

Characteristics of People in Japan Based on Their Perceptions about Food-related Risks

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The terror attacks of 2001 increased the dangers of food terrorism worldwide. Similarly, in Japan, false labeling of food and the occurrence of health hazards caused by frozen dumplings produced in China increased awareness about food safety. This study aimed to clarify the characteristics of people perceiving the risk of food contamination. A questionnaire survey on a random sample of people assessed their awareness about food defense and hygiene. Topic analysis conducted with respondents as documents and question items as terms. Univariate linear regressions conducted with topics as the objective variables and other questionnaire items as explanatory variables to understand the topic characteristics. We found that topics regarding food from abroad and where they are sold were particular concern. This study revealed how food hygiene is taken for granted in Japan, and how food protection is considered an additional factor requiring utmost care.

Keywords: food defense, food hygiene, food risk, questionnaire survey, intentional contamination

INTRODUCTION

After the September 11 attacks, countries worldwide have become aware of the dangers of food terrorism [1]. However, there have been no reports of large-scale food-mediated terrorism, although cases that threaten the safety and security of food (i.e., food frauds such as labeling over food deadlines and concealing the place of origin of food) have been reported [2, 3].

Initiatives for food safety and measures for food hygiene are becoming common [1, 4–7]. Measures to ensure food hygiene involve monitoring food and beverages to prevent foodborne health hazards. These measures cover each stage of the food supply chain, from production, transportation, packaging, cooking, and sale of food and beverages, to preventing food pollution from pathogenic microorganisms, as well as corruption and contamination of food by harmful chemical substances. In other words, measures for food hygiene ensure that consumption of food is safe and free of foodborne disease. Measures for food defense are aimed at preventing health hazards caused by intentional contamination

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of food and beverage by some foreign matter [4, 6, 7]. In other words, food defense is not against accidental contamination, such as that caused by human error, but against deliberate contamination with malicious intent. Therefore, food defense measures to maintain food safety are required not only in food factories but also in food stores and restaurants.

Although not food terrorism, there have been multiple reports of intentional foreign matter contamination in food inside and outside Japan [2]. Especially in Japan, the health hazard caused by Chinese frozen dumplings and pesticide contamination in domestic frozen foods has increased awareness about the importance of ensuring food safety in the food manufacturing process [4]. In the past 10 years, the efforts to prevent intentional contamination of foods, mainly by large food manufacturing companies in Japan have been widely recognized as food protection measures [8]. Currently, food defense is required for the management and employees of food manufacturers, food retailers, and restaurants throughout the food chain. Moreover, citizens themselves need to ensure food safety in terms of food defense at the end of the food chain. To prevent the health hazards caused by intentional contamination of food, it is important to understand citizens' viewpoints about food safety and food defense, in addition to food defense measures adopted by companies for policy making. However, there are few reports on citizens' awareness of food protection, especially for food defense. Therefore, this study conducted a questionnaire survey to clarify the characteristics influencing people's perception of the risk of future cases of food threats.

MATERIALS AND METHODS

Questionnaire Acquisition

A cross-sectional survey was conducted using an internet panel survey in January 2021. All participants were monitors registered with the panel research company. First, to recruit participants, the research company randomly sampled and created a list of about 100,000 people, aged 15–79, from among their registrants. An email was sent to everyone on this list asking if they were interested in participating in this survey. Registration of this survey was

completed when the number of participants in each group (i.e., gender, age group) reached the target sample size (103 people in each group). Participants completed the questionnaire on the web survey screen. After survey completion, each participant received a small cash reward. There were a total of 1442 participants; however, after data cleaning, the number of participants analyzed in this study was 1360.

Items of the Questionnaire

Age, gender, weight, height, family, and area of residence were already recorded when the monitor was registered with the survey panel. The questionnaire survey comprised 28 major questions, including items related to food safety, security, hygiene, and defense. Four major questions were about food uneasiness, such as location of manufacturing, the provision location, and the location of contamination to evaluate the sense of unease they experienced for each item. Table 1 shows the contents of related questions.

Data Analysis

Topic analysis (Latent Dirichlet Allocation, LDA) [9] is a method of extracting topics contained in each document from the frequency of words appearing in a document, or bag of words, in text analysis. According to the theory, if a document contains multiple topics and the probability of word occurrence is determined for each topic, then the word occurrence rate in the document can be expressed by the proportion of topics. Each respondent expresses their own views in the questionnaire. Topic analysis can be applied in cases where there is document-topic-word relationship. The questionnaires had the respondent-view-answer relationship similar to that of the document-topic-word. Although topic analysis is mainly used for textual analysis, Zhao *et al.* studied its application in the fields of biology and medicine and demonstrated its effectiveness [10]. Tanaka considered the functions of a hospital from the Diagnosis Procedure Combination (DPC [11]) data by topic analysis and examined the possibility of its application [12]. Maeda *et al.* counted the number of facilities, such as cultural facilities, near each railway station in the Kinki area

Table 1. Questions about risks in the future

Q13 Considering that there have been instances of intentional contamination of food with foreign substances (metal, pesticide, etc.), the following types of food are at high risk. ("Intentional contamination of food with foreign substances" refers to introducing foreign substances (metal, pesticide, etc.) into food with malicious intent.)
1. Food produced domestically by large domestic enterprises
2. Food produced domestically by small- and medium domestic enterprises
3. Food produced overseas by large foreign enterprises
4. Food produced overseas by small- and medium foreign enterprises
5. Food produced by privately managed domestic stores
Q14 The food sold at the following places is at high risk of intentional contamination with foreign substances.
1. Privately managed restaurants
2. Chain restaurant outlets
3. Exclusive restaurants
4. Sports stadiums (baseball grounds, etc.)
5. Kitchen cars/street stalls
Q15 The drinks sold at the following places are at high risk of intentional contamination with foreign substances.
1. Kitchen cars/street stalls
2. Sports stadiums (baseball grounds, etc.)
3. Vending machines
4. Sold directly by vendors
5. Chain restaurant outlets
Q20 Considering that there have been several incidents of intentional contamination of food with foreign substances (pesticide, etc.) in Japan, such incidents will recur in the future at the following places.
1. Food factories
2. Food service chain stores (restaurants, etc.)
3. Retail stores (supermarkets, convenience stores, etc.)
4. Food-related logistics facilities
5. Event venues (sports, etc.)
6. Stores selling imported food items

in Japan and applied topic analysis to characterize the stations [13]. Topic analysis (LDA) also derives results similar to factor analysis. Each topic is interpreted from the results.

First, for future risks (Table 1) regarding food safety and contamination, respondents were required to rate their answers on a scale of 1–6: "1: Strongly disagree," "2: Disagree," "3: Somewhat disagree," "4: Somewhat agree," "5: Agree," and "6: Strongly agree." We replaced data from 1–3 with "0" and from 4–6 with "1," so those become binary data. With the replaced data, the list was narrowed down to people with two or more "1"s to conduct topic analysis. The respondents corresponded to the "documents" in the topic analysis, whereas question items correspond to the "terms." The topic analysis was

conducted with four topics and 21 question items (terms) on the manufacturing location, the provision location, and the location of a possible future recurrence of food contamination.

Next, univariate linear regressions were executed with the weight of each topic as the objective variable and the questionnaire items not used for topic analysis as the explanatory variables. The topics were interpreted using the results of univariate linear regressions.

We performed the analysis in R4.1.0 on Windows using a topicmodels package.

RESULTS

Table 2 shows the topic-term weights. Topic 1 was

Table 2. Topic-term weights

	Topic 1	Topic 2	Topic 3	Topic 4
Place of production: Food produced domestically by large domestic enterprises	0.0000	0.0000	0.0480	0.0999
Place of production: Food produced domestically by small- and medium domestic enterprises	0.0000	0.0018	0.0554	0.1234
Place of production: Food produced overseas by large foreign enterprises	0.0639	0.0520	0.0475	0.1621
Place of production: Food produced overseas by small- and medium foreign enterprises	0.0925	0.0725	0.0462	0.1762
Place of production: Food produced by privately managed domestic stores	0.0284	0.0000	0.0569	0.0817
Place where food is served: Privately managed restaurants	0.0094	0.0281	0.0536	0.0224
Place where food is served: Chain restaurant outlets	0.0224	0.0389	0.0610	0.0000
Place where food is served: Exclusive restaurants	0.0000	0.0029	0.0392	0.0000
Place where food is served: Sports stadiums (baseball grounds, etc.)	0.0066	0.0617	0.0542	0.0000
Place where food is served: Kitchen cars/street stalls	0.0071	0.0713	0.0492	0.0346
Place where drinks are served: Kitchen cars/street stalls	0.0061	0.0793	0.0441	0.0416
Place where drinks are served: Sport stadiums (e.g., baseball grounds, etc.)	0.0000	0.0768	0.0483	0.0054
Place where drinks are served: Vending machines	0.0000	0.0046	0.0338	0.0000
Place where drinks are served: Sold directly by vendors	0.0000	0.0567	0.0405	0.0140
Place where drinks are served: Chain restaurant outlets	0.0000	0.0255	0.0462	0.0000
Place where contamination can recur in the future: Food factories	0.1358	0.0713	0.0464	0.0503
Place where contamination can recur in the future: Food service chain stores (e.g., restaurants, etc.)	0.1321	0.0675	0.0515	0.0000
Place where contamination can recur in the future: Retail stores (e.g., supermarkets, convenience stores, etc.)	0.1230	0.0648	0.0460	0.0000
Place where contamination can recur in the future: Food-related logistics facilities	0.1223	0.0677	0.0427	0.0290
Place where contamination can recur in the future: Event-venues (e.g., ports, etc.)	0.1189	0.0769	0.0433	0.0339
Place where contamination can recur in the future: Imported food	0.1315	0.0798	0.0458	0.1254

strong regarding the whole place of recurrence in the future. In addition, “food produced overseas by large foreign enterprises” and “food produced overseas by small and medium foreign enterprises” were strong as manufacturing locations. Topic 2 had a high overall location in the future. In addition, “kitchen cars / stalls” and “sports stadiums (baseball stadiums, etc.)” were at high risk as well. As for the manufacturing location, both “food produced overseas by small and medium foreign enterprise” and “food produced overseas large foreign enterprise” were high. Topic 3 was evenly high for the 21 sub-questions targeted for the topic analysis. Topic 4 revealed a high risk of overseas enterprise as a manufacturing location. Although it has the same meaning, imported food also held a high weight as the place of recurrence of contamination.

Table 3 shows the results of univariate linear regression for Topic 1. In Topic 1, the negative

t-values for the question, “Are you worried?”, indicated that they were not very worried. In response to the question, “Should measures be taken at International Political Event Venues (Summits etc.) and at International Sports Event Venues (Olympic Games etc.)?”, the t-values were positive, indicating an affirmative response. Table 4 shows the results of univariate linear regressions for Topic 2. For the question “Considering this, should such measures be adopted for food manufactured/provided at the following places?”, the responses to “Food factory” showed positive t-values at the first position, and “International sports event venues (Olympics, etc.)” appeared with a positive t-value at the second position. Moreover, for “Are you anxious about eating in the following style/places amid the coronavirus (COVID-19) pandemic?”, “Home” appeared with a negative t-value at fifth position. Table 5 shows the results of the univariate linear regressions for Topic

Table 3. Results of univariate linear regressions for topic 1 (Top 20)

No.	Question Statement	t-value	p-value
1	You worry about the following at international sports events held in the summer in Japan: Intentional contamination of food with foreign substances	-7.412	2.18E-13
2	You consider the following as “unhygienic” when eating at a restaurant: Disposable chopsticks (individually packed)	-6.544	8.45E-11
3	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called “food defense.” Considering this, such measures should be adopted for food manufactured/provided at the following places: International political event venues (summits, etc.)	6.538	8.80E-11
4	You consider the following as “unhygienic” when eating at a restaurant: wet towels (disposable)	-6.373	2.53E-10
5	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called “food defense.” Considering this, such measures should be adopted for food manufactured/provided at the following places: International sports event venues (Olympics, etc.)	6.358	2.78E-10
6	You find extra item(s), which you had not ordered, in the food parcel delivered to you. You…: dispose of all the items	-6.248	5.54E-10
7	You consider the following “unhygienic” when eating at a restaurant: Drinks placed on the table (pitchers with a lid)	-6.146	1.04E-09
8	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called “food defense.” Considering this, such measures should be adopted for food manufactured/provided at the following places: Food factories	5.919	4.11E-09
9	You consider the following “unhygienic” when eating at a restaurant: wet towels (reusable and made of cloth)	-5.776	9.48E-09
10	You consider the following “unhygienic” when eating at a restaurant: Drinks bar (self-service beverage corner)	-5.745	1.13E-08
11	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs is called “food defense.” Considering this, such measures should be adopted for food manufactured/provided at the following places: Retail stores (supermarkets, convenience stores, etc.)	5.626	2.24E-08
12	You find extra item(s), which you had not ordered, in the food parcel delivered to you. You…: upload information about this incident on SNS	-5.392	8.21E-08
13	You consider the following “unhygienic” when eating at a restaurant: Buffet style layout	-5.384	8.56E-08
14	You consider the following “unhygienic” when eating at a restaurant: Eco-friendly (i.e., reusable) chopsticks	-5.346	1.05E-07
15	You find extra item(s), which you had not ordered, in the food parcel delivered to you. You…: dispose of only the extra item(s)	-5.291	1.42E-07
16	You consider the following “unhygienic” when eating at a restaurant: Condiments placed on the table (containers with a lid)	-5.164	2.78E-07
17	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called “food defense.” Considering this, such measures should be adopted for food manufactured/provided at the following places: Food service chain stores (restaurants, etc.)	4.996	6.61E-07
18	You consider the following important buying electrical appliances: Price	4.871	1.24E-06
19	You consider the following “unhygienic” when eating at a restaurant: Disposable chopsticks (kept in a chopstick stand without packaging)	-4.663	3.42E-06
20	You consider the following important when buying clothes: Price	4.656	3.54E-06

Table 4. Results of univariate linear regressions for topic 2 (Top 20)

No.	Question Statement	t-value	p-value
1	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called "food defense." Considering this, such measures should be adopted for food manufactured/provided at the following places: Food factories	5.357	9.91E-08
2	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called "food defense." Considering this, such measures should be adopted for food manufactured/provided at the following places: International sports event venues (e.g., Olympics, etc.)	5.307	1.30E-07
3	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called "food defense." Considering this, such measures should be adopted for food manufactured/provided at the following places: International political event venues (e.g., summits, etc.)	5.223	2.03E-07
4	You consider the following "unhygienic" when eating at a restaurant: Disposable chopsticks (kept in a chopstick stand without packaging)	5.146	3.05E-07
5	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Home	-5.122	3.45E-07
6	You worry about the following at international sports events held in the summer in Japan: The spread of COVID-19	4.917	9.87E-07
7	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Event venues (e.g., stores)	4.849	1.38E-06
8	When making a purchase, you always check product labels (e.g., marks, etc.) indicating that the product has been manufactured in a factory that adopts the following measures: Food hygiene measures	4.738	2.39E-06
9	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called "food defense." Considering this, such measures should be adopted for food manufactured/provided at the following places: Food service chain stores (e.g., restaurants, etc.)	4.722	2.57E-06
10	You worry about the following at international sports events held in the summer in Japan: Heat stroke	4.661	3.46E-06
11	The frozen food you purchased has a bad (e.g., rotten, chemical, etc.) smell. You...: Eat it without worrying	-4.522	6.66E-06
12	You are worried the following will increase the risk of infection when eating at a restaurant amid the COVID-19 pandemic: Buffet style layout	4.439	9.76E-06
13	When making a purchase, you check product labels (e.g., marks, etc.) indicating that the product has been manufactured in a factory that adopts the following measures: allergen labeling	4.429	1.02E-05
14	You have child(ren) (Yes/No)	4.376	1.30E-05
15	You are worried the following will increase the risk of infection when eating at a restaurant amid the COVID-19 pandemic: Disposable chopsticks (kept in a chopstick stand without packaging)	4.360	1.40E-05
16	You consider the following "unhygienic" when eating at a restaurant: wet towels (e.g., disposable)	-4.341	1.52E-05
17	You consider that the following are important when buying food: Safety	4.307	1.77E-05
18	You check this when purchasing food: Expiry date/best-before date	4.280	2.00E-05
19	When making a purchase, you check product labels (e.g., marks, etc.) indicating that the product has been manufactured in a factory that adopts the following: Food defense measures	4.257	2.22E-05
20	Have you heard of the following terms? (Yes/No): Food security and safety	-4.170	3.24E-05

Table 5. Results of univariate linear regressions for topic 3 (Top 20)

No.	Question Statement	t-value	p-value
1	You consider the following “unhygienic” when eating at a restaurant: wet towels (disposable)	12.716	< 2E-16
2	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Home	11.904	< 2E-16
3	You worry about the following at international sports events held in the summer in Japan: Intentional contamination of food with foreign substances	10.779	< 2E-16
4	You are worried the following will increase the risk of infection when eating at a restaurant amid the COVID-19 pandemic: Wet towels (disposable)	10.222	< 2E-16
5	The frozen food you purchased has a bad (rotten, chemical, etc.) smell. You···: Eat it without worrying	10.093	< 2E-16
6	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called “food defense.” Considering this, such measures should be adopted for food manufactured/provided at the following places: International political event venues (summits, etc.)	-9.698	< 2E-16
7	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Exclusive restaurants	9.581	< 2E-16
8	You find extra item(s), which you had not ordered, in the food parcel delivered to you. You···: upload the information on SNS	9.509	< 2E-16
9	You find extra item(s), which you had not ordered, in the food parcel delivered to you. You···: dispose of all the items	9.441	< 2E-16
10	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called “food defense.” Considering this, such measures should be adopted for food manufactured/provided at the following places: International sports event venues (e.g., Olympics, etc.)	-9.419	< 2E-16
11	You consider the following “unhygienic” when eating at a restaurant: Disposable chopsticks (individually packed)	9.100	< 2E-16
12	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called “food defense.” Considering this, such measures should be adopted for food manufactured/provided at the following places: Food factories	-8.998	< 2E-16
13	You find extra item(s), which you had not ordered, in the food parcel delivered to you. You···: dispose of only the extra item(s)	8.106	1.15E-15
14	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Family restaurants	7.725	2.16E-14
15	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs (of which there have been several instances in the past) is called “food defense.” Considering this, such measures should be adopted for food manufactured/provided at the following places: Food service chain stores (e.g., restaurants, etc.)	-7.302	4.82E-13
16	The frozen food you purchased has a bad (e.g., rotten, chemical, etc.) smell. You···: upload it on SNS	7.277	5.76E-13
17	The frozen food you purchased is contaminated with foreign substances (e.g., metal, hair, etc.). You···: Upload the information on SNS	7.010	3.74E-12
18	Implementing measures to prevent instances of intentional contamination of food with foreign substances/drugs is called “food defense.” Considering this, such measures should be adopted for food manufactured/provided at the following places: Retail stores (supermarkets, convenience stores, etc.)	-6.846	1.15E-11
19	You consider the following “unhygienic” when eating at a restaurant: Drinks bar (self-service beverage corner)	6.690	3.25E-11
20	The following are important to prevent food poisoning when eating at home: Heat the food before eating	-6.669	3.74E-11

Table 6. Results of univariate linear regressions for topic 4 (Top 20)

No.	Question Statement	t-value	p-value
1	You worry about the following at international sports events held in the summer in Japan: Intentional contamination of food with foreign substances	-7.169	1.23E-12
2	You consider the following as “unhygienic” when eating at a restaurant: Buffet style layout	-6.369	2.60E-10
3	You consider the following as “unhygienic” when eating at a restaurant: Drinks bar (self-service beverage corner)	-5.873	5.36E-09
4	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Event venues (stores)	-5.751	1.10E-08
5	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Family restaurants	-5.666	1.78E-08
6	You worry about the following at international sports events held in the summer in Japan: Mass food poisoning	-5.530	3.83E-08
7	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Bars	-5.342	1.07E-07
8	You worry about the following at international sports events held in the summer in Japan: Heat Stroke	-5.136	3.21E-07
9	You worry about the following at international sports events held in the summer in Japan: Terror attack(s)	-4.992	6.75E-07
10	You consider the following as “unhygienic” when eating at a restaurant: Disposable chopsticks (kept in a chopstick stand without packaging)	-4.797	1.79E-06
11	You are worried the following will increase the risk of infection when eating at a restaurant amid the COVID-19 pandemic: Buffet style layout	-4.591	4.82E-06
12	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Buffet	-4.531	6.39E-06
13	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Exclusive restaurants	-4.382	1.27E-05
14	You consider the following as “unhygienic” when eating at a restaurant: wet towels (reusable and made of cloth)	-4.368	1.35E-05
15	You are worried the following will increase the risk of infection when eating at a restaurant amid the COVID-19 pandemic: Drinks bar (self-service beverage corner)	-4.137	3.73E-05
16	You worry about the following at international sports events held in the summer in Japan: The spread of COVID-19	-4.085	4.66E-05
17	You consider the following as “unhygienic” when eating at a restaurant: Drink put on the table (pitchers with a lid)	-3.936	8.72E-05
18	You are anxious about eating in the following style/places amid the COVID-19 pandemic: Home	-3.773	0.000168
19	You are worried the following will increase the risk of infection when eating at a restaurant amid the COVID-19 pandemic: Wet towels (disposable)	-3.624	0.000301
20	You consider the following when purchasing food: Hygiene control measures in the manufacturing process	-3.396	0.000704

3. Upon being asked “Which among the following do you consider ‘unhygienic’ when eating at a restaurant?,” “Wet towels (disposable)” appeared in the first position. For the question “Are you anxious about eating in the following style/places during the COVID-19 pandemic?,” “Home” appeared in the second position. Further, its absolute t-values were greater compared to that of other topics. Table 6 shows the results of univariate linear regressions for Topic 4. For the question “What do you worry about most at the international sports events to be held in the summer in Japan?,” “Intentional contam-

ination of food with foreign substances” appeared in the first position. Finally, for that of “What do you consider as ‘unhygienic’ when eating at a restaurant?,” “Buffet style layout” was in the second position.

DISCUSSION

The results of the topic analysis reveal that Topic 1 reaffirms questions about food manufactured in overseas factories, large and small, and elsewhere too, considering even places where the risk of future

recurrence exists. Thus, Topic 1 is concerned with overseas factories, whereas Topic 2 is concerned with places where food is offered, such as kitchen cars, street stalls, and sports stadiums. This indicates worry about cases where one or two people operate a store that is easy to start up. In Topic 3, all question items are evenly assigned and are considered to represent a group of people who are difficult to classify, that is, responders who have no decisive thoughts about food defense and hygiene. Topic 4 indicates the degree of concern about contamination that could occur during the manufacturing process, mainly in overseas factories.

The results of the univariate linear regressions showed that according to people's responses in Topic 1, they are not too worried about food hygiene or about the same in international sports events such as the Olympics. However, they seem to be of the opinion that food defense should be thoroughly implemented. Topic 2 is concerned with eating out, regardless of food hygiene and defense, especially about food sold at food stalls and about vendors at events. In addition, as a countermeasure, the "mark indicating that food defense measures are taken and food safety is ensured" on food produced in factories appears to be effective according to many who ranked this as high. Topic 3 received large *t*-values from many linear regressions. However, the question of "unsanitary for individually wrapped chopsticks" was more strongly correlated to Topic 3 than the question for "unsanitary for unwrapped chopsticks." Similarly, Topic 3 was strongly correlated to "unsanitary for disposable hand towels" than "unsanitary for reused hand towels." These represent people whose ideas are not based on logic. In Topic 4, all the question items that appeared in the top 20 had negative values, suggesting that people are not too worried and that they believe Japan's food defense measures to be effective and food hygiene not a cause of concern.

Considering the results of the topic analysis and univariate linear regressions together, Topic 1 indicates that a majority of people believe that domestically produced foods are safe, with food defense and hygiene measures in place. Topic 2 shows that people are worried about eating out, particularly concerned about food defense measures and food

hygiene in kitchen cars, food stalls, and among the people serving them food. Since a kitchen car can be set up without requiring much investment, people are worried about whether sufficient measures for food safety have been taken. Topic 3 assigns similar weight to all the question items in the topic analysis and is uncharacteristic in terms of inconsistent results. For instances, the results of univariate linear regressions relating to disposable towels and hand towels. This topic represents people who are less interested in or are not very aware about food defense and hygiene. From the results of Topic 4, it can be seen that participants consider food in Japan to be safe. A majority of food in Japan comes from overseas, although people believe that domestic production is good.

This study has a few limitations that must be acknowledged. First, data were collected only from respondents registered with the Internet Panel company, indicating a bias. Older adults who use computers and the internet may be more active and healthier than those who do not. However, panel surveys are being widely used for questionnaire surveys [14–16]. Second, this was not a population-based study; hence, the participants may not be representative of the general population in Japan. Third, the participants received a small cash reward for participating, which may affect the randomness of the sample. However, the survey company minimized the bias by creating the panels for our questionnaires using their large scale of registrants (the total number of registrants with the survey company was enormous).

CONCLUSION

People in Japan broadly come under any of the following three types based on the topic analysis of the survey responses to questions on food safety and food defense: (1) People who consider food hygiene take the executed measures for food hygiene for by all companies in their food supply chains for granted (with few exceptions). Food defense, for them, is an additional factor, but they expect it to be implemented meticulously. (2) People who understand the dangers of selling food at simple facilities such as kitchen cars, food stalls, and

through salespeople. (3) People who are indifferent or have little interest in food hygiene.

Considering that some people feel high anxiety about food, a “mark indicating that sufficient measures are taken” at food manufacturing facilities, including kitchen cars and food delivered by salespeople, can be effective in removing such concerns.

Ethics Approval

This study was conducted with the approval of the Ethics Committee of National Institute of Public Health, Japan (authorization code: NIPH – IBRA#12302). All participants provided informed consent (completed online) for data collection and storage.

Author Contribution

SM designed the project, executed the analysis, and drafted the initial manuscript. YK, TI, and MA developed the questionnaires. SM, KN, TI, and MA interpreted the results. MA directed and coordinated the project. All authors approved the final manuscript.

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Conflict of Interest

To the best of our knowledge, the named authors have no conflict of interest, financial or otherwise.

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