The Effect of the Knowledge, Attitude, and Behavior of Workers Regarding COVID-19 Precautionary Measures on Food Safety at Foodservice Establishments in Jordan

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Abstract: The novel coronavirus (COVID-19) pandemic has caused sequential ripples of public health concern worldwide. Restaurant owners and workers have been significantly affected by safety regulations which have governed the activities of both employees and consumers. The objective of this study was to investigate the knowledge, attitude, and practices (KAP) of restaurant owners and workers in the context of COVID-19 and assess the effect of COVID-19 precautions on the implementation of food safety measures at foodservice establishments in Jordan. A cross-sectional survey was conducted that involved 605 participants from 91 restaurants and catering establishments in Jordan. The questionnaire was filled out during a face-to-face interview or via online platforms. Most (77%) of the respondents were male and under 35 years old (79%), with 42% of them having a high educational level (bachelor’s degree or postgraduate studies) and 46% having 1–5 years of work experience. It was found that only 20% of workers possessed good knowledge (scores above 75%), 56% had positive attitudes, and 55% had good practices, with a mean of 47% being compliant with the KAP levels expected. In total, 19 to 34% of participants observed that the precautions and preventive measures put in place during the pandemic improved the application of key food safety regulations within their workplaces. It is evident that more training is required for both employees and employers to ensure the effective implementation of the regulations required to prevent the spread of COVID-19 and food-borne pathogens via the application of good hygienic practices that improve food safety, reducing illnesses and food waste while maintaining food security and economic sustainability.

Keywords: food system; coronavirus; SARS-CoV-2 food workers; foodborne illnesses

1. Introduction

Coronavirus disease 2019 (COVID-19), caused by Severe Acute Respiratory Syndrome coronavirus 2 (SARS-CoV-2), was first reported in Wuhan, China in December 2019, with the illness then spreading rapidly across many regions [1]. The World Health Organization (WHO) proclaimed COVID-19 to be a pandemic on 12 March 2020 [2]. Up until now, the WHO has reported approximately 476.4 million confirmed cases of COVID-19, with more than 6.1 million deaths worldwide [3]. In Jordan, the total number of positive cases has reached 1.7 million, with 14,000 COVID-19 deaths [3]. Person-to-person contact
and respiratory droplets dispersed by coughing or sneezing have been identified as the virus’s primary modes of transmission [2]. Although SARS-CoV-2 is airborne, can remain suspended in air for lengthy periods, and is spread through saliva, there are still no reports describing its transmission through food products. However, food could serve as an indirect vehicle for transmission of this virus via its contamination of food packaging materials [4]. SARS-CoV-2 has been found to be stable at temperatures as low as -20 °C for 3 weeks on salmon filets, chicken, and pork [6]. On the other hand, it was reported that the contamination of a food product by SARS-CoV-2 was reduced by 4 log colony forming units (CFU)/g when the food was cooked at 63 °C for 4 min [7].

The practices employed during the production and trading of food products may have an impact on sustainable development. Furthermore, the sustainability of food systems becomes an important issue during large-scale pandemics such as COVID-19 to prevent crises in the food sector. Food systems play a major role in accomplishing some of the sustainable development strategies that were adopted by the United Nations (UN) Agenda for implementation by 2030. For example, the achievement of food security, the enhancement of nutrition among communities, and the implementation of food safety are crucial factors to end poverty in all its forms across the globe, to ensure sustainable consumption and production patterns, and to ensure healthy lives and promote well-being for communities. Therefore, the definition of sustainability focuses on human health as well as the protection of the environment. Thus, the implementation of safety and hygiene programs during all stages of food production is a challenge for the food industry since the transmission of pathogenic microorganisms may occur at any stage from farm to table. This has also become more urgent during the COVID-19 pandemic [8,9].

COVID-19 outbreaks have caused health and behavior problems for both consumers and producers as well as for owners of food processing facilities and foodservice companies [10]. Food safety programs were modified during the present pandemic to minimize the impact of foodborne illnesses, in addition to COVID-19. Further, many countries including China have suspended the import of food items from countries that experienced COVID-19 outbreaks among workers in food facilities [11]. While food establishments have been required to implement social distancing guidelines, most organizations went further and cancelled food safety training classes for food workers in response to restrictions on the size of public gatherings. As might be expected, this has had a negative impact on the implementation of food safety measures [12]. Although COVID-19 vaccines have been developed and been approved by the WHO for emergency use, they do not provide perfect (100%) protection. However, those vaccinated are more likely to have less severe symptoms if they become ill [13]. Even in the presence of vaccines, good hygienic practices, minimal interactions with others, and avoidance of physical contact are the major strategies used to prevent viral transmission by those in the food industry. Before the pandemic, about 59% of food workers in the military hospital in Jordan were found to be incorrectly applying food hygiene practices [14]. In contrast, Osaili et al. [15] showed that the COVID-19 pandemic resulted in significant beneficial behavioral shifts amongst university students in Jordan, with the majority adopting more hygienic behaviors.

Food safety guidelines are commonly used by many industries including foodservice businesses according to the Codex Alimentarius. However, food safety standards are mandatory (such as the implementation of HACCP) according to Codex rules and regulations. Both the WHO and U.S. Food and Drug Administration (FDA) implemented extra rules and regulations intended to further protect consumers during or after COVID-19. Among these regulations, food retail shops were to provide customers with hand sanitizer and sanitation wipes, shopping baskets were to be disinfected after every use, physical distancing was to be maintained, and overcrowding was to be prevented by regulating the number of customers that entered the store. Food advertising campaigns and promotions were to be discouraged, while the frequent washing and sanitizing of utensils, catering tools, and surfaces was encouraged. Furthermore, delivery drivers were to be alone in
vehicles during work; the use of face masks and gloves was to be strictly implemented within the work environment; disposable containers were to be used; and, in addition, drivers were to place delivered food items in designated pick-up zones to avoid physical contact with clients [16,17].

According to the knowledge, attitude, and practices (KAP) model, knowledge positively influences an individual’s attitude, which in turn influences their practices. In other words, food workers’ knowledge influences their attitudes and practices, and, as a result, their personal hygiene, kitchen cleanliness, and disease mitigation. Several studies have attempted to apply the KAP model to explore food workers’ knowledge, attitudes, and practices in various situations throughout the years [18]. Olaimat et al. [19], reported that 80% of students in Jordanian universities had adequate general knowledge about the symptoms, complications, and transmission of COVID-19. It would be expected that informed individuals such as restaurant owners and workers would have more knowledge, better attitudes, and would use acceptable practices toward COVID-19 due to them being more receptive to restrictive policies and precautions, that they would be more likely to understand the associated benefits, and that they would be aware that the adoption of proposed rules would minimize inconvenience and health risk. To the best of our knowledge, there are no data that highlight COVID-19 KAP among food workers in Jordan and examine the effect of precautions on food safety. Therefore, the main objectives of the current study were to assess the knowledge, attitudes, and behaviors regarding COVID-19 of restaurant owners and workers and investigate the effect of COVID-19 precautions on food safety implementation at foodservice establishments in Jordan.

2. Materials and Methods

2.1. Sample Size Calculation

In this study, the sample size was calculated using the online Raosoft sample size calculator [20], and this was based on the industry establishments studied which employed a total of 130,000 workers. The sample size was determined based on a response distribution rate of 50%, a confidence interval of 95%, and a margin of error of 5% while assuming a 10% non-response or dropout rate. Although this meant a sample size of 424 was required, the current study used a sample size of 605 to provide additional confidence in the interpretation of results.

2.2. Study Design

This was a cross-sectional online survey and interpersonal interview study that used a self-administered questionnaire. As indicated, there were 605 participants involved and they were from 91 restaurants and catering establishments located in Jordan. The survey was conducted between 2 February and 30 March 2021.

2.3. Ethical Considerations

All participants were informed before the study and were asked to sign a consent form. The objectives and the study protocol were briefly explained to the participants by the investigators. The protocol of the study was designed to meet the criteria established by the Institutional Review Board (IRB) at the Jordan University of Science and Technology. The study was conducted in accordance with the Declaration of Helsinki.

2.4. The Questionnaire

A self-administered questionnaire used to assess the KAP related to COVID-19 among individuals who worked in catering establishments in Jordan via a questionnaire that contained close-ended questions. The questions were created based Tarver [21] and Olaimat et al. [19], who recommended guidelines for the food industry to keep workers and consumers safe during the COVID-19 pandemic. The survey was modified based on information available on the websites of the Centers for Disease Control (CDC) and the WHO.
The questionnaire consisted of three parts with 74 questions and was filled out by participants with the help of the investigators through a face-to-face interview or through an online google form link that was sent to the participants using email, Facebook, or WhatsApp. Some participants were able to answer the questions alone, while others required assistance from the investigators to read the questions due to illiteracy or a low level of education. The three parts of the questionnaire contained the following:

1. Socio-demographic information which consisted of seven questions about gender, age, education, marital status, experience, job information, and data related to the food establishment.
2. Questions on the KAP model regarding COVID-19. There were a total of 60 questions in this part, including 14 knowledge-, 30 attitude-, and 16 behavior-based questions.
3. This part contained seven questions about the effect of precautions against COVID-19 on aspects of food safety.

2.5. Validity and Reliability of Questionnaire

The survey questionnaire was first developed in English, and then translated into Arabic with the help of a native Arabic translator. Modifications were made to a small number of questions for clarification. The meaning of terms in the English and Arabic versions were compared to ensure that the meaning of the two versions did not change. Food safety professionals and academics evaluated and assessed the questions to ensure the validity of the content and that they accurately measured what was supposed to be tested. In addition, 15 participants were randomly chosen to validate the questionnaire. The participants were asked about the content clarity, the time required to finish the survey, and the language and terminology used. Food safety specialists and academics evaluated and discussed their responses to the questionnaire’s instructions and content. In response to their comments and suggestions, minor changes and modifications were made. In addition, a total of 30 food workers were involved in a pilot study to assess the reliability of the questionnaire, and they were asked not to respond to the final version of the questionnaire. The ability of the COVID-19 KAP test to consistently assess what it was supposed to evaluate was determined. In terms of overall internal reliability, the questionnaire was found to be dependable, yielding a Cronbach’s Alpha = 0.881, which is a sign of strong reliability.

2.6. Statistical Analysis

The Statistical Package for Social Science SPSS (IBM version 21 for Windows 2011, IBM-SPSS Inc.) was used for data processing and analysis. The significance level was set at a \( p \)-value \( \leq 0.05 \). For descriptive statistics, mean, standard deviation, and percentages were used. The T-test and ANOVA were used to detect the differences in knowledge, attitude, and practice between socio-demographic characteristics. Binary logistic regression analysis was used to identify the contributing factors associated with worker KAP scores. Based on the internationally recognized Likert scale, all the questions included five possible answers (strongly agree, agree, neutral, disagree, and strongly disagree) to assess the level of KAP about COVID-19 during the pandemic.

KAP responses were given 1 point for each correct response, while an incorrect response was scored as zero. All scores were calculated by a summation of correct answers, with a maximum possible correct answer score of 14 for knowledge, 30 for attitudes, and 16 for practices for a maximum total possible correct answer score of 60. Then, these scores were converted into percentages, and the ordered distribution of responses was divided into three parts: poor knowledge, attitude, and practice (<50%); adequate knowledge, attitude, and practices (50–75%); and good knowledge, attitude, and practices (>75%). For the regression analysis, a cut-off point of 50% was used [19,22].
3. Results

3.1. General Characteristics of Participants

The socio-demographic characteristics of the food workers from restaurants and catering establishments in Jordan are shown in Table 1. Of the 605 food workers from 91 restaurants and catering establishments in the study, 77% were male. More than half (59%) of participants were single and 79% were under 35 years old. The educational levels of the participants varied, with 42% of participants having a high educational level including a bachelor’s degree and even postgraduate study. In contrast, only 9% were illiterate. Additionally, 68% had less than 5 years of experience in the foodservice area and only 8% had >15 years career experience. The participants had different types of jobs in food establishments and were made up of those who worked in management, as cooks, waiters, cleaners, drivers, and quality control personnel.

Table 1. Socio-demographics, experience, and occupations of participants (N = 605).

| Characteristics          | Frequency (N) | Percentage (%) |
|--------------------------|---------------|----------------|
| Gender                   |               |                |
| Male                     | 466           | 77.0           |
| Female                   | 139           | 23.0           |
| Age (years)              |               |                |
| 18–24                    | 251           | 41.5           |
| 25–34                    | 226           | 37.4           |
| 35–44                    | 90            | 14.9           |
| ≥45                      | 38            | 6.3            |
| Education Level          |               |                |
| Illiterate               | 57            | 9.4            |
| Secondary-preparatory    | 297           | 49.1           |
| University               | 237           | 39.2           |
| Postgraduate study       | 14            | 2.3            |
| Experience (years)       |               |                |
| <1                       | 131           | 21.7           |
| 1–5                      | 281           | 46.4           |
| 6–15                     | 144           | 23.8           |
| >15                      | 49            | 8.1            |
| Marital status           |               |                |
| Single                   | 355           | 58.7           |
| Married                  | 215           | 35.5           |
| Other                    | 35            | 5.8            |
| Occupation               |               |                |
| Cooks                    | 165           | 27.3           |
| Waiters                  | 109           | 18.0           |
| Cleaners                 | 49            | 8.1            |
| Quality control          | 12            | 2.0            |
| Management               | 240           | 39.7           |
| Drivers                  | 30            | 5.0            |
| Business Type            |               |                |
| Hospitals                | 132           | 21.8           |
| Cafeterias               | 108           | 17.9           |
| Restaurants              | 237           | 39.2           |
| Other                    | 128           | 21.2           |

3.2. The Knowledge of Workers at Foodservice Establishments in Jordan Regarding Various COVID-19 Attributes

Table 2 shows that the workers had poor knowledge of some COVID-19 attributes. Low percentages of workers correctly answered questions about social distancing, duration of hand washing, the multiplication of SARS-CoV-2 in food, and the benefit of natural
immunity resulting from disease. However, higher percentages of employees correctly answered that SARS-CoV-2 can survive on hard surfaces such as stainless steel, plastic, cardboard, and paper, that vaccines are safe and effective, that the virus can spread via coughing or sneezing and via infected individuals with or without mild symptoms, and that the virus can be transmitted among workers. In addition, a high percentage of participants knew that infected workers should be isolated and not allowed to enter food facilities; that vehicle drivers who deliver raw food items and packaging materials to food facilities should wear a mask and physically distance themselves; and that food attendants (waiters) should wear a mask and practice social distancing.

Table 2. The knowledge of workers at food foodservice establishments in Jordan about various COVID-19 attributes.

| Knowledge Inquiry Statement                                                                 | Correct Answer N (%) |
|---------------------------------------------------------------------------------------------|----------------------|
| Workers should maintain a 2 m distance during work.                                         | 164 (27.1%)          |
| A person who has COVID-19 can spread the virus upon coughing or sneezing.                   | 510 (84.3)           |
| The COVID-19 virus can be transmitted among workers in food facilities.                     | 498 (82.3)           |
| The COVID-19 virus can survive on hard surfaces such as stainless steel, plastic, cardboard, and paper. | 445 (73.6)           |
| The duration of hand washing is ≥20 s.                                                      | 212 (35.0)           |
| Workers infected with the COVID-19 virus should not be allowed to enter food facilities.    | 501 (82.8)           |
| Infected people with no symptoms or mild symptoms can still spread the virus.               | 480 (79.3)           |
| The COVID-19 virus cannot multiply in food.                                                 | 93 (15.4)            |
| Vehicle drivers who deliver raw and packaging materials to your food facility should wear a mask and practice social distancing. | 540 (89.3)           |
| Vehicle drivers who deliver ready meals to customers should wear a mask and practice social distancing. | 527 (87.1)           |
| Food attendants (waiters) who serve meals to customers, must wear a mask and practice social distancing. | 533 (88.1)           |
| All vaccines are safe and adequate safety tests have been completed and carried out for them. | 319 (52.7)           |
| All vaccines are effective, as they 100% protect against disease.                          | 365 (60.3)           |
| Natural immunity resulting from the disease is better than immunity acquired from the vaccine. | 69 (11.4)            |

3.3. Attitude of Workers at Foodservice Establishments in Jordan towards COVID-19 Attributes

Table 3 provides the attitude-related responses of employees in catering establishments in Jordan towards COVID-19. A high percentage of the workers showed positive attitudes at work towards COVID-19 precautions such as social distancing, wearing masks and gloves even when not at the workplace, handwashing when touching a potentially contaminated object and before touching the mouth or nose and the food, disinfecting food contact surfaces, and covering the mouth and nose when coughing or sneezing. About 82–87% of the employees correctly believed that the most frequently used surfaces including workstations, keyboard, control buttons, door handles, light switches, table tops, and toilet handles should be cleaned and sanitized and that the correct procedure to follow when experiencing symptoms of COVID-19 would be to conduct a test and stay home after informing the employer until the results are obtained. On other hand, more than half (53–62%) of employees agreed that not conducting a COVID-19 test or not informing company administration would not be proper procedure when a person has COVID-19 symptoms. Most employees correctly believed that SARS-CoV-2 can be transmitted via speaking, droplets, and aerosols in the air or on surfaces and via infected individuals and, assuming that social distancing is not be possible in the workplace, workers should wear face masks. About two-thirds of employees believed that there was a risk of getting infected with COVID-19 in a work facility and that they should cover their mouth and nose with a tissue or use the inside of an elbow before coughing or sneezing (79%). Most employees believed they should use soap and water (77%) or sanitizers (86%) to prevent the virus spreading from surfaces, while only 40% of employees believed that dry wiping would not prevent spreading the virus. In terms of vaccines, about half of the workers believed that vaccines could protect people from infection with COVID-19 and reduce the symptoms of COVID-19 disease in the event of infection. About two-thirds of employees believed
that when a vaccinated person gets infected with COVID-19, they may spread the disease and cause others to be infected and that companies should encourage workers to become vaccinated. On the other hand, 17% of employees believed that wearing gloves could prevent COVID-19 infection and that vaccines were linked to long-term health problems such as diabetes, infertility, and autism.

Table 3. Attitude of workers at foodservice establishment in Jordan towards COVID-19 attributes.

| Attitude Inquiry Statement                                                                 | Correct Answer N (%) |
|-------------------------------------------------------------------------------------------|----------------------|
| There is a risk of getting infected by the COVID-19 virus in a work facility.               | 405 (66.9)           |
| A person who has COVID-19 when speaking can spread the virus.                              | 487 (80.5)           |
| The droplets and aerosols from infected people that land on frequently touched surfaces and objects can cause infection to others. | 511 (84.5)           |
| The droplets and aerosols from infected people can be directly inhaled by others standing nearby and cause infection to others. | 495 (81.8)           |
| Social distancing is not possible in the workplace, so workers should wear face masks.     | 518 (85.6)           |
| Workers should take precautions (social distancing, wearing a face mask, etc.) when not at the workplace. | 510 (84.3)           |
| You should cover your mouth and nose with a tissue or use the inside of your elbow before you cough or sneeze. | 476 (78.7)           |
| Wearing gloves prevents infection with COVID-19.                                            | 103 (17.0)           |
| You should wash your hands with soap and water when touching a potentially contaminated object. | 503 (83.1)           |
| You should wash your hands with soap and water when touching your mouth and nose.         | 494 (81.7)           |
| You should wash your hands with soap and water when washing food.                         | 468 (77.4)           |
| Dry wiping is sufficient to prevent the virus from spreading on surfaces.                  | 242 (40.0)           |
| Using soap and water is sufficient to prevent the virus from spreading on surfaces.       | 466 (77.0)           |
| Using sanitizers is sufficient to prevent the virus from spreading on surfaces.            | 521 (86.1)           |
| Door handles should be cleaned and sterilized frequently.                                 | 522 (86.3)           |
| Light switches should be cleaned and sterilized frequently.                               | 496 (82.0)           |
| Tabletops should be cleaned and sterilized frequently.                                    | 526 (86.9)           |
| Workstations should be cleaned and sterilized frequently.                                 | 522 (86.3)           |
| Keyboards should be cleaned and sterilized frequently.                                    | 501 (82.8)           |
| Control buttons should be cleaned and sterilized frequently.                              | 505 (83.5)           |
| Toilet handles should be cleaned and sterilized frequently.                               | 525 (86.8)           |
| Companies should suspend their absence policy, so that employees do not feel pressured to come to work if they feel sick. | 443 (73.2)           |
| If you have symptoms of COVID-19, the appropriate procedure is to conduct a COVID-19 test, inform the administration, and follow home isolation until the result is issued. | 512 (84.6)           |
| If you have symptoms of COVID-19, the appropriate procedure is to conduct a COVID-19 test and continue working without informing your business administration until the result is issued. | 319 (52.7)           |
| If you have symptoms of COVID-19, the appropriate procedure is not to conduct a COVID-19 test and continue working without informing anyone. | 374 (61.8)           |
| The COVID-19 vaccines can protect people from infection with COVID-19.                     | 290 (47.9)           |
| Vaccines are linked to long-term health problems such as diabetes, infertility, and autism. | 104 (17.2)           |
| The COVID-19 vaccines may reduce the symptoms of COVID-19 disease in the event of infection. | 333 (55.5)           |
| A person who takes the vaccine and is infected can spread the disease and cause infection in others. | 401 (66.3)           |
| Companies should encourage all employees to take the COVID-19 vaccine.                    | 388 (64.1)           |

3.4. Practices of Workers at Foodservice Establishments in Jordan towards COVID-19 Attributes

The results in Table 4 show that foodservice establishment employees in Jordan were generally accepting of the COVID-19 restrictions imposed. It appeared that most of the COVID-19 restrictions practiced in the workplace included adopting social-distancing among workers or customers, avoiding direct personal contact at work, avoiding crowded places for breaks/meetings, avoiding touching the face with unwashed hands, avoiding groups or places where people congregate, and adhering to designated social distancing areas. Furthermore, a significant percentage of participants commented that their companies follow COVID-19 preventive precautions by: measuring their employees’ body temperatures once upon entering the work facility; placing hand sanitizer dispensers near every door; placing disinfecting spray in every catering lounge, so that employees can wipe down tables and chairs before and after each costumer; and by ensuring that all
areas where a virus-positive individual worked are thoroughly cleaned and disinfected. Most of the respondents noted that employees who have COVID-19 symptoms or those who had contact or live with a person exhibiting COVID-19 symptoms would notify their supervisors and follow the guidelines recommended by the government. Unfortunately, only less than half of the employees had received or will take the COVID-19 vaccine, and more than a third of them had discontinued shaking hands or hugging.

Table 4. Practices of workers at foodservice establishments in Jordan in the context of COVID-19.

| Practice Inquiry Statement                                                                 | Correct Answer N (%) |
|------------------------------------------------------------------------------------------|----------------------|
| All workers follow the social distancing policy to prevent the spread COVID-19 virus in your work facility. | 471 (77.9)           |
| All customers follow the social distancing policy to prevent the spread COVID-19 virus in your work facility. | 422 (69.8)           |
| During the COVID-19 pandemic, do you avoid direct personal contact at work.              | 446 (73.7)           |
| During the COVID-19 pandemic, do you stagger breaks/meetings to de-densify common areas. | 434 (71.7)           |
| Workers avoid touching their faces (i.e., eyes, nose, and mouth) with unwashed hands.    | 454 (75.0)           |
| Workers adhere to designated social distancing areas in your work area.                 | 473 (78.2)           |
| Workers still shake hands or hug.                                                      | 230 (38.0)           |
| Workers avoid people who are sick at work.                                             | 504 (83.3)           |
| Workers avoid groups or places where people congregate.                                 | 446 (73.7)           |
| Employees who have COVID-19 symptoms notify their supervisors and follow the guidelines recommended by the government. | 488 (80.7)           |
| Employees who had contact or live with someone exhibiting COVID-19 symptoms notify their supervisors and follow the guidelines recommended by the government. | 472 (78.0)           |
| In the event of a worker being confirmed to be positive for COVID-19, all areas where the virus-positive individual worked are thoroughly cleaned and disinfected. | 504 (83.3)           |
| The body temperature of employees is checked before they enter the work facility.      | 455 (75.2)           |
| Hand sanitizer dispensers have been placed near every door.                            | 481 (79.5)           |
| Disinfecting spray is present in every catering lounge, so that employees can wipe down tables and chairs before and after each costumer. | 475 (78.5)           |
| I took or will take the Coronavirus vaccine.                                            | 282 (46.6)           |

3.5. Description of Knowledge, Attitudes, and Practices and Total KAP Scores Regarding COVID-19 Attributes among Workers

Table 5 contains the results of the classification of KAP score percentages of COVID-19 among workers in foodservice establishments. Only 20% of the workers had a good level of knowledge, while more than half of the participants had a positive attitude and good practices. However, 17, 13, and 18% of participants displayed poor knowledge, negative attitudes, and poor practices, respectively. In general, less than half of participants had a good total KAP score, while 15% of participants had a poor total KAP score.

Table 5. Description of knowledge, attitudes, practices and total KAP of COVID-19 attributes among workers at foodservice establishments in Jordan.

|                          | Poor (<50%) | Adequate (50–75%) | Good (>75%) |
|--------------------------|-------------|-------------------|-------------|
| Knowledge (K)            | 100 (16.5)  | 384 (63.5)        | 121 (20.0)  |
| Attitudes (A)            | 79 (13.1)   | 186 (30.7)        | 340 (56.2)  |
| Practices (P)            | 106 (17.5)  | 168 (27.8)        | 331 (54.7)  |
| Total KAP                | 89 (14.7)   | 229 (37.9)        | 287 (47.4)  |

Values are frequency (percentage).
3.6. Association between Socio-Demographic Characteristics of Workers in Foodservice Establishments and KAP Scores Regarding COVID-19 Attributes

Table 6 summarizes the association between the socio-demographic characteristics of workers in foodservice establishments and the KAP score percentages of COVID-19 attributes. The results show that there were significant associations between age, education level, work experience, and marital status and COVID-19 knowledge and total KAP score. Higher levels of knowledge and total KAP scores were observed among married, higher educated, older, and more experienced employees. Married employees showed the higher levels of knowledge and total KAP scores compared with single individuals. Employees aged ≥ 45 years or with >15 years of experience showed the highest level of knowledge and total KAP scores. Meanwhile, illiterate employees and those with low levels of education or only secondary/preparatory levels displayed the lowest knowledge and total KAP scores.

All socio-demographic variables tested were significantly associated with the attitudes and practices of employees except in the cases of the association between gender and education level and practices. Female participants demonstrated a more positive attitude than males. A positive attitude and good practices were clearly associated with increased age. Similarly, employees with >15 years of experience had higher positive attitudes (and practices) compared to those who had 1–5 years of experience. Married employees displayed more positive attitudes and practices than single individuals.

3.7. Association between Type of Occupation and KAP Score Percentages of Workers Regarding COVID-19 Attributes

Table 7 summarizes the results concerning the associations between the different roles of the workers, namely, whether they are cooks, waiters, cleaners, quality control workers, managers, or drivers, and their KAP score percentages. It is clear that there were significant associations between the COVID-19 KAP score and the type of workplace occupation. Furthermore, there were significant differences among the types of job performed by workers regarding their knowledge, attitude, practices and total KAP attributes. It is of interest and somewhat surprising that in terms of knowledge, cooks and quality control workers had the lowest score of approximately 59%.

3.8. Effect of Precautionary Measures to Combat COVID-19 on Food Safety Implementation

The results in Table 8 summarize the effect of COVID-19 preventive measures on the implementation of food safety measures in foodservice establishments. A significant percentage of participants noted that the precautions and preventive measures during the pandemic did not improve the key food safety initiatives within their facilities, including the enhancement of food contact surface cleanliness and sanitization, did not enhance consumers’ satisfaction in terms of food safety measures, did not enhance food handlers’ personal hygiene, did not improve temperature control, did not improve food safety levels, did not decrease the extent of cross-contamination, and did not increase the establishments’ productivity.
Table 6. Association between socio-demographic characteristics of workers in foodservice establishments and KAP score percentages of COVID-19 attributes.

| Gender | Knowledge Mean ± SD | p-Value | Attitude Mean ± SD | p-Value | Practice Mean ± SD | p-Value | KAP Mean ± SD | p-Value |
|--------|---------------------|---------|-------------------|---------|-------------------|---------|--------------|---------|
| Male   | 61.42 ± 16.73       | 0.084   | 70.34 ± 19.13     | 0.010   | 72.73 ± 24.53     | 0.945   | 68.16 ± 17.10 | 0.133   |
| Female | 64.18 ± 15.78       | 0.037   | 74.96 ± 16.65     | 0.000   | 72.57 ± 23.77     | 0.000   | 70.57 ± 14.16 | 0.000   |
| Age    |                     |         |                   |         |                   |         |              |         |
| 18–24  | 60.96 ± 16.90       | 0.007   | 67.70 ± 20.52     | 0.000   | 66.78 ± 25.78     | 0.000   | 65.15 ± 17.18 | 0.000   |
| 26–34  | 61.00 ± 17.41       | 0.018   | 71.18 ± 16.92     | 0.000   | 75.61 ± 23.44     | 0.000   | 69.26 ± 16.16 | 0.000   |
| 36–44  | 64.60 ± 13.79       | 0.013   | 77.63 ± 16.21     | 0.000   | 78.47 ± 20.93     | 0.000   | 73.57 ± 14.45 | 0.000   |
| ≥45    | 69.55 ± 12.39       | 0.000   | 82.37 ± 13.10     | 0.000   | 80.76 ± 18.80     | 0.000   | 77.56 ± 11.31 | 0.000   |
| Education Level |                |         |                   |         |                   |         |              |         |
| Illiterate | 57.14 ± 20.11 | 0.000   | 72.22 ± 16.93     | 0.011   | 72.37 ± 20.39     | 0.204   | 67.24 ± 15.30 | 0.000   |
| Secondary-preparatory | 59.02 ± 17.10 | 0.000   | 68.91 ± 19.85     | 0.011   | 70.69 ± 25.95     | 0.000   | 66.10 ± 17.92 | 0.000   |
| University | 66.94 ± 13.36 | 0.000   | 74.28 ± 16.92     | 0.011   | 75.10 ± 22.98     | 0.000   | 72.11 ± 14.04 | 0.000   |
| Postgraduate study | 63.78 ± 13.26 | 0.000   | 72.38 ± 22.77     | 0.011   | 75.89 ± 26.39     | 0.000   | 70.68 ± 19.22 | 0.000   |
| Experience in years |            |         |                   |         |                   |         |              |         |
| <1     | 61.17 ± 17.78       | 0.005   | 71.20 ± 18.32     | 0.013   | 68.56 ± 23.43     | 0.000   | 66.98 ± 15.45 | 0.000   |
| 1–5    | 60.65 ± 16.15       | 0.000   | 69.55 ± 19.93     | 0.013   | 69.86 ± 26.21     | 0.000   | 66.69 ± 17.33 | 0.000   |
| 6–15   | 63.09 ± 16.40       | 0.000   | 73.26 ± 16.73     | 0.013   | 77.73 ± 21.29     | 0.000   | 71.36 ± 15.50 | 0.000   |
| >15    | 69.39 ± 13.98       | 0.000   | 77.14 ± 16.40     | 0.013   | 85.20 ± 16.86     | 0.000   | 77.24 ± 13.39 | 0.000   |
| Marital status |         |         |                   |         |                   |         |              |         |
| Single | 61.31 ± 16.87       | 0.024   | 70.28 ± 19.07     | 0.002   | 70.32 ± 25.74     | 0.001   | 67.30 ± 16.89 | 0.000   |
| Married| 64.02 ± 15.71       | 0.000   | 74.48 ± 16.66     | 0.000   | 77.67 ± 21.23     | 0.000   | 72.06 ± 14.78 | 0.000   |
| Other  | 57.35 ± 17.32       | 0.000   | 63.90 ± 23.14     | 0.000   | 66.25 ± 23.10     | 0.000   | 62.37 ± 18.86 | 0.000   |
Table 7. Association between type of occupation and knowledge, attitude, and behavior score percentages of workers about COVID-19 attributes.

| Job                        | Knowledge      | Attitude       | Behavior       | KAP            |
|---------------------------|----------------|----------------|----------------|----------------|
| Cooks                     | 59.35 ± 18.64 b| 66.12 ± 22.71 c| 67.88 ± 27.68 b| 64.45 ± 19.73 c|
| Waiters                   | 61.47 ± 18.77 b| 70.24 ± 16.91 c| 73.05 ± 24.20 a| 68.25 ± 17.18 b|
| Cleaning workers          | 68.95 ± 12.59 b| 76.46 ± 16.93 a| 79.34 ± 21.99 a| 74.92 ± 13.95 a|
| Quality control workers   | 59.09 ± 17.23 b| 71.52 ± 21.57 b| 81.25 ± 14.52 a| 70.62 ± 16.06 b|
| Management                | 62.35 ± 15.01 ab| 74.19 ± 15.47 a| 74.38 ± 22.55 a| 70.31 ± 13.70 b|
| Drivers                   | 66.43 ± 7.77 a | 74.56 ± 19.99 a| 70.00 ± 22.17 a| 70.33 ± 14.53 b|
| p-value                   | 0.008          | 0.000          | 0.023          | 0.001          |

* Values with different superscript letters are significantly different within each column.

Table 8. The effect of preventive measures to combat COVID-19 on food safety programs.

| Questions                                                                 | Frequency | Percent | p-Value |
|---------------------------------------------------------------------------|-----------|---------|---------|
| The preventive measures taken during COVID-19 led to improved food safety levels in your facility. | 149       | 24.6    | 0.0001  |
| Yes                                                                       | 149       | 24.6    | 0.0001  |
| No                                                                        | 456       | 75.4    |         |
| The preventive measures taken during COVID-19 reduced the chances of food cross-contamination. | 166       | 27.4    | 0.0001  |
| Yes                                                                       | 166       | 27.4    | 0.0001  |
| No                                                                        | 439       | 72.6    |         |
| The preventive measures taken during COVID-19 encouraged food handlers to maintain their personal hygiene at a high level. | 133       | 22.0    | 0.0001  |
| Yes                                                                       | 133       | 22.0    | 0.0001  |
| No                                                                        | 472       | 78.0    |         |
| The initiatives of COVID-19 precautions enhanced food safety measures with regards to the temperature control of food. | 147       | 24.3    | 0.0001  |
| Yes                                                                       | 147       | 24.3    | 0.0001  |
| No                                                                        | 458       | 75.7    |         |
| The initiatives of COVID-19 precautions enhanced food safety measures with regards to the cleaning and sanitation of food contact surfaces. | 117       | 19.3    | 0.0001  |
| Yes                                                                       | 117       | 19.3    | 0.0001  |
| No                                                                        | 488       | 80.7    |         |
| The initiatives of COVID-19 precautions increased consumers’ satisfaction in terms of food safety measures in food facilities. | 130       | 21.5    | 0.0001  |
| Yes                                                                       | 130       | 21.5    | 0.0001  |
| No                                                                        | 475       | 78.5    |         |
| The preventive measures taken during COVID-19 increased the productivity of food facilities. | 203       | 33.6    | 0.0001  |
| Yes                                                                       | 203       | 33.6    | 0.0001  |
| No                                                                        | 402       | 66.4    |         |

4. Discussion

In this study, the knowledge, attitude, and behavior regarding COVID-19 of workers in foodservice establishments and the effect of COVID-19 preventive actions on the implementation of food safety measures were assessed through a cross-sectional study. In general, the results showed that workers in foodservice establishments in Jordan exhibited appropriate attitudes, used acceptable practices, and had adequate total KAP scores regarding COVID-19, but their levels of knowledge could be improved. Overall, the knowledge of food workers regarding COVID-19 in different foodservice establishments such as cafeterias in hospitals was rated at 61%, in other cafeterias it was 66%, and in restaurants it was 60%, while the overall KAP score for COVID-19 in the case of hospital workers was 68%, was 73% in cafeterias, and was 67% in restaurants. However, 13–18% of workers had poor knowledge, attitudes, practices and total KAP scores toward COVID-19. A study conducted
by Almohammed et al. [23] among healthcare workers in Saudi Arabian Hospitals showed higher levels of KAP toward COVID-19, where two-thirds of the participants (68%) had good knowledge, positive attitudes (72%), and good practices (80%) toward COVID-19. This is due to differences in terms of population and occupation, with healthcare workers being more knowledgeable and familiar with good practices. Similarly, 31% of the waiters working in food and drink establishments in Southwest Ethiopia had poor knowledge about COVID-19, while only 28% had strong knowledge [24]. Quality control officers had the highest practices score (81%), which is likely because they are responsible for maintaining the quality and safety of foodservice establishments. Cleaners, meanwhile, had the highest knowledge, attitude, and total KAP scores, and this is because they are trained regarding the importance of maintaining the cleanliness of an establishment and the effectiveness of sanitizing. Qanche et al. [24] also found that only 21% of waiters and bartenders working in restaurants and bars in Southwest Ethiopia had good preventive behaviors towards COVID-19.

Habiballah et al. [25] assessed restaurant employees’ food handling practices in Irbid City, Jordan, and they found that females were significantly more committed to proper food handling practices than males; older employees also reported significantly better food handling practices than younger employees. Restaurant employees aged 45 years and older had higher average scores in food handling than those aged 35–44 years, those aged 24–34 years, and the 16–24-year-old group. These results were consistent with the findings of the present study where age, education level, work experience, and marital status had an impact on workplace knowledge. Females had higher KAP scores, as it was likely that they were more engaged in preparing meals at home, with them having a greater motivation to pay more attention to COVID-19, especially if they were raising children [26]. Furthermore, Grewal et al. [27] found that older age groups and higher education levels were associated with better knowledge scores. Cough etiquette and hygiene practices had a significant correlation with increased age and education level, whereas washing hands had a statistically significant correlation with age, education, and job rank. This study showed that the more experience a person had, the more knowledge they possessed. It was also seen that older workers were more likely to adhere to the attitudes required by COVID-19 regulations at their workplace. Those with higher experience levels (>15 years) also showed a higher attitude level. Furthermore, the youngest respondents had the lowest total KAP scores, while the oldest respondents had the highest KAP scores. Workers with more than 15 years of experience had high KAP scores. Liu et al. [28] found that there was a significant association between differences in age and KAP scores. In this study, the respondents with more experience had better attitudes, knowledge, and practices regarding COVID-19 precautions. Similar results were obtained by Lee et al. [29], who found that food handlers in Malaysia with greater experience in the foodservice business had better overall food safety knowledge (more than 6 years > 5–6 years > 2–4 years > 2 years) than those with less experience.

During the COVID-19 pandemic, research conducted in Iran looked at the impact of health and food safety training on restaurant food handlers and it showed that before training, 18% of participants had low total knowledge scores, 35% had moderate scores, and 47% had good ones. However, after training, 5% were low, 24% were moderate, and 71% were good. With regard to the attitudes among food handlers prior to training, 1% held strongly negative views, 77% were negative, 18% were positive, and 4% were highly positive. These positions were altered to 0% (strongly negative), 49% (negative), 33% (positive), and 18% (highly positive). Participants’ self-reported practice scores before training were 1, 56, and 43 for weak, acceptable, and preferred practices, respectively, while after the intervention of training, the scores improved to 0, 26, and 74%, respectively [26]. This demonstrated the importance of food safety training in improving the KAP scores of employees and enhancing the application of food safety standards in order to reduce foodborne illnesses and food waste and facilitate the establishment of sustainable food systems.
The present work showed that only 20% of workers had a good level of knowledge (scores above 75%), 56% had positive attitudes, and 55% had good practices; however, 17, 13, and 18% of respondents showed poor knowledge, negative attitudes, and poor practices, respectively, with scores of ≤50%. In another study, food workers at food factories in Jordan had a mean knowledge score of 5.8/10 for prospective SARS-CoV-2 viral sources, which was considered to be a low level. In general, the mean knowledge score of participants’ attitudes and hygienic practice among food handlers was 7.2/10, which was regarded as good, while the mean knowledge score for the participants’ understanding of the basic requirements to manage COVID-19 was 6.1/10. This research found that although food workers had a fair understanding of food safety, this did not always reflect their positive attitude. This study reported an overall score of 79% [25]. COVID-19 is not a foodborne virus; however, it can be spread through the improper handling of foods where inadequate hygiene and COVID-19 transmission precautions such as covering the mouth during coughing or sneezing are not followed [2]. Various stages in the food supply chain, from production to consumption, may involve risks with respect to the transmission of microorganisms including viruses. Therefore, the management of safe food production and respecting the health of workers and consumers during food distribution have been significant challenges during the pandemic due to mandated changes in shopping behaviors [30].

Studies show that SARS-CoV-2 is an airborne virus that remains viable in aerosols for a long time and can also spread through fluids (saliva) and droplets generated by coughing and sneezing. Therefore, this organism can spread from an infected person to someone else if no social distancing occurs, particularly when infected individuals do not wear face masks [31]. For this reason, foodservice workers are at a higher risk of being infected with COVID-19, as they communicate directly with clients and with each other. Therefore, workers should be properly trained in the correct ways to prevent the spread of this virus. Although experiments have shown that the coronavirus can remain viable up to 72 h on hard surfaces such as steel and plastic, there is still not enough evidence to conclude that contaminated packaging material can transmit the virus [5]. That is because packages are subject to different conditions and temperatures that may cause the virus to become more sensitive. On the other hand, when the virus is found on human skin, it can be transferred to the respiratory system by an individual touching their face or sneezing [32]. However, according to the results of the current study, only 35% of workers understand that the duration of hand washing should be at least 20 s. It has been indicated that hand hygiene is more important than cleaning and disinfecting food surfaces in terms of controlling the spread of pathogens. That is because hands are considered the main vehicle for spreading pathogenic microorganisms and intestinal parasites to foods [32]. Some studies have shown that SARS-CoV-2 is stable at lower temperatures up to −20 °C [2]. On the contrary, when food is cooked for 4 min at 63 °C, the contamination of a food product by SARS-CoV-2 is reduced by 4 log CFU/g [7]. However, this reduction might not be sufficient for full inactivation. Nonetheless, this represents strong evidence that it is more likely that workers in food establishments may spread the virus through person-to-person interaction rather than through contaminated food or packaging material [33]. About 75% of the workers followed COVID-19 restrictions in their workplace and 74% avoided direct personal contact at work.

In order to prevent COVID-19 infection, it is essential that food workers follow the best hygiene practices possible, especially during a pandemic scenario, since poor hygiene can increase the risk of illness [34]. Moreover, poor hygiene can cause the transmission of a number of diseases that may affect the respiratory system and cause pneumonia or even gastrointestinal infections. Thus, maintaining high standards for cleaning and hygiene levels is essential for employees and their work environment [35]. In the current study, most workers were committed to wearing masks and gloves even when they were not at work. It was encouraging that the number of correct actions associated with wearing masks in the present survey was significantly higher than in India [27] and Iran [36], despite them being lower than in China [37].
The CDC [38] suggests that restaurant operators should consider how to limit risk for employees, customers, and communities and slow the spread of COVID-19 by applying preventive measures. These include wearing masks when not eating or drinking and when social distancing (6 feet) measures are difficult to maintain. The more individuals interact with others and the longer the interaction, the higher the chance of COVID-19 spreading. Employees who have tested positive for COVID-19 or who are showing COVID-19 symptoms should stay at home and monitor their health. Employees who have recently had close contact with a person who is infected with COVID-19 should also stay at home and monitor their health. In the present study, most employees agreed that if they had symptoms of COVID-19, the appropriate procedure would be to conduct a COVID-19 test, inform the company, and follow home isolation guidelines. When masks are worn, employees should not touch them and if masks are touched, employees should wash their hands with soap and water for at least 20 s. Proper handwashing is also required in other situations such as before, during, and after preparing meals and after touching rubbish. Employees should wear gloves when performing tasks such as removing garbage bags or handling and disposing of trash, cleaning, and disinfecting surfaces. The manufacturer’s guidelines on the disinfectant’s label should be consulted and followed to ensure its safe and effective use [38].

The COVID-19 pandemic created many complications beyond the spread of viruses and food-borne illnesses that have affected physical health. Thus, it is very important for governments to control the spread of the virus by implementing strict rules regarding public gatherings, especially in restaurants and other foodservice establishments [39]. It is notable that the current study showed that a significant proportion of employees at foodservice establishments did not believe that these restrictions and regulations improved food safety conditions and they had not noticed any improvements regarding food safety in their establishments since the pandemic began. However, consumers expect foods that they purchase to be safe to eat. Despite this, foodborne illness outbreaks and recalls continue, and efforts must be continuously exerted to ensure the required standards are applied to minimize product loss through recalls and illnesses from contaminated food. Therefore, the safety of food is an integral part of the food security equation.

All COVID-19 vaccines that have been licensed by the World Health Organization for emergency use have undergone randomized clinical trials to ensure their quality, safety, and efficacy. Vaccines must have an efficacy rate of $\geq 50\%$ in order to be authorized. After they have been approved, they are monitored continuously to ensure that they are safe and effective. Vaccination protects not only the vaccinated person, but also those in the community who are unable to be vaccinated [2]. In the current study, only about 47% of the respondents had received the COVID-19 vaccine or were willing to take it. In the United Kingdom, 72% of the population were willing to be vaccinated, 17% were extremely unsure, and 12% were very afraid [40].

To improve the commitment to COVID-19 precautions and food safety standards, institutions should improve the food safety culture of workers. The most important component of food safety culture is the personnel. Employee behaviors and activities, from farm production procedures to customer service, all contribute to food safety and can reduce or increase the risk of disease transmission. The knowledge generated by educating personnel and promoting good behavior as well as establishing proper governance and metrics are major factors in this regard. It is critical that all employees should be aware of the procedures, methods, and behaviors that serve as preventative controls. Workers in food establishments should be educated on the importance of proper health and safety standards on a regular basis; all employees are consumers with families, and they should feel the sense of responsibility that comes with working in the food industry. As a result, they should be involved in decision-making and have the authority to apply solutions to reduce health and safety concerns. This should be reflected at all levels of the organization’s communications. Food safety must go beyond rules and regulations and exist within a company’s culture in order to be successful and sustainable [41].
A potential limitation of this study is that it was based on a self-reported questionnaire regarding knowledge, attitude, and behaviors in the workplace. Thus, the results cannot be generalized in terms of all food handlers across Jordan or other countries. Another limitation may be that this survey was limited to online responses and some face-to-face interviews, which might decrease its accuracy. In addition, the questionnaire was long, and therefore, some respondents may have randomly answered the questions without reading their answers. Moreover, studying the effect of gender may have been another limitation, as females are fewer in number than males in the foodservice industry. Another very substantial limitation includes the restrictions imposed during the pandemic, where some employees were hesitant to fill out the questionnaire, thinking that it was tied to the government and regulations during the lockdowns.

5. Conclusions

In this study, only 20% of the workers had good knowledge, 56% had positive attitudes, and 55% had good practices, with a mean of 47% in terms of the total KAP score. Less one-third of employees agreed that COVID-19 precautions improved food safety levels, reduced cross-contamination, enhanced productivity in food facilities, and improved food handlers' personal hygiene to a significant degree. It is crucial that workers are trained and made more aware of suitable COVID-19 precautions in institutional foodservice facilities to encourage the application of all regulations. Workers and owners of foodservice establishments should also understand the importance of COVID-19 precautions and the implementation of food quality and hygiene assurance systems as sustainable approaches for the production, preparation, and handling of foods for local markets and for international trade, since the management of food safety risks is an economic prerequisite regardless of nationality.

Author Contributions: Conceptualization, A.N.O., A.A.A.-N., M.A. and R.A.H.; data curation, M.O.N., T.M.O., H.A., M.A.-H. and M.A.; formal analysis, A.N.O. and M.O.N.; funding acquisition, A.N.O. and A.A.A.-N.; investigation, A.N.O., A.A.A.-N., M.O.N., T.M.O. and M.A.-H.; methodology, A.N.O., A.A.A.-N., M.O.N., T.M.O., H.A., M.A. and R.A.H.; project administration, A.N.O. and A.A.A.-N.; software, M.A.-H.; supervision, A.N.O. and A.A.A.-N.; validation, A.N.O., A.A.A.-N., M.O.N., T.M.O., H.A. and R.A.H.; visualization, A.N.O., T.M.O. and M.A.; writing—original draft, A.N.O. and M.O.N.; writing—review and editing, A.N.O., A.A.A.-N., T.M.O., H.A., M.A.-H., M.A. and R.A.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Jordan University of Science and Technology (146/2021). The Article Processing Charge (APC) was funded by the Hashemite University and the Jordan University of Science and Technology.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of Jordan University of Science and Technology (21/146/2021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Acknowledgments: The authors thank the Jordan University of Science and Technology for funding this research and the Hashemite University for funding the APC.

Conflicts of Interest: The authors declare no conflict of interest.

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