

Evaluation of the Behavioral Changes Related to Food Hygiene and Safety During COVID-19 Outbreak

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Abstract

Background: The aim of the present study was to investigate behavior changes related to food hygiene and safety during Covid-19 outbreak.

Methods: In this cross-sectional study, a digital questionnaire was used to collect the data. The questionnaire consisted of 36 questions in three sections: demographic characteristics, knowledge of food hygiene during the coronavirus epidemic, and food hygiene performance before and after Covid-19 outbreaks.

Results: 675 questionnaires were completed. The ways through which foods are washed and subsequently packed, before and after the Covid-19 outbreak, have changed significantly. It was revealed that the use of dishwashing liquid, sanitizing liquid, vinegar ($P<0.001$), and alcohol ($P=0.03$) has drastically increased for washing the fruits; salt and bleach are used for washing the vegetables ($P<0.05$), and dishwashing liquid, sanitizing liquid and alcohol for washing egg and packaged food ($P<0.001$) after the outbreak. Covid-19 caused 35.5% of the participants to avoid sweetmeat, 23.7% of them did not use takeaway foods, and 21.4% of them eliminate nuts and seeds from their diet.

Conclusion: According to the results of this study, people's knowledge about coronavirus transmission and food disinfection is insufficient. Given that people's knowledge about the mentioned cases can affect the choice of food groups and the quality of people's diet, introducing valid information sources and providing necessary training to people in the community can lead to the correction of beliefs and behaviors regarding food hygiene during the Corona outbreak.

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Introduction

The new coronavirus, known as Covid-19, first emerged in China in late 2019 and grew rapidly throughout the world. The disease, induced by the SARS-CoV-2 virus (severe acute respiratory syndrome coronavirus 2), affects a large number of people every day¹ According to the World Health Organization (WHO), since the outbreak of the disease until January 31, 2021, over 102

million people in 222 countries have been infected with the disease and more than 2.2 million people have died.²

Given its rapid spread, the new coronavirus has become a global challenge to the extent that its prevalence has increased 13-fold in countries outside China, and 114 countries have been affected since the first person was infected by March 11, 2020.³ Upon identification of the first case of Covid-19 in Qom, Iran, 14,991 cases of COVID-19 and 853 deaths from

29 provinces of Iran have been reported until March 16, 2020.⁴

The main concern about COVID-19 is the way it is transmitted since the lack of any clinical signs in the early stages of the virus development makes it difficult to identify how it is transmitted.⁵ Although COVID-19 is a respiratory disease mainly transmitted through direct contact with respiratory droplets caused by sneezing and coughing in an infected person,⁶ given the transmission of many known infectious diseases through food, water, and the environment,⁷ concerns have grown about the spread of the coronavirus through food. Nonetheless, there is no conclusive evidence showing that the virus can be transmitted through food and food packaging. Moreover, the impact of factors such as ambient temperature and humidity on the persistence and spread of the Covid-19 virus has not been adequately examined.⁸ Likewise, given the lack of any approved treatment for this disease,^{9, 10} the use of preventive behaviors by people in the community is one of the most effective ways to prevent the disease and promote health.¹¹

The outbreak of coronavirus has a destructive impact on global health systems, and it has affected not only the physical body, but also the psychosocial health and all aspects of human life.¹² At the same time with the outbreak of the disease in the community and in line with the announcement as to prevent this disease, contradictory information about the principles of food hygiene and safety was also spread. As misleading information about public health can complicate the status quo, it is vital to properly guide public opinion through further education.¹³ The aim of this study was to examine the health and food safety changes of the community after the outbreak of coronavirus in order to provide effective solutions and decisions to improve knowledge and enhance people's quality of life.

Methods

Study Design

This is a cross-sectional study conducted between June 20 and December 10, 2020 using an online self-report questionnaire to assess awareness and examine the changes associated with food hygiene and safety after the outbreak of COVID-19 in Shiraz, Iran. Online studies of this type not only are recommended as a method for rapid access to individuals, but also ensure their safety in pandemic situations.

The questionnaire used in this study was written in Persian and gained the approval of two experts in the field of food hygiene and nutrition. After the questionnaire was evaluated and the ambiguities were also resolved by 15 respondents, the preparation steps for online distribution were taken, and finally they were distributed online through social media (Telegram and WhatsApp).

The snowball method was used to distribute the questionnaire such that a number of questionnaires were sent to the available people and then they each sent the questionnaire to the available people. Moreover, given the lack of a similar study, a total of 675 individuals were selected as the research sample, using the sample size formula to estimate a ratio and $P=50%$, and an error of 0.05. The research protocol of the study was approved by the Research Ethics Committee of Shiraz University of Medical sciences (IR.SUMS.REC.1399.413).

Study Participants

All participants who lived in Shiraz were selected from volunteers recruited through a digital ad to participate in the study. Inclusion criteria for our study were age over 18, internet access and conditions for answering the digital questionnaire online and also residence in Iran. People from all walks of life could participate in the study. After starting to answer the questionnaire, if participants were not willing to continue their cooperation, they were free to withdraw from the study. The poll was recorded only if all the questions were answered.

Questionnaire

The questionnaire was digital and was devised by the researchers of this research. The digital questionnaire employed in this study contained three parts. The first part contained demographic information including age, sex, level of education, employment status, and marital status. The second part consisted of 16 questions about people's knowledge of food hygiene during the coronavirus epidemic like ways of transmitting corona through food as well as its persistence in heat and humidity. Likewise, participants were asked about the ways they received information about coronavirus. In the third part of the questionnaire (Questions 17 to 36), the participants' food hygiene performance before and after coronavirus outbreaks was compared. Participants could provide one or more answers to some questions of the questionnaire.

The digital questionnaire was produced on the "Porsline" platform (www.porsline.ir) and disseminated through the Internet. Afterwards, the link consisting of the e-form of the questionnaire was sent via social media platforms. The recipients were asked to respond if they were willing to do so. In order to prevent receiving repeated responses, the domain limited the access using IP addresses.

Statistical Analysis

Statistical analysis of the data was done using the SPSS software Ver.23. Data are reported in frequency and frequency percentage. To compare the qualitative variables, we used the Chi-square test. McNemar test

was used to compare the frequency of answers before and after the outbreak of Covid-19 disease, and P value < 0.05 was considered significant.

Results

Table 1 shows the general characteristics of the participants. A total of 675 men and women with a mean age of 37.7 (\pm 12.3) years participated in this study.

When asked about food hygiene training, approximately 55% of participants said they had not received any training in this area. Most of them (65.2%) cited the Internet and cyberspace as sources of information on food hygiene. Additionally, they mentioned television (54.4%), experts (44%), people around (38.7%), and short messages from the Ministry of Health (22.2) as sources of information.

Table 2 displays the participants' awareness of the Covid-19 transmission methods as well as ways to eradicate the virus. As the Table shows, most people (>55%) think that the virus is transmitted by eating

the infected food or touching infected packaged food products. In addition, when participants were asked, "Which food is more likely to transmit coronavirus?" 44% of the participants chose the option "It does not depend on the type of food"; 14% of them chose "fruits", 13.4% "dairy", 6.5% "vegetables", 6% "meat", 6.1% "nuts and seeds", and 10% chose other food groups. Differences in the answers between men and women as well as different educational levels were assessed by Chi-square test, and no significant differences were found for any of the answers.

Table 3 displays ways to wash foods and pack them before and after the outbreak of Covid-19 disease. Before the outbreak of this disease, 255 people (39.1%) used water alone to wash the fruit and after the outbreak of the disease, the number significantly decreased to 89 people (13.6%), ($P < 0.001$) and the use of dishwashing liquid, sanitizing liquid, vinegar ($P < 0.001$ for all of them) and even alcohol ($P = 0.03$) for washing the fruits has increased significantly after the outbreak of

Table 1: General characteristics of the subjects

General characteristics		Frequency (%)
Age (years)	17-25	119 (18.2)
	26-35	188 (28.8)
	36-45	150 (23)
	46-60	196 (30)
Marital status	Single	242 (37.1)
	Married	411 (62.9)
Level of education	High school	124 (19)
	Diploma	140 (21.4)
	Associates	60 (9.2)
	Bachelors	216 (33.1)
	Masters or higher	113 (17.3)
Gender	Male	210 (32.2)
	Female	443 (67.8)
Employment status	Unemployed/housewife	344 (52.7)
	Employed	309 (47.3)
Income (Iranian currency, Rial)	Less than 30 million	285 (43.6)
	30-100 million	319 (48.9)
	More than 100 million	49 (7.5)

Table 2: Participants' awareness about Covid-19 virus transmitting and death

Statement	Frequency of responses (%)		
	Yes	No	I don't know
Is it possible to become infected with the Covid-19 virus by eating infected food?	360 (55.1)	97 (14.9)	196 (30)
Is it possible to become infected with the Covid-19 virus by just touching infected packaged food products?	375 (57.4)	241 (36.9)	37 (5.7)
Does refrigerating food (Temperature 0- 4 ° C) eliminate the Covid-19 virus?	31 (4.7)	549 (84.1)	73 (11.2)
Does freezing food (Temperature -18 ° C) eliminate the Covid-19 virus?	48 (7.4)	575 (88.1)	30 (4.6)
Does the Covid-19 virus die at normal cooking temperatures?	487 (74.6)	110 (16.8)	56 (8.6)
Does cooking food at high temperatures have an effect on killing the Covid-19 virus?	194 (29.7)	383 (58.7)	76 (11.6)
Can preparing food by people with suspected symptoms of respiratory illness cause the Covid-19 virus to be transmitted to food?	582 (89.1)	43 (6.6)	28 (4.3)
Does the use of gloves when preparing food reduce the transmission of Covid-19 virus to food?	357 (54.7)	265 (40.6)	31 (4.7)
Do you know the proper methods for disinfecting equipment and surfaces in contact with food?	586 (89.7)	67 (10.3)	0
Can using a dishwasher disinfect dishes?	366 (56)	146 (22.4)	141 (21.6)
Does drinking alcohol help prevent or treat Covid-19 disease?	18 (2.8)	600 (91.9)	35 (5.4)

Table 3: Washing methods of food and food packaging before and after the outbreak of Covid-19 disease

Statement	Multiple-choice responses	Frequency of responses (%)		Pvalue ^a
		Before ^b	After ^b	
What method (s) did you sanitize the fruits before and after the outbreak of Covid-19 disease?	Water	255 (39.1)	89 (13.6)	<0.001
	Water + dishwashing liquid	261 (40)	429 (65.7)	<0.001
	Sanitizing liquid	171 (26.2)	258 (39.5)	<0.001
	Water+vinegar	168 (25.7)	224 (34.3)	<0.001
	Water+salt	257 (39.4)	259 (39.7)	0.92
	Bleach	11 (1.7)	17 (2.6)	0.3 ^c
	Alcohol	0	6 (0.9)	0.03 ^c
What method (s) did you sanitize the vegetables before and after the outbreak of Covid-19 disease?	Water	144 (22.1)	75 (11.5)	<0.001
	Water+dishwashing liquid	305 (46.7)	346 (53)	0.01
	Sanitizing liquid	238 (36.4)	326 (49.9)	<0.001
	Water+vinegar	203 (31.1)	248 (38)	0.004
	Water+salt	323 (49.5)	285 (43.6)	0.02
	Bleach	5 (0.8)	22 (3.4)	<0.001 ^c
	Alcohol	0	0	-
What method (s) did you use to wash eggs before and after the outbreak of Covid-19 disease?	Other	0	0	-
	No washing	379 (58)	277 (42.4)	<0.001
	Water	220 (33.7)	218 (33.4)	0.95
	Water+dishwashing liquid	130 (19.9)	259 (39.7)	<0.001
	Sanitizing liquid	30 (4.6)	92 (14.1)	<0.001
	Alcohol	0	18 (2.8)	<0.001 ^c
What method (s) did you use to clean the food packaging before and after the outbreak of Covid-19 disease?	Other	0	0	-
	No cleaning	420 (64.3)	17 (2.6)	<0.001
	Water	203 (31.1)	106 (16.2)	<0.001
	Water + dishwashing liquid	110 (16.8)	415 (63.6)	<0.001
	Sanitizing liquid	36 (5.5)	204 (31.2)	<0.001
	Alcohol	24 (3.7)	231 (35.4)	<0.001
	Other	0	0	-

^aMcNemar test was used with a significance level of P<0.05; ^bBefore and after the outbreak of Covid-19 disease; ^cBinomial distribution used

Table 4: The effect of Covid-19 disease on the elimination of food groups

Statement	Multiple-choice responses	Frequency of responses (%)
Sanitization problems and the fear of becoming infected with the Covid-19 virus have caused which food group(s) to eliminate from your diet?	Fruit	17 (2.6)
	Vegetable	92 (14.1)
	Meat	0
	Nut and seed	140 (21.4)
	Sweetmeat	219 (33.5)
	Fast food and takeaway food	155 (23.7)
	Egg	0
	Dairy	17 (2.6)
	None	299 (45.8)

the disease. With regard to washing the vegetables, before the outbreak of disease, 144 people (22.1%) used water alone and after the outbreak of the disease, the number significantly decreased to 75 people (11.5%), (P<0.001); moreover, the use of dishwashing liquid, sanitizing liquid, vinegar, salt, and bleach for washing the vegetables has increased significantly after the outbreak of the disease (P<0.05).

Table 4 shows the kinds of food groups that have been eliminated from the participants' diets due to the Covid-19 disease. Nearly 33.5% of the participants stated that sanitization problems and the fear of becoming infected with the Covid-19 virus made them eliminate sweetmeat from their diet.

More than half of the participants (57%) asserted that the cooking time of food rose after the outbreak than it used to be, and 43% stated that their cooking time had not changed. Additionally, a total of 27.1% of the participants stated that before the Covid-19 outbreak, they used to heat the bread before consumption, and after the outbreak, the number increased to 73.4%, which was significantly higher than it used to be (P<0.001). Moreover, the number of people who heated nuts and seeds before consumption rose from 3.7% to 58.5% after the outbreak (P<0.001).

Discussion

The present study revealed that the prevalence of

Covid-19 disease had a great influence on individuals' lifestyle, washing methods, food preparation, and diet, so that some food groups had even been removed from the people's diet. Most participants do not know exactly how the Covid-19 virus is transmitted, and more than half of them think that the coronavirus is transmitted by eating contaminated food or touching contaminated packaged food. This understanding is probably common among people following unreliable sources of information.

In our study, 55% of people asserted that they had not received any training on food hygiene in coronary conditions. In a public health crisis, access to precise and credible information is of utmost importance, and this can help people gain a better understanding of the crisis. Lack of proper education not only raises concerns about people's trust in false information sources and the spread of misconceptions, but can also affect the people's quality of life.

In this study, the mostly used source of information was the Internet and cyberspace (62.2%) and the least used source was the messages of the Ministry of Health (22.2%). Gender, age, and level of concern about Covid-19 were the factors influencing the choice of news sources in this study.¹⁴ A Taiwanese study found that women received more information from traditional media and family members. Older people were also found to prefer the use of traditional news media than searching the Internet. However, healthcare workers are likely to learn from formal courses, medical staff, and colleagues.¹⁴ In another study that investigated the news sources utilized by people in six countries of Argentina, Germany, South Korea, Spain, the United States, and the United Kingdom, it was shown that, in addition to age, education level and political affiliation affected which source of news people tended to select. People with higher education rely more on health-related information and specialists' views. Moreover, young people and those with low education were shown to use social networks with higher frequency.¹⁵ In our study, most of the participants were housewives and unemployed women. In another study carried out in Iran, the Internet was the chief source of information for the people during the Corona era, while people considered the most reliable source of information to be health professionals.¹⁶ Consequently, the degree of access to news sources can be one of the effective factors in adopting a news source in Iran. Regrettably, given that social media has played a negative role in spreading wrong information and misconceptions about Covid-19 among people,^{17, 18} it cannot be mentioned as a reliable source on Corona issues, and more people need to be educated to pick the right and reliable news sources.

In the present study, most people (55%) thought that the coronavirus could be transmitted through contaminated food or food packaging. The WHO

had previously reported the transmission of the coronavirus through respiratory droplets and, in an interim guide, stated that the coronavirus was unlikely to be transmitted to humans through food.⁵ Nonetheless, discrepancies in the results of different studies and the lack of a definitive announcement by the relevant organizations regarding the transmission of the virus through food have increased the concerns in this regard among the people although more than a year has passed since the epidemic of Covid-19. The presence of the SARS-COV virus in human fecal samples reported in some studies increased the likelihood of transmission of the coronavirus through food.¹⁹ Yet, according to the latest announcement from the Food and Drug Administration (FDA), the virus is not likely to be transmitted through food and food packaging.²⁰ The organizations have declared food resources and food packaging as safe and healthy. According to the FDA, the amount of transmissible virus is very low when it comes in contact with food packaging or food inhalation, and the possibility of contamination is minimal.²⁰

In our study, when people were asked which food was more likely to transmit the coronavirus, 44% of them believed that the type of food did not affect the transmission of Covid-19 through food. However, among the participants in this study, fruit (14%) and dairy (13.6%) had the highest probability of transmitting Covid-19. This negative attitude towards the possibility of transmitting the coronavirus through fruits and dairy products can be effective in reducing the consumption of these two valuable nutrients. Although we did not ask questions in the present study as to why these options were selected, we assume that concerns about the transmission of coronavirus through fruits may be related to the persistence of the coronavirus on the surface of substances²¹ as well as the raw consumption of this nutrient. However, according to WHO, there have been no reports of coronavirus through the consumption of fruits and vegetables.²² From our point of view, the negative attitude towards dairy products may also be due to the report of the presence of various bacteria in milk and the report of past poisoning by dairy products.²³ However, there have been no reports of transmission of the coronavirus through this nutrient in relation to milk.²⁴ It should be noted that due to the beneficial effects of fruit²⁵ and dairy products on human health,²⁶ the need for more information in this area and the help required to dispel misconceptions about the transfer of these two nutrients among the people is emphasized. Although previous studies reported negative attitudes toward meat,²⁷ in our study, meat was the least likely to transmit the coronavirus among respondents. This can be due to the consumption of cooked meat and the use of heat during the cooking process.

Examination of fruit, vegetable, and egg washing

methods before and after the coronavirus outbreak in this study showed that the use of disinfectants has increased for all three nutrients. It makes sense that fruits and vegetables that are eaten with their skin cause more concerns about transmitting the infection to people. However, excessive and improper use of disinfectants can have harmful effects. Various studies have reported an increase in the use of disinfectants as well as the misuse of substances after the Corona outbreak.^{27, 28} Recent reports also indicate an increase in visits to poisoning centers due to exposure to cleaners and disinfectants since the outbreak of coronavirus.²⁹ Adding chemical cleaners to foods (to disinfect fruits and vegetables), eating methanol, or gargling with diluted bleach are high-risk behaviors reported to be used by individuals to combat coronavirus.²⁷ In order to reduce the potential risks of improper use of disinfectants, it is better to follow the current recommendations offered by relevant reputable organizations. The WHO recommends that you should wash the vegetable fruit in the same way as before the Corona outbreak.²² The CDC also recommends washing fruits and vegetables under running water before slicing. The CDC also states that there is no need to wash fruits and vegetables with soap, detergents, or commercial detergents.³⁰

In the present study, fear of transmission of the coronavirus and food disinfection problems led to the elimination of some food groups among the subjects after the Corona outbreak. This included meat, fast foods, and ready meals, nuts, seeds, and vegetables. Buying food is one of the first reactions to the fear of transmitting the Coronavirus through food, which can lead to the removal of some food groups.¹⁷ Reduction of and change in food pattern after Coronavirus outbreak, in addition to fear of transmission and disinfection problems, can be due to traffic restrictions and spatial distance from the food preparation site. However, dietary changes after the coronavirus outbreak have been reported in many studies. Some of these changes led to improved dietary patterns and healthy choices^{31, 32} and some led to increased unhealthy eating habits.¹⁷ The Butler Bieler's study confirms changes in dietary patterns and calories after coronavirus outbreak, but in contrast to our study, this study reported higher consumption of meat, fruits, vegetables, and grains in people than before Coronavirus outbreak. They followed a healthier diet after the outbreak of Coronavirus and reduced the amount of fast food and prepared foods and increased the consumption of vegetables, fruits, and olive oil.³² A Chinese study also found a significant reduction in the frequency of consumption of rice, meat, poultry, fresh fruits and vegetables, soy products, and dairy products.³³ Although different studies have reported contrasting or varying results regarding changes in food intake after the outbreak of coronavirus, what is clear is the impact of the Coronavirus on different

aspects of people's lives and their eating patterns.³⁴

Increased cooking time and heating of bread, nuts, and seeds were other behavioral changes reported to fight Coronavirus in this study. Various studies have investigated the effect of temperature on Coronavirus stability and transfer. However, most studies have ruled out the effect of heat on its transfer; none of these studies have been related to cooking heat.³⁵⁻³⁷ Prolonged cooking and high heat cause the loss of some vitamins,³⁸ proteins and amino acids in meat and vegetables^{39, 40} and antioxidants in various foods.⁴¹ In contrast, the negative effects of high heat and longer cooking time on food have not been reported to have any positive effect on the eradication of the Coronavirus. On the other hand, according to a recent report by the FDA, the transmission of Coronavirus through food is unlikely, so it is necessary to provide more information and education to the public on ways to transmit and prevent Coronavirus from spreading misconceptions and misconduct before they are turned into people's habits and lifestyles. Although this study was the first research on people's attitudes and behavioral changes regarding food health and safety during the Covid-19 epidemic in Iran, only people who had access to social networks and media were included in this study because the study was online (illiterate people and people who did not have access to mobile phones were removed). Accordingly, the results of this study may not be generalizable to the whole community.

Conclusion

According to the results of this study, people's knowledge about Coronavirus transmission and food disinfection is insufficient. Given that people's knowledge about the mentioned cases can affect the choice of food groups and the quality of people's diet, introducing credible information sources and providing the necessary training to people in the community can lead to the correction of beliefs and behaviors regarding food hygiene during the corona outbreak.

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