19, Hygiene, GMP, Pandemic, food handlers; occupational health

الخلاصة: قامت هذه الدراسة بتقييم مدى التزام المتاجر والمطاعم والفنادق في محافظة مسقط بالإجراءات الاحترازية للسيطرة على انتشار كوفيد-١٩. ووجدت الدراسة أن ١٨٪ فقط من الفنادق قامت بتنفيذ نظام إدارة سلامة الغذاء (FSMS) بينما لم تقم أي من المطاعم أو المتاجر بتنفيذ أي نظام لإدارة سلامة الغذاء. لم تقم الأغلبية العظمى من المتاجر (٨٩٪) والمطاعم (٩٦٪) بإجراء تقييم للإجراءات المتعلقة بكوفيد-١٩، في حين قام ٥٣٪ من الفنادق بإجراء التقييم. قام جميع مقدمي الطعام بتقييم الزوار/الموردين بشأن أعراض كوفيد-١٩ واحتفظ ٩٤٪ منهم بالتفاصيل في سجل، يليهم ٩٦٪ و٧٦٪ على التوالي من المتاجر والمطاعم. على صعيد آخر، تم تنفيذ تدابير التباعد الآمن، والإشارات، والحواجز، ونظام الاتجاه الواحد من قبل مختلف منشآت الطعام بنسب متفاوتة. أدت جائحة كوفيد-١٩ إلى إحداث تغييرات عديدة في ممارسات النظافة المتعلقة بالطعام، مثل تعقيم الأيدي، وارتداء القفازات، وارتداء الكمامات. في الختام، كان مستوى الالتزام العام لمنشآت الطعام تجاه مراقبة الصحة والأعراض، والتباعد الجسدي، وارتداء الكمامات مرتفعًا نسبيًا. أسفرت الفترة عن إدخال ممارسات صحية كانت دائمًا موصى بها في قطاع خدمات الطعام

الكلمات الرئيسية: سلامة الغذاء، كوفيد-١٩، النظافة، ممارسات التصنيع الجيدة (GMP)، الجائحة، متعاملو الغذاء، الصحة المهنية

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Introduction

Up to August 9, 2023, COVID-19 resulted in more than 760 million cases and 6.9 million deaths around the world (WHO, 2023). It has been recognized that the symptomatic or asymptomatic food handlers can potentially become significant sources of virus transmission (Thippareddi et al., 2020). To mitigate the risk of COVID-19 transmission, numerous precautionary measures have been recommended. These encompass adherence to Good Manufacturing Practices (GMP) and the implementation of Hazard Analysis and Critical Control Point (HACCP) protocols (Olaimat et al., 2020). Additionally, conducting COVID-19 risk assessments is crucial, as indicated by BSI (2020) and BRCGS (2020). Proper hand hygiene, including thorough hand washing, is emphasized (CDC, 2020a; FAO and WHO, 2020), and there is an emphasis on enhancing access to hand washing facilities (FAO and WHO, 2020). The use of alcohol-based hand sanitizers containing 75% iso-propanol or 80% ethanol (v/v) is recommended. Furthermore, wearing masks and maintaining physical distancing are essential preventive measures (CDC, 2020b; FAO and WHO, 20 20). As part of strategies aimed at preventing and controlling the spread of airborne viruses like the COVID-19 virus, it is essential to implement a robust system of food safety management, such as HACCP, which includes screening and personal hygiene recommendations aligned with CDC and WHO precautionary measures (Zimmerman et al., 2021). Notably, some of these recommended practices were not consistently employed in the food industry sector before the advent of the COVID-19 era, as highlighted by Al-Ghazali et al. (2020). According to de Freitas and Stedefeldt (2020), it is crucial to sustain the new practices adopted during the COVID-19 pandemic. This includes the continued implementation of all safety measures established during the pandemic, along with ongoing adherence to social distancing and rigorous hygiene practices.

In Oman, the initial reports of COVID-19 cases emerged in February 2020, prompting a series of concerted efforts to mitigate the adverse effects of the pandemic. On March 10, 2020, The Sultan Haitham bin Tariq, the Sultan of the Sultanate of Oman, issued directives to establish a committee titled "The Supreme Committee tasked with studying the scopes for a mechanism to address developments resulting from the spread of the coronavirus (Covid-19) pandemic" (Shaddad Al Musalmy, 2021). The committee, chaired by the Minister of Interior and comprising representatives from various governmental units, including the Ministry of Health and the Oman Royal Police (ROP). On March 23, 2020, all retail shops in commercial centers (with the exception of essential businesses) were closed, and food service in restaurants and cafes was limited to take-away orders (Decree.com, 2020a). Subsequently, on May 18, 2020, the ROP was granted the authority to monitor and enforce compliance, with the ability to levy financial penalties and detain individuals for any violations (Decree.com, 2020b). Furthermore, a mandatory face-mask for all public spaces, including workplaces and public transportation, was introduced through Decision 151/2020, dated May 21, 2020 (Official Gazette, 2020a). In June 2020, the Ministry of Labor, formerly known as the Ministry of Manpower at that time, issued Decision 167/2020 (Official Gazette, 2020b). This decision included an increase in fines for violations of the directives established by the supreme committee. These fines were consistent at 100 Omani Rial (approximately $260) each and applied to individuals found not wearing masks, failing to provide sanitizers with a minimum alcohol content of 60%, and lacking proper signage and information pertaining to social distancing and COVID-19 symptoms. These measures exemplify Oman's unwavering commitment to combatting COVID-19 and safeguarding the well-being of its residents.

Furthermore, research indicates that chain restaurants tend to exhibit fewer violations compared to independent restaurants. This trend can be attributed to the presence of quality control programs and internal food safety monitoring systems in chain establishments (Murphy et al., 2011; Harris et al., 2014). Independent res-

taurants, on the other hand, are more frequently cited for critical food safety violations across various districts, which aligns with previous findings.

As such, the objectives of study were to assess the changes in food handling practices at food service establishments in Muscat Governorate resulting from the COVID-19 pandemic, and to evaluate the extent to which these establishments adhere to precautionary measures to control the spread of COVID-19.

Materials and Methods

Target Population and Sample

This study focused on three specific categories within the food service industry: restaurants, food retailers, and hotel catering services. An up-to-date listing of establishments falling into these three categories, situated within Muscat governorate, Sultanate of Oman, was procured through direct communication with Muscat Municipality. Within each of the specified categories, this study included 10% of the available facilities, following specific criteria:

- Restaurants: This category encompassed tourist and international restaurants offering on-site dining. Selected restaurants had to demonstrate a reduced seating capacity to ensure a minimum 2-meter spacing between each table.
- Retailers: Included all retail establishments equipped with food production and/or preparation facilities. This category covered butcheries, bakeries, pastry shops, and any retailing activities with a floor area exceeding 100 square meters where food handlers were engaged in food preparation.
- Hotel Catering: Encompassed all 3- to 5-star hotels equipped with internal meal preparation facilities.

These criteria were rigorously applied to guarantee the selection of a representative sample of facilities from each category for the study. The included samples within each group were chosen through convenient sampling. Convenient sampling was selected due to practical considerations (i.e., accessibility and time constraints). The participants were chosen based on their availability and willingness to participate. Consequently, the study comprised 25 first-class restaurants, 45 food retailers, and 17 hotel catering establishments, all of which were selected to participate in the research.

Data Collection

Data collection was conducted using a structured questionnaire administered through face-to-face interviews with the facility manager or Person-in-charge (PIC). Additionally, on-site observations were employed as part of the data collection process. This data collection phase took place between October and December 2020. The questionnaire is provided as an appendix.

Questionnaire Design

A meticulously structured questionnaire was developed, drawing upon food safety guidelines provided by authoritative sources such as the FAO and WHO (2020) and the FDA (2020). The questionnaire comprised a total of 30 questions, meticulously designed to assess the adherence to safety precautionary measures and to juxtapose food safety and hygiene practices before and after the onset of the COVID-19 pandemic. The survey questions were categorized into six distinct sections as outlined below:

Section A: Obtained information related to the foodservice establishment such as the establishment type (i.e., First class restaurants, Hotel's catering and food retailers), number of customers per day.

Section B: Gathered information on the implementation of food safety management systems.

Section C: Evaluated food handlers' personal hygiene practices and training before and during covid-19.

Section D: Evaluated the adherence to cleaning and sanitization within the establishment.

Section E: Assessed the adherence to physical distancing methods and practices.

Section F: Assessed symptoms screening and monitoring practices

Statistical Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS), version 22.0. Chi-square test was used to assess the association of precautionary measures and establishment types. Friedman and McNemar tests were used for the data comparison before and after the pandemic. P-value of less than 0.05 was considered significant.

Results and Discussion

Food Safety and COVID-19 Management

Table 1 presents the percentages of food establishments that have implemented a Food Safety Management System (FSMS) or conducted a COVID-19 risk assessment. Interestingly, none of the surveyed food retailers and restaurants had implemented an FSMS. Conversely, only 3 out of the 17 caterers (17.6%) had integrated a food safety system such as HACCP into their operations. A statistically significant relationship between the implementation of FSMS and the type of establishment was observed (X2(2) = 7.771, p =0.007).

During personal communication with the participants, it became evident that some barriers hindered the adoption of FSMS. A notable barrier was the lack of knowledge and awareness about these systems. This finding aligns with previous research conducted in food businesses in Turkey, which identified a lack of understanding of HACCP by managers and employees as a primary obstacle to its implementation (Bas et al., 2007). Other barriers may include the cost associated with certification, staff shortages, and time constraints (Maldonado-Siman et al., 2014). It is important to emphasize that FSMS play a critical role in ensuring the production and service of safe food (Panghal et al., 2018).

Notably, a substantial majority of food retailers (89%) and restaurants (69%) did not perform a COVID-19 risk assessment. In contrast, a relatively higher proportion of hotels (53%) had undertaken such assessments. This data underscores the variability in risk assessment practices among different types of food establishments, with hotels showing a greater tendency to conduct COVID-19 risk assessments compared to food retailers and restaurants. A significant association observed between the COVID-19 risk assessment and the type of establishment (X2(2) = 12.264, p =0.002).

Table 1. Implementation of FSMS and risk assessment in food establishments

Food safety indicators	Response (n) %				*p*-value
		Retailers	Restaurants	Hotels	
FSMS	Yes	0	0	3 (17.6)	0.007
	No	45 (100)	24 (100)	14 (82.4)	
COVID-19 risk assessment	Yes	5 (11.1)	8 (31.2)	9 (52.9)	0.002
	No	40 (88.9)	17 (68.8)	8 (47.1)	

FSMS: Food Safety Management System

Table 2 presents data on the frequency of COVID-19 Symptoms Assessment and the presence of COVID-19 awareness posters in food establishments. The majority of the establishments, including 76% of restaurants, 96% of retailers, and 100% of hotel caterers, reported consistently screening visitors and suppliers for COVID-19 symptoms. Furthermore, a significant proportion of restaurants (84%) and caterers (94%) maintained daily logs to document the results of these screenings, whereas only 58% of retailers adopted this practice. Overall, these findings indicate commendable practices across all types of establishments regarding the monitoring of COVID-19 symptoms. Importantly, there was no significant difference in monitoring practices observed based on the type of establishment ($X2(8) = 9.610$, $p = 0.140$). However, a significant association was identified between the type of establishment and the recording of health status data ($X2(2) = 10.514$, $p = 0.005$).

According to the persons-in-charge at these establishments, the absence of body temperature measurement was primarily attributed to a lack of designated personnel responsible for conducting temperature checks and a shortage of screening devices. Additionally, a lack of awareness regarding the importance of temperature screening and the necessity of maintaining records of employee screening status contributed to the absence of data on monitoring practices in some cases.

Observational data revealed that a substantial portion of the establishments had taken proactive measures to raise COVID-19 awareness, with 84% of retailers, 76% of restaurants, and 82% of hotels found to have COVID-19 awareness signs prominently displayed at entrances and workplace areas. Importantly, there was no significant difference in the practice of posting COVID-19 awareness signs among these food service businesses, as demonstrated in Table 2. It is noteworthy that these awareness posters featured multiple languages and dialects, including Arabic, English, Malayalam, Urdu, and Bangali. This inclusive practice serves to disseminate information effectively on COVID-19 to both local residents and the diverse foreign population, contributing to heightened awareness during this critical period.

Table 2. The frequency of COVID-19 Symptoms Assessment and the presence of COVID-19 awareness posters in Food Establishments

Practice	Response n (%)			*P* value*
	Retailers	Restaurants	Catering	
Frequency of symptom assessment				
Never	1 (2.2)	3 (12.0)	0	0.140
Rarely	0	1 (4.0)	0	
often	0	1 (4.0)	0	
Sometimes	1 (2.2)	1 (4.0)	0	
Always	43 (95.6)	19 (76.0)	17 (100)	
Posting COVID-19 Posters				
Yes	38 (84.5)	19 (76.0)	14 (82.4)	0.666
No	7 (15.5)	6 (24.0)	3 (17.6)	

* The *p* value shows the significance between establishments

Hand Hygiene and Sanitizers

Hands play a critical role in the transmission of pathogens, and hand washing is a highly effective preventive measure to mitigate the spread of coronaviruses. Proper hand washing techniques recommended by organizations like the CDC (2020a) and FAO and WHO (2020) are essential. Furthermore, improving access to hand washing facilities and encouraging their use in the workplace is of utmost importance (FAO and WHO, 2020). Table 3 presents data on the availability of hand washing basins and sanitizers. The presence of hand washing stations equipped with hot water, soap, and means of drying was observed in 47% of the retailer premises. Approximately 53% of these establishments were not adequately equipped with hot water and soap before the onset of COVID-19. This may be attributed to the nature of the facilities, with some lacking butchery activities or similar food preparation tasks. In contrast, a substantial proportion of restaurants (92%) and caterers (88%) were already equipped with proper hand washing stations prior to the pandemic. When comparing the availability of well-equipped hand washing stations before and during the COVID-19 pandemic, no statistically significant differences were found among retailers, restaurants, and hotel catering establishments ($p > 0.05$). Given that food handlers are directly involved in various activities that require contact with different surfaces, both food contact and non-contact, the lack of proper hand washing facilities can pose a significant barrier to adhering to appropriate hand hygiene practices (Shahbaz et al., 2020; Soon et al., 2021).

Hand sanitizers with at least 70% alcohol have been recommended as a viable alternative to hand washing (FAO and WHO, 2020). Table 3 also provides insights into the availability of hand sanitizers in various types of establishments both before and during the COVID-19 pandemic and the concentration of alcohols in these sanitizers. Interestingly, there was no significant difference observed in the availability of hand sanitizers (irrespective of alcohol concentration) in restaurants and hotels before and during the pandemic. However, a noteworthy finding is the significant increase ($p = 0.001$) in the availability of hand sanitizers in retailers during this period. Additionally, there were significant increases in the availability of sanitizers with active ingredients (ethanol or isopropanol) in concentrations ranging from 70 to 80% in retailers ($p < 0.001$), restaurants ($p = 0.004$), and caterers ($p = 0.004$) when comparing the pre-COVID-19 and during-COVID-19 periods.

It is important to consider that, as suggested by de Freitas & Stedefeldt (2020), sanitary requirements may not have been consistently enforced in restaurants before the COVID-19 era or may have been interpreted differently in practice. The observed improvements in the availability of hand sanitizers during the pandemic reflect an effort to enhance hygiene practices and align with recommended guidelines.

The U.S. FDA Food Code offers clear guidelines on the prevention of food contamination by workers, emphasizing the importance of avoiding bare-hand contact when handling both Ready-to-Eat (RTE) and non-Ready-to-Eat (non-RTE) food items. This recommendation is rooted in the understanding that hand washing practices alone may not always provide sufficient protection against the transmission of pathogens. To provide an effective barrier, the FDA Food Code suggests the use of hand gloves as one example of a preventive measure (FDA, 2005). These measures are essential to uphold the highest standards of food safety and minimize the risk of contamination in food handling and preparation processes.

Use of Gloves and Face Masks

Contamination has been identified as a primary factor contributing to foodborne illness outbreaks (Raspor, 2008), and using bare hands in food preparation can promote cross-contamination. Table 4 shows the changes in the use of personal protective equipment (PPE) specifically gloves and face masks and the availability of training on using PPE in general before and after the pandemic. A significant difference was observed in the use of gloves by retailers before (80%) and

Table 3. The responses of hand hygiene practices in food retailers, restaurants, and hotels caterings before and during the pandemic

Practice	Establishment type	Before COVID-19		During COVID-19		*p*-value
		Yes (n) %	No %	Yes %	NO %	
Availability of hand washing basins	Retailers	21 (46.7)	24 (53.3)	21 (46.7)	24 (53.3)	1.000
	Restaurants	23 (92.0)	2 (8.0)	24 (96.0	1 (4.0)	1.000
	Hotels	15 (88.2)	2 (11.8)	15 (88.2)	2 (11.8)	1.000
Availability of sanitizer dispensers	Retailers	28 (62.2)	17 (37.8)	40 (89.1)	4 (8.9)	0.001
	Restaurants	23 (92.0)	2 (8.0)	25 (100.0)	0.0	0.500
	Hotels	17 (100.0)	0	(14) 100.0	0.0	1.000
Sanitizers meeting requirement of active ingredients concentration	Retailers	1) (24.4)	34 (75.6)	39 (86.7)	6 (13.3)	<0.001
	Restaurants	15 (60.0)	10 (40.0)	24 (96.0)	1 (4.0)	0.004
	Hotels	8 (47.1)	9 (52.9)	(100.0)	0.0	0.004

after (97%) the pandemic (p = 0.02). In contrast, there were no significant differences in the use of gloves before and after the pandemic in either restaurants or hotel catering establishments. Notably, 100% of the surveyed restaurants and caterers were already employing gloves before the pandemic, indicating a commendable level of compliance with recommended practices even prior to the COVID-19 era.

Research by Yap et al. (2019) has demonstrated higher plate counts in food prepared by bare hands compared to food handled with gloves. Similarly, elevated plate counts have been observed on the hands of food handlers. The study also highlights that changing gloves, in combination with hand washing, can be an effective strategy to minimize cross-contamination. Therefore, while the use of gloves is important, it must be accompanied by strict adherence to proper hand hygiene practices to maintain food safety.

Research investigations have demonstrated that the use of face mask can significantly halt the transmission of viruses (Seto et al., 2003; Leung et al., 2020; Prather et al., 2020). In response to the emergence of the new coronavirus, face masks have gained widespread popularity worldwide as a preventive measure. In response to the emergence of the new coronavirus, face masks have gained widespread popularity worldwide as a preventive measure. The exponential surge in COVID-19 cases has necessitated the widespread adoption of face masks by many individuals. Due to the exponential increase in COVID-19 cases, many individuals were compelled to wear face masks. Before the COVID-19 pandemic, the majority of food handlers in retailers (89%), restaurants (72%), and hotels

(65%) were not using face masks. However, during the COVID-19 pandemic, there was a significant shift in behavior, with nearly all retailers (98%, $p < 0.001$), restaurants (100%, $p < 0.001$), and hotels (100%, $p < 0.001$) adopting the use of face masks.

This high level of adherence to mask-wearing and the use of gloves can be attributed to several factors. Effective awareness campaigns by global organizations and local authorities, along with strict instructions provided to establishments by Muscat Municipality and the Supreme Committee, played a crucial role in promoting these practices. Similar trends were observed in other regions as well. In Brazil, for example, mask-wearing was the most widely adopted preventive measure by the majority of surveyed individuals (94.1%) (Finger et al., 2021). However, it is important to note that, as per the guidance provided by the World Health Organization (WHO, 2020b), while masks are a part of the preventive measures, relying solely on masks is not sufficient to provide comprehensive protection against the novel coronavirus. Proper mask usage should be complemented by other preventive measures such as physical distancing, hand hygiene, and vaccination to reduce effectively the risk of transmission.

However, it is essential to underscore that the effectiveness of glove usage hinges on proper techniques and precautions. If gloves are not worn and handled correctly, they may inadvertently increase the risk of virus transmission, especially if workers fail to avoid touching their faces and mobile devices (Yadav et al., 2020). Additionally, the use of gloves should not replace the crucial practice of hand washing, as over-reliance on gloves can lead to neglect of hand hygiene measures (Lynch et al., 2005).

Table 4. The use of gloves and face masks in food service establishments before and during COVID-19 pandemic

Safety measure/ practice	Establishment type	Before COVID-19		During COVID-19		p-value*
		Yes	NO	Yes	NO	
		n (%)	n (%)	n (%)	n (%)	
Wearing gloves	Retailers	36 (80.0)	9 (20.0)	44 (97.2)	1 (2.2)	0.021
	Restaurants	25 (100)	0	25 (100)	0	1.000
	Hotels	17 (100)	0	17 (100)	0	1.000
Wearing face mask	Retailers	5 (11.1)	40 (88.9)	44 (97.2)	1 (2.2)	<0.001
	Restaurants	7) (28.0)	18 (72.0)	25 (100)	0	<0.001
	Hotels	6 (35.3)	11 (64.7)	17 (100)	0	<0.001

* The *p* values show the statistical difference within each type of establishment before and during COVID-19

Physical Distancing at Workplaces

The effective implementation of physical distancing measures, encompassing spacing protocols, signage, physical barriers, and one-way traffic systems, played a pivotal role in containing the transmission of COVID-19. Table 5 shows the response of food service establishments to recommended physical distancing measures. In regards to spacing measures and signage, a significant proportion of retailers (89%), restaurants (84%), and hotels (88%) utilized strategies such as floor markers and stickers. Notably, our analysis revealed no statistically significant variance in the adoption of spacing measures across these three establishment types ($X2(2) = 0.517$, $p = 0.909$). This underscores the uniform commitment of all food establishments to implementing spacing measures in alignment with public health guidelines. Moreover, with respect to maintaining a two-meter distance between food handlers, the majority of surveyed retailers (93.3%) adhered to this practice, as did all restaurants and hotels. This commitment remained consistent across all establishment categories, with no statistically significant disparities ($X2(2) = 1.758$, $p = 0.427$). This adherence to the recommended two-meter social distancing guideline is notable in light of research supporting the efficacy of physical distancing in reducing viral transmission. Distances of at least one meter were found to reduce transmission risk by 2.6% compared to distances of less than one meter (Chu et al., 2020).

In the context of physical barriers, particularly concerning cashier counters, 69% of retailers employed such measures. In contrast, only 40% of restaurants and 47% of hotels implemented similar physical barriers. A statistically significant discrepancy emerged between the type of establishment and the use of physical barriers ($X2(2) = 6.179$, $p = 0.049$). This suggests that retailers were more inclined to incorporate physical barriers, possibly influenced by the nature of their customer interactions at cashier counters.

Table 5. The responses of physical distancing in the workplace in food retailers, restaurants and hotels catering

		Retailers	Restaurants	Hotels caterer	p-value
Spacing measures	Yes n (%)	40 (88.9)	21 (84.0)	15 (88.2)	0.909
	No n (%)	5 (11.1)	4 (16.0)	2 (11.8)	
Dividers or barriers	Yes n (%)	31 (68.9)	10 (40.0)	8 (47.1)	0.049
	No n (%)	14(31.1)	15 (60.0)	9 (52.0)	
2-meter distance	Yes n (%)	42(93.3)	25 (100.0)	17 (100.0)	0.427
	No n (%)	3 (6.6)	0	0	
One-way system	Yes n (%)	26 (57.8)	4 (16.0)	1 (5.9)	0.001
	No n (%)	19 (42.2)	21 (84.0)	16 (94.1)	

According to on-site observations of food establishments, it was found that 58% of retailers had implemented a one-way system for entry and exit to facilitate physical distancing. In contrast, a higher percentage of restaurants (84%) and hotel catering services (94%) did not follow a one-way system. Significantly, there was a difference observed between the type of establishment and the implementation of a one-way system ($X2(2) = 20.383$, $p = 0.001$). This suggests that retailers, with their typically multiple entrance points, were more able to implement a one-way system compared to restaurants and hotels.

In summary, the data underscores a concerted effort across all categories of food establishments to implement physical distancing measures, thereby safeguarding the well-being of both customers and employees during the ongoing pandemic. The study by Shumsky et al. (2021) underscores the effectiveness of implementing a one-way movement system in markets to significantly reduce the transmission of the virus by one-third. This intervention strategically limits face-to-face customer interactions, thereby it is expected to lower the spread of COVID-19.

Cleaning and Sanitization of Surfaces

Surface contamination stands as a substantial avenue for coronavirus transmission, with the virus demonstrating remarkable persistence on various materials, including stainless steel, plastic, copper, and cardboard, for up to 72 hours (van Doremalen et al., 2020). Given this prolonged viability, the imperative for systematic surface cleaning and disinfection in food establishments cannot be overstated (Castaño et al., 2020). Table 6 shows data on the frequency of cleaning and disinfecting of non-food-contact and food-contact surfaces.

Non-Food-Contact surfaces: In Food Retailers, in the pre-COVID-19 period, 38% of food retailers reported no engagement in the cleaning and disinfection of food contact surfaces between uses, while only 27% affirmed consistent performance of these sanitization procedures. Remarkably, the study findings do not indicate a statistically significant alteration in these percentages amid the COVID-19 pandemic. Currently, 31% claim "always," while 36% continue to adhere to "never" ($p = 0.083$). On-site observations additionally unveiled instances of chopping or cutting boards and knives undergoing neither cleaning nor sanitization between uses. In stark contrast to food retailers, nearly all restaurants (96%) consistently reported "always" undertaking cleaning and disinfection of food contact surfaces between uses, both prior to and during the COVID-19 pandemic. The data exhibited no statistically significant variation ($p > 0.05$) between reports pre- and during the pandemic, underscoring unwavering adherence to these hygienic practices. Analogous to restaurants, 88% of hotels indicated that they "always" performed cleaning and disinfection of food contact surfaces between uses before the advent of COVID-19. This adherence remained unchanged during the pandemic, with no statistically significant difference in the reported data ($p > 0.05$).

Overall, the data suggests that food retailers faced challenges in maintaining consistent cleaning and disinfection practices for food contact surfaces between uses, both before and during the pandemic. In contrast, restaurants and hotels displayed a higher level of consistency in adhering to these critical practices. Proper cleaning and disinfection of food contact surfaces are essential for preventing surface contamination and reducing the risk of virus transmission in food establishments.

The recommendations by Shahbaz et al. (2020) emphasizing the frequent cleaning and sanitization of food-contact surfaces, ideally every two hours during COVID-19, are essential to maintain food safety standards. Additionally, the practice of holding sanitized utensils, such as cutting boards and knives, in sanitized containers or boxes after washing and sanitization, as suggested by Sapers (2001), contributes to preventing potential contamination.

Food-Contact Surfaces: In the realm of

Table 6. Responses to cleaning and disinfecting of food contact and noncontact surfaces in food establishments

Practice	Establishment type	Response n (%)			
			Before COVID-19	After COVID-19	p-value
Cleaning and disinfecting food-contact surfaces	Retailers	Never	17 (37.8)	16 (35.6)	0.083
		Rarely	6 (13.3)	5 (11.1)	
		Often	3 (6.7)	4 (8.9)	
		Sometimes	7 (15.5)	6 (13.3)	
		Always	12 (26.7)	14 (31.1)	
	Restaurants	Never	1 (4.0)	(4.0)	NC
		Rarely	0.0	0.0	
		Often	0.0	0.0	
		Sometimes	0.0	0.0	
		Always	24 (96.0)	(96.0)	
	Hotels	Never	0.0	0	NC
		Rarely	0.0	0.0	
		Often	0.0	0.0	
		Sometimes	2 (11.8)	2 (11.8)	
		Always	15 (88.2)	15 (88.2)	
Cleaning and disinfecting food-noncontact surfaces	Retailers	Never	11 (24.4	1 (2.2)	< 0.001
		Rarely	3 (6.7	1 (2.2)	
		Often	8 (17.8	4 (8.9)	
		Sometimes	9 (20.0	8 (17.8)	
		Always	14 (31.1	31 (68.9)	
	Restaurants	Never	2(8)	0	.014
		Rarely	0	0.0	
		Often	1 (4)	0.0	
		Sometimes	4 (16)	1 (4.0)	
		Always	18 (72)	24 (96.0)	
	Hotels	Never	1 (5.9)	0.0	.025
		Rarely	0.0	0.0	
		Often	2 (11.8)	0.0	
		Sometimes	3 (17.6)	1 (5.9)	
		Always	11 (64.7)	16 (94.1)	

Note. Statistical significant difference determined at p-value < 0.05 using Friedman Test
NC: Not Computed

cleaning and sanitizing non-food contact surfaces, which encompasses items such as chillers, microwave handles, doors, and light switches, this study provides substantial insights. Preceding the onset of the COVID-19 pandemic, a mere 31% of establishments demonstrated unwavering adherence, denoted as "always," to the cleaning and sanitization of non-food contact surfaces. In stark contrast, 24% of establishments exhibited a complete absence of such hygiene practices, marked as "never." A notable improvement in these practices was discerned during the COVID-19 pandemic, ($p < 0.001$). Presently, approximately 69% of retailers assert consistent adherence to cleaning and sanitizing non-food contact surfaces, with only 2% reporting non-compliance. Comparable significant shifts were also evident in restaurants ($p = 0.014$) and hotels ($p = 0.025$). In restaurants, the proportion of establishments consistently cleaning and disinfecting non-food contact surfaces escalated from 72% to 96%, while in hotels, it surged from 65% to a complete 100%.

These findings underscore the profound impact of the COVID-19 pandemic on the adherence to cleaning and sanitization practices for non-food contact surfaces within a variety of food establishments. This heightened attention to the hygiene of non-food contact surfaces represents a positive development for overall food safety and public health, as these surfaces can also serve as potential vectors for the transmission of pathogens.

Conclusion

A Food Management System (FMS) was adopted by a low percentage of hotels, while no restaurants or retailers implemented any FSMS. Among the hotels, 53% conducted COVID-19 assessments, but the majority of retailers and restaurants did not. Fever emerged as the most widely recognized symptom of COVID-19, followed by dry cough, headache, and sore throat. Significant association (evaluated by Pearson's chi-square test) was found between establishments and FSMS, COVID-19 risk assessment. The study revealed that symptom posters were displayed in 84% of retailers, 76% of restaurants, and 82% of caterers. Various measures, including directional stickers, physical barriers, and one-way systems, were implemented by different food establishments to ensure compliance with safety distance requirements. Significant changes were brought about by the COVID-19 pandemic, particularly in terms of the availability of sanitizers, the use of gloves, the wearing of masks, and the cleaning and disinfection of non-food contact surfaces. Overall, there was commendable adherence to health and symptom monitoring, physical distancing, and face mask usage. It can be concluded that the pandemic induced positive changes in certain practices that have the potential to enhance the overall hygiene standards of these establishments. The limitations are: (i) The scope of the research was constrained by the inclusion of a limited number of food establishments. This was due to the COVID-19 pandemic and its attached restrictions. Not all persons-in-charge were available – at that time – to participate in the study. (ii) This study focused to Muscat Governorate, thereby limiting the generalizability of the findings to a broader context. (iii) Convenient sampling is based on accessibility and willingness to participate which may impact the generalizability of the findings.

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Appendix

COVID-19 Food Safety Precautionary Measures Questionnaire

Please complete the following questionnaire with specific regard to the above enquiry, by placing a CROSS in the appropriate box

A. Premise type

1 Activity

☐ First class restaurant

☐ Food retailer

- Number of meals per day — Before COVID-19 ☐ / After COVID-19 ☐
- The premises area allocated to practice the retailing activities — ☐ ≥ 100 m2 ☐ < 100 m2
- Number of customers who can enter the premise — Before COVID-19 ☐ / After COVID-19 ☐

B. Food Safety system

		Yes	No
2	The premise is well aware about the Supreme Committee instructions related to food handling during covid-19	☐	☐
3	The premise is certified with at least one of food safety or quality management systems? Specify	☐	☐
4	Risk assessment has been done to the premise to identify, assess and manage the risks of COVID-19	☐	☐

C. Food handlers personal hygiene

			Yes	No
5	Food handlers are aware of personal hygiene requirements at work.		☐	☐
6	Food handlers are aware about legal action of violation of personal hygiene requirements at work.		☐	☐
7	Hand washing basins (with hot and cold water, soap and a means of drying hands) are available in the entrance of food preparing/production area	Before COVID-19	☐	☐
		After COVID-19	☐	☐
8	Liquid antimicrobial sanitizer dispensers are provided for food handlers	Before COVID-19	☐	☐
		After COVID-19	☐	☐

9	It is priority when purchasing hand sanitizer to contain ethanol or isopropanol in concentrations of 70-80% as active ingredients	Before COVID-19		
		After COVID-19		
10	Gloves are worn while dealing with raw and finished goods	Before COVID-19		
		After COVID-19		
11	Face mask is worn in work place by all workers	Before COVID-19		
		After COVID-19		
12	Food hygiene and safety signs and posters are displayed in the food preparing/production area	Before COVID-19		
		After COVID-19		
13	All employees are trained in putting PPE on and taking PPE off, including washing or sanitizing hands	Before COVID-19		
		After COVID-19		
14	Food handlers were trained in food handling during covid-19.			

			Never	Rarely	often	Sometimes	Always
D.	**Cleaning and Disinfecting**						
15	All raw vegetables and fruits are sanitized before serving	Before COVID-19					
		After COVID-19					
16	Food contact surfaces like utensils and cutting boards are cleaned and disinfected between use	Before COVID-19					
		After COVID-19					

17	Non-food contact surfaces like door and kitchen cabinet handles are cleaned and sanitized between use	Before COVID-19					
		After COVID-19					
18	Disposable tableware/Cutleries are used in facility	Before COVID-19					
		After COVID-19					
19	Dishwashing machine is used to clean and sanitize the dishware and cutleries	Before COVID-19					
		After COVID-19					
20	The work place is cleaned and disinfected if someone suspected or confirmed to have COVID-19						
21	Cleaning staff is provided with appropriate PPE including disposable gloves and safety eyewear.						

E.	**Social/physical distances**	Yes	No
22	The premise use the spacing measures (floor markers, stickers)		
23	The work place is maintained to keep two meters distance between each food handlers		
24	The premise maintained the dividers/barriers between the employees at each workstation		
25	Separate cabin or room is available in the premise for isolation if anybody is COVID-19 suspected		
26	One-way system is implemented in premise at entry and exit points		
F.	**Health and symptoms monitoring and screening**	Yes	No
27	Signs and/or posters about the symptoms of COVID-19 are displayed in the workplace		
28	Employee are instructed to report any COVID-19 symptoms to line manager/supervisors		
	Visitors including suppliers are assessed for COVID-19 symptoms before entering the premise.		

29	Daily update on health status of employees and suppliers is maintained in record book.	☐ ☐
30	Workers are allowed to stay home if they have the following symptoms of COVID-19 (you can select more than one):	☐ Headache ☐ Fever ☐ Dry cough ☐ Tiredness ☐ Loss of taste or smell ☐ A rash on skin ☐ Aches and pains ☐ Sore throat ☐ Diarrhea ☐ Conjunctivitis