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Impact of COVID-19 on Food Consumption and Dietary Behavior in South Korea

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ABSTRACT

The recent outbreak of COVID-19 in South Korea has significantly raised the perceived risk of people about the new epidemic. Consumers' perceived risks made them reluctant to make face-to-face contact, changing their food consumption behavior. Knowing the changes in the food industry caused by COVID-19 can help plan mid- to long-term measures in the future. In this regard, we examined how consumers' tendency to avoid face-to-face contact changed their food consumption behaviors, and impacted on food-related industries. Our study shows that offline food consumption is expected to decrease overall while online food consumption is expected to increase. However, some offline channels such as convenience stores and marts nearby residences, the number of visitors would increase. The study also shows that eating out consumption would decrease while delivery and takeout consumption would increase. Consumers' reluctance to face-to-face contact seems to have influenced food consumption behaviors in most domains, but delivery and takeout consumption does not. Contrary to common beliefs, delivery and takeout consumption behavior rather seems to be affected by other factors.

Keywords : COVID-19, food consumption behavior, restaurant, delivery, take-out, online, retail, supermarkets

INTRODUCTION

Since the end of 2019, COVID-19 has spread around the world changing the lifestyles of the people. Concerns about infections have forced people to wear masks all the time and to refrain from going out. The disease has also altered the way people consume foods. Consumers preferred online to offline mode when they shop for groceries and bought more food than usual visiting stores less frequently (Chenarides *et al*., 2021). In some cases, people stockpiled food to prepare for the crisis (Long and Khoi, 2020). In addition, consumers increased the frequency of eating at home instead of eating out (Kartari *et al*., 2021).

South Korean consumers are not exceptions of this change. As the spread of infection intensifies, Korean consumers have also become more accustomed to online shopping instead of offline, and preferred eating at home rather than eating out. Consequently, there has been an economic turmoil in the food industry due to this behavioral change. Especially for the restaurant industry, where small-business holders who earn less than US$100,000 annually consists half of the total business, the impact was deep and harsh (Yoon, 2021). To overcome this economic crisis, the Korean government has been implementing various assistance policies. In August 2020, the government promoted the 'Restaurant Consumption Revitalization' campaign to galvanize the food service industry and offered emergency relief funds to all or partial households in Korea expecting a positive impact on the food service industry. The local government also has been operating various projects such as issuing local currency and designating a 'germ-free restaurant'. However, some criticize these government measures as rather short-sighted measures that cannot cope with the mid- to long-term changes in the food industry (Jang, 2021; Ju, 2020).

Knowing the changes in the food industry caused by COVID-19 can help plan mid- to long-term measures in the future. In this regard, we examined how consumers' tendency to avoid face-to-face contact changed their food consumption behaviors, and impacted on food-related industries.

The chapters of this study are organized as follows; in the 'literature review' chapter, we will examine what changes occurred in food consumption behavior in various regions of the world immediately after the spread of COVID-19, and studies to explain the causes of these changes; in the next chapter, we will explain our research framework presented in this study; afterwards, we will describe the data and analysis methods used in this study; next, we will examine what changes were observed for each domain of food consumption behavior immediately after the outbreak of COVID-19, and verify the impact of the consumers' tendency to avoid contact on the change in food consumption behavior; in the concluding remarks, finally, we will discuss the implication of this analysis and further research agenda.

LITERATURE REVIEW

Immediately after the World Health Organization (WHO) declared a pandemic crisis on March 11, 2020, the number of restaurant visitors in many countries, including Australia, Canada, United States, United Kingdom, and Germany, decreased by 10-20% (Dube, Nhamo & Chikodzi, 2020). There are involuntary factors such as social distancing, shelter-in-place order, and restrictions on business at restaurants where an infectious disease has occurred, but there are also cases in which people voluntarily reduced outside activities (Bartik *et al*., 2020; Alcott *et al*., 2021).

One of the biggest factors that discouraged consumers from going to restaurants is the risk perception about the disease (Sung and King, 2021). Consumers are expected to prefer cooking at home, using delivery or take out services instead of going to restaurants due to the risk perception (Zwanka & Buff, 2020).

Risk perception is a concept that includes a subjective perception of risk, and the probability of getting a disease by eating out may differ between the subjective probability and the objective probability. Previous studies have tried to find the factors that cause systematic differences between perceived risk and actual risk in various domains. These domains range from everyday topics such as automobile defects (Slovic, Macgregor & Kraus, 1987), medicine (Slovic et al., 1989) or smoking and drinking (Benthin *et al*., 1995) to nuclear waste (Kunreuther *et al*., 1990) or natural disasters (Wachinger *et al*., 2011).

Kasperson *et al*. (1988) tried to explain, through a conceptual framework, how news about disasters or epidemic spreads to people and forms social risk perception. When a new disaster occurs, information about the disaster is first transmitted and spread directly or indirectly by various members of society such as the mass media, the government, and individuals. In this process, people increase or decrease their risk perception about the disaster by assessing risks, filtering information, or attaching social values on information. Risk perception is amplified through the diffusion of information that provokes secondary impacts such as social turmoil, changes in government policies, or economic stagnation. Depending on the pathway through which information is transmitted, factors affecting risk perception may vary. When the relevant information is directly transmitted to an individual (that is, when the corresponding disaster is directly experienced), the more dramatic the experience, the longer the memory and the greater the risk perception about the disaster. In the case that the information about a disaster is transmitted indirectly (this case accounts for most of the information transmission) through conversations, mass media, or government announcements, the risk perception of the disaster increases as the bigger the volume of information transmitted, more controversial or dramatic the information. Also, when the disaster is of a new type that was not previously known, the risk perception about the disaster increases (Slovic, Lichtenstein & Fischhoff., 1984). Considering the framework presented by Kasperson et al., COVID-19 has several conditions to increase the perceived risk of the public; not only has COVID-19 been frequently reported by the press and social media (Haroon & Rizvi, 2020), but it has also sparked numerous debates about itself, especially on social media (Cinelli *et a*l., 2020; van Dijck & Alinejad, 2020), and many dramatic articles related to it have appeared (Presti *et al*., 2020); also, COVID-19 is a new disease previously unknown to mankind (Chakraborty, 2020).

As the risk perception of new diseases increases, consumers are expected to take various health prevention measures, and several theories have been proposed to explain this (van der Pligt, 1996): Subjective expected utility theory (Edwards, 1954), Theory of reasoned action (Fishbein & Ajzen, 1975), and the Health belief model (Rosenstock, 1974; Janz & Becker, 1984). According to the presented theories, when consumers' perceived risk about disease increases, it is expected that consumers will take health prevention measures. In food consumption domain, it was expected that these health prevention measures will include preference for cooking at home and delivery or takeout services, or the avoidance from sit-down restaurants (Zwanka & Buff, 2020; Chenarides, Grebitus & Lusk, 2020). Looking at the results of several studies conducted after the actual spread of COVID-19, it appears that there is a positive relation between risk perception and preventive action in food consumption domain (Sung and King, 2021;

Kachanoff *et al*., 2021; Peng & Chen, 2021).

Summarizing the former literatures, a new epidemic such as COVID-19 provokes several preventive behaviors due to high social risk perception, which is expected to cause a secondary impact in the restaurant industry. This study aims to examine how COVID-19 spread in Korean society and how the social risk perception formed in this process affected consumers' behavior and the Korean restaurant industry..

RESEARCH FRAMEWORK

According to the framework suggested by Kasperson *et al*. (1988), this study constructed a research framework as shown in Figure 1 below; information about an epidemic such as COVID-19 raises perceived risk, making consumers take several preventive behaviors. As a result of the behavioral change, secondary impacts such as economic damage, social turmoil, and change in policies are expected. In this study, we will try to examine what kind of preventive behaviors consumers took in food consumption and what factors affect these behaviors.

The preventive measures taken by consumers in the framework of this study are divided into two stages. First, as the perceived risk of a disease increases, reluctancy to contact (RTC) with other people will emerge. Then, RTC will lead to change in food consumption behavior in several domains. This study examines the effect of RTC on consumers' food consumption behavior in five domains: offline food purchasing, online food purchasing, eat-out consumption, delivery/takeout service usage and consumption by each product. As consumers are reluctant to contact with people, it is likely that they decrease offline food purchasing, or they may change their shopping area to the place where less people gather. On the other hand, online food purchasing is expected to increase due to the advantage of being able to purchase foods without contacting people. In addition, consumers will prefer to eat at home rather than eating out, and as a result, the number of meal at home or delivery/take-out service usage will increase.

The change in food consumption behavior is expected to vary depending on the characteristics of consumers. For example, the perceived risk about disease may be greater when there are other family members than when there is no other family member, and RTC is also expected to be higher for the former case than the other cases. In this study, the characteristic factors of consumers are largely divided into demographic factors and regional factors. Demographic factors include gender, age, household income, single-person households, and whether or not children exist, while regional factors include residential area, classification of urban and rural areas, and whether or not there are confirmed cases near the place of residence (Table 1).

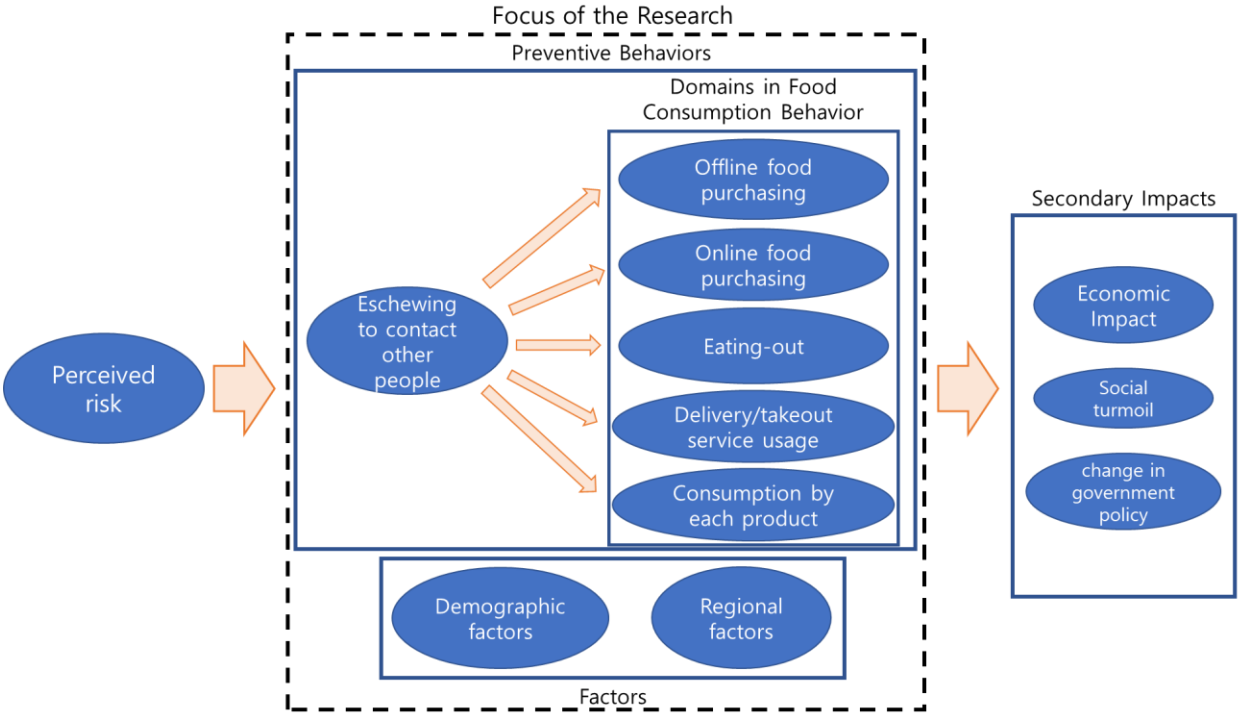

Figure 1. Framework of the research

Table 1. Demographic / Regional factors considered in the research

Demographic factors	Gender	Male / Female
	Age	
	Household income	
	Single-person household	
	Have children in the household	Have pre-school children / elementary school children / middle school or high school children
Regional factors	Region	Metropolitan cities: Seoul / Busan / Incheon / Gwangju / Daejeon / Ulsan / Sejong Provinces: Gyeong-gi / Gangwon / Chungbuk / Chungnam / Jeonbuk / Jeonnam / Gyeongbuk / Gyeongnam / Jeju
	Rural	
	COVID-19 cases are occurred within respondents' residential area (in district level)	

DATA AND METHODS

To understand changes in food consumption behavior due to COVID-19, we conducted an online consumer survey. The online consumer survey was done to the 'main food purchasers', who mainly purchase food for their household members, in *2019 Consumer behavior survey for food (CBSF)*[1]. Samples are constituted in proportion to the distribution of main food purchasers in the same survey by gender, region, and age. For the age, we could not obtain the samples over 60 since the sample were not available in online survey. Also, considering that food consumption behavior could vary depending on whether or not a respondent lives in a rural area or is a single-person household, a certain amount of the proportion of the respondent is allocated (Tables 2 and 3).

Table 2. Survey design

Subject to investigation	Food purchasers : 'Food purchasers' are identified by a questionnaire 'Do you mainly buy food and ingredients for your home?' in *2019 Consumer Behavior Survey for Food (CBSF)*
Sampling method	Population-proportional allocation : Samples are constituted in proportion to the distribution of food purchasers in *2019 CBSF* by gender, region, and age. Also, certain amounts of respondents who live in rural area (200 respondents), or living in a single-person household (250 respondents) were selected.
Size of the sample	1,000
Investigation method	Online research using email and online platform
Investigation period	March 11, 2020 - March 16, 2020

[1] *Consumer Behavior Survey for Food* is an annual survey conducted on a regular basis by Korea Rural Economic Institute (KREI) since 2013 to understand the food consumption behaviors in detail. The survey is conducted on a household basis for about 3,000~3,500 households in Korea every year. In order to represent the entire households in Korea, the sample design is carried out according to the distribution of households as shown in *Population and Housing Census* by Statistics Korea..

Table 3. Distribution of respondents by characteristics

Characteristics		Number of cases	Share in total	Characteristics		Number of cases	Share in total
Gender	Male	178	17.8	**Urban/Rural**	Urban	800	80.0
	Female	822	82.2		Rural	200	20.0
Age	20 - 29	77	7.7	**Single-person household**	Single	250	25.0
	30 - 39	273	27.3		Non single	750	75.0
	40 - 49	339	33.9	**Job**	Managers, Professionals, Office Workers	605	60.5
	50 - 59	311	31.1		Service, sales person	163	16.3
Region	Seoul	219	21.9		Equipment machine operation, assembly workers, agricultural and fishery workers, and simple labor workers	99	9.9
	Gyeong-gi / Gangwon	324	32.4		soldier	6	0.6
	Chungcheong	98	9.8		inoccupation	97	9.7
	Jeolla	109	10.9		student	20	2.0
	Northern Gyeongsang	96	9.6		freelancer	10	1.0
	Southern Gyeongsang	154	15.4	**Total**		1,000	100.0

The survey is divided into 6 parts; Offline store grocery purchase behavior, Online grocery purchase behavior, Eat-out consumption, Delivery/takeout behavior, Specific grocery purchase behavior and Diet and lifestyle. Questions in each parts were designed to seize the change in food consumption behavior before and after COVID-19 outbreak in South Korea (Table 4).

Table 4. Survey questionnaires

Part	Questionnaires
Offline store grocery purchase behavior	• Frequency in offline store grocery purchase before COVID-19 outbreak • Changes in the number of offline store grocery purchases since the outbreak of COVID-19 • Frequency in offline store grocery purchase after COVID-19 outbreak • Whether have changed the place to buy groceries offline after the outbreak of COVID-19 • Place to purchase grocery in offline - before/after change • Changes in the amount of offline store grocery purchases by item after the outbreak of COVID-19
Online grocery purchase behavior	• Frequency in online grocery shopping before COVID-19 outbreak • Changes in the number of grocery purchases online since the outbreak of COVID-19 • Frequency in online grocery shopping after COVID-19 outbreak • Average grocery purchases online last week • The proportion of online food purchases before the outbreak of COVID-19 • The proportion of online food purchases after the outbreak of COVID-19 • Changes in online grocery purchases after the outbreak of COVID-19 • Rank of main purchase online food stores after the outbreak of COVID-19 • Satisfaction with the price of food purchased online • Satisfaction with food quality purchased online • Expected change in the number of food purchases online after the end of COVID-19

Eat-out consumption	• Frequency in eat-out before the outbreak of COVID-19 • Changes in the frequency of eat-out after the outbreak of COVID-19 • Frequency in eat-out after the outbreak of COVID-19 • Changes in the frequency of eat-out by restaurant after the outbreak of COVID-19 • Expected change in the frequency of eat-out after the end of COVID-19
Delivery/takeout behavior	• Frequency in delivery/takeout before the outbreak of COVID-19 • Changes in the number of deliveries/takeouts after the outbreak of COVID-19 • Frequency in delivery/takeout after the outbreak of COVID-19 • Changes in the number of deliveries/takeouts by restaurant after the outbreak of COVID-19 • Expected to change the number of deliveries/takeouts after the end of COVID-19
Specific grocery purchase behavior	• Functional food of which a respondent increased intake after the outbreak of COVID-19 • Groceries of which a respondent increased consumption since the outbreak of COVID-19 • Groceries of which a respondent decreased consumption since the outbreak of COVID-19
Diet and lifestyle	• Number of times the family has eaten together in the past week • Changes in the number of meals with family members after the outbreak of COVID-19 • Changes in total food consumption expenditure since the outbreak of COVID-19 • Average total food purchase cost per month before/after COVID-19 outbreak • Changes in food consumption behavior due to the outbreak of COVID-19; in terms of frequency in food purchasing, location to purchase food, and frequency in eat-out with family • The degree of sensation; Grocery prices have risen since the outbreak of COVID-19 • Necessity of domestic production of agricultural products and food after the outbreak of COVID-19

Additionally, data from Nielsen Korea were used as auxiliary data to help understand the results of online consumer surveys. The Nielsen data that we used are retail sales data.

Based on the responses to the online consumer survey, we were able to find some clues that could estimate the economic impact of COVID-19 on the restaurant industry. We went one step further to figure out which characteristics of consumers could strengthen or weaken specific food consumption behaviors. As discussed in the previous paragraph, we anticipate that consumers who elevated their perceived risk will avoid interpersonal contact changing various food consumption behaviors. First, we tried to find out which characteristics of consumers reinforced RTC. An ordered logit analysis was performed under the assumption that the latent variable (y^*), which is the degree to which consumers tend to avoid interpersonal contact, is affected by the consumers' characteristics:

$$y^* = \boldsymbol{x}'\boldsymbol{\beta}$$

In the above equation, vector $\boldsymbol{x}$ represents the consumer characteristics presented in Table 1, and vector $\boldsymbol{\beta}$ is a parameter representing the effect of each consumers' characteristics on y^*. The latent variable of the survey respondents has the following relationship by being mapped with the identifiable response result (y):

$$\begin{aligned} P(y = k|\boldsymbol{x}) &= P(\mu_{k-1} < y^* \leq \mu_k|\boldsymbol{x}) \\ &= P(\mu_{k-1} < \boldsymbol{x}'\boldsymbol{\beta} + \varepsilon \leq \mu_k) \\ &= \Lambda(\mu_k - \boldsymbol{x}'\boldsymbol{\beta}) - \Lambda(\mu_{k-1} - \boldsymbol{x}'\boldsymbol{\beta}) \\ &= \frac{\exp(\mu_k - \boldsymbol{x}'\boldsymbol{\beta})}{1 + \exp(\mu_k - \boldsymbol{x}'\boldsymbol{\beta})} - \frac{\exp(\mu_{k-1} - \boldsymbol{x}'\boldsymbol{\beta})}{1 + \exp(\mu_{k-1} - \boldsymbol{x}'\boldsymbol{\beta})} \end{aligned}$$

In addition, ordered logit analysis or logit analysis was performed in the same way as above to examine how consumers' RTC changes food consumption behavior. Even though the method is almost same, the analysis mainly includes consumers' RTC as explanatory variables on food consumption behavior. As RTC is a key variable to examine its effect in this study, we added various variables that can affect food consumption behavior in stages from model 1 to 3 in addition to RTC to check the robustness of the main variable. For the additional variables, consumers' characteristics are included; in model 1, variables such as gender, age, income, and whether or not COVID-19 cases occurred within respondents' residential area are included; in model 2, presence of children in the household by type (preschool, elementary, middle and high school student) and whether or not the respondent lives in a single-person household; lastly, model 3 includes dummy variables for each region and whether or not the respondent lives in a rural area.

THE SPREAD PROGRESS OF COVID-19 IN SOUTH KOREA

The COVID-19 became known to Korea after the first report of the World Health Organization (WHO) on December 31 since it was first discovered in Wuhan, China on December 1, 2019. The first official confirmed case in Korea appeared on January 20, 2020, and the sixth confirmed case due to secondary infections appeared on January 30, followed by the cases from 7 to 11 on January 31 did. As the novel coronavirus started to spread, mass media raised its reports regarding to the new disease. On February 18, 2020, the 31st confirmed case occurred in Daegu, and the community infections spread around the Daegu/Gyeongbuk area. Subsequently, COVID-19 infection spread across the country, and the Korean government raised its crisis alert to the 'serious' stage on February 23, 2020 (Figure 2). As media reports on COVID-19 continue and the proportion is increasing day by day, and the government also pronouncing a crisis situation for the new infectious disease, the public's risk perception has grown more.

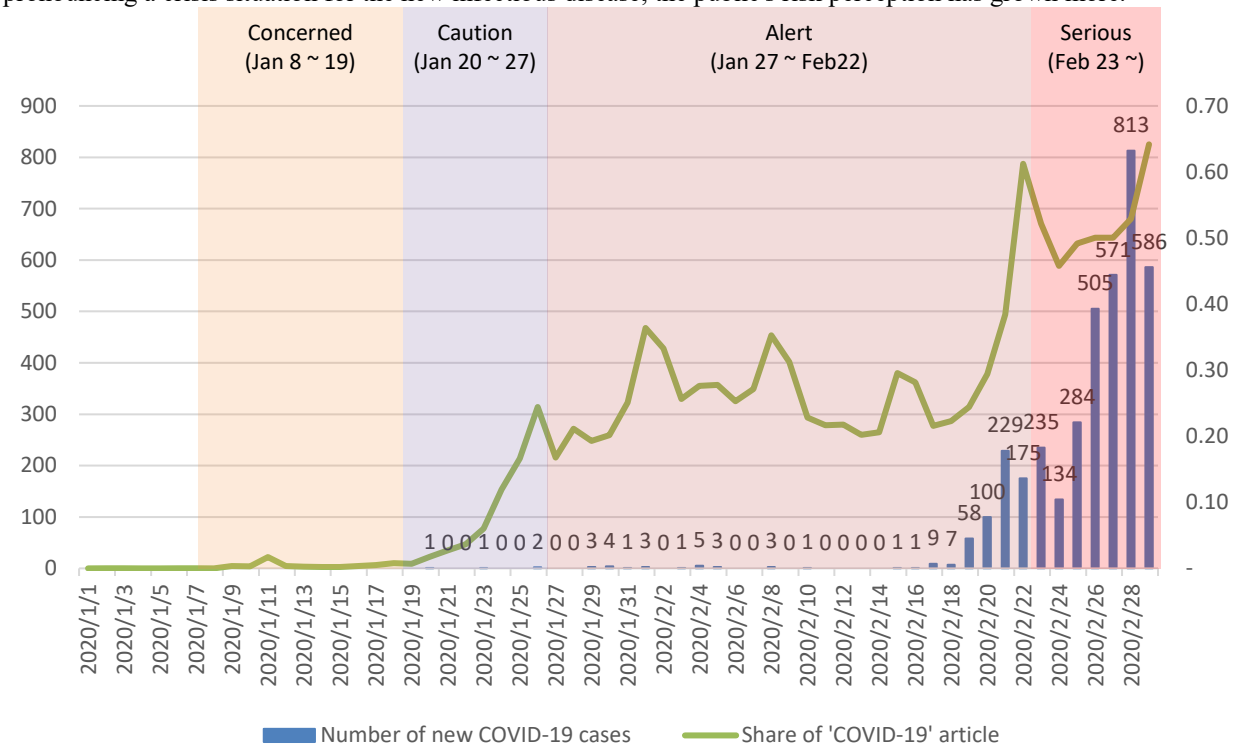

Figure 2. Daily number of new COVID-19 cases and the share of 'COVID-19' article

Source 1. Coronaboard (for the number of COVID-19 cases, retrieved from: https://github.com/jooeungen/coronaboard_kr)
2. Big Kinds (for the number of articles, retrieved from: https://www.bigkinds.or.kr/)

Note 1. The color of the graph shows the period of each alert stages pronounced by the government of South Korea

2. Share of 'COVID-19' article refers to the daily ratio of articles which have keywords such as 'COVID-19', '코로나19 (COVID-19 in Korean)', '코로나바이러스 (coronavirus in Korean)', '신종 코로나바이러스 (novel coronavirus in Korean)' in their headline or contents to the whole articles.

As the perceived risk of infectious diseases intensifies, consumers appear to eschew to make a contact with others. Ninety point eight percent (90.8%) of our survey participants answered that they refrained from going out after the spread of COVID-19 in Korea[2]. To the question of 'Do you eschew to contact others after the outbreak of COVID-19?,' 52.4 % of the survey participants said 'really I do' (Figure 3).

Among the characteristics of the respondents, gender, age, and household income variables of the respondents do not seem to affect the response results. This suggests that the tendency not to contact people after the outbreak of COVID-19 occurred in the entire population, regardless of gender, age, and income. However, the tendency seems to differ according to several characteristics of respondents; in the case of Daegu, where the local infection started in the

[2] The survey was conducted for a thousand (1,000) consumers using a structured questionnaire, and was conducted online from March 11, 2020 to March 16, 2020, by requesting the research institute MACROMILL EMBRAIN. See Appendix 1 to look the overview of the survey.

initial stage of the disease spread, there is a higher concern about infection by contact with other people than in other areas. Respondents residing in Daegu, where the local infection began, are found to shun to contact others more than in other areas. Also, if there are confirmed cases in the residential town, the tendency intensifies. It is interesting to note that concerns about infection tend to increase in the case that there are preschool children at home, and, conversely, concerns decrease in the case of single-person households (Table 5).

We suspect that the background of these results is that the perceived risk for the new epidemic is different between these groups. For example, in the case of a single-person household with only one member, compared to a household with two or more members, there is no concern about secondary infection of other household members after the initial infection. The expected loss from infection in young children may be greater than the loss expected from infection in an adult member of the family; in general, it is recognized that young children do not have strong immunity to diseases compared to adults.

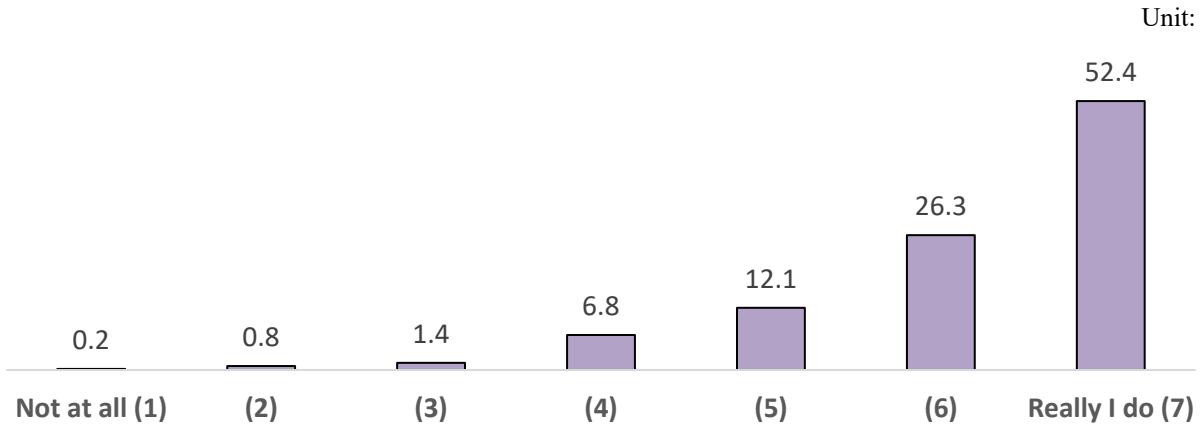

Figure 3. Respondent rates by the degree of RTC (Q. Do you eschew to contact others after the outbreak of COVID-19?)

Source: KREI online consumer survey (n=1,000)

Table 5 Factors which affect on the degree of RTC after the outbreak of COVID-19

Explanatory variables		Logit
Female		0.325 (0.171)
Age		0.004 (0.008)
Income		0.005 (0.025)
Single person household		-0.452** (0.178)
Children in the household	pre-school children	0.562** (0.220)
	elementary school children	0.279 (0.185)
	middle school or high school children	0.129 (0.175)
Region (Base=Gangwon)	Busan	0.050 (0.738)
	Daegu	1.553*** (0.356)
	Incheon	-0.144 (0.285)
	Gwangju	0.159 (0.377)
	Daejeon	-0.004

		(0.352)
	Ulsan	0.741* (0.332)
	Gyeong-gi	0.361* (0.183)
	Gangwon	1.431*** (0.510)
	Chungbuk	0.746 (0.410)
	Chungnam	1.211*** (0.418)
	Jeonbuk	-0.208 (0.328)
	Jeonnam	-0.066 (0.367)
	Gyeongbuk	0.813** (0.357)
	Gyeongnam	0.291 (0.240)
	Jeju	0.381 (0.710)
	Sejong	0.681 (0.746)
Rural		-0.042 (0.185)
Have COVID-19 cases within the residential town		0.353** (0.148)
cut1		-5.307
cut2		-3.689
cut3		-2.797
cut4		-1.349
cut5		-0.315
cut6		0.991
Pseudo R^2		0.0405
N		1,000
Log likelihood		-1188.854
d.f.		31

Note 1. The data in this analysis is retrieved from KREI online consumer survey (n=1,000)
2. The number in parenthesis refers to the standard error of each coefficients.
3. *: significant in 5%, **: significant in 2.5%, ***: significant in 1%

THE IMPACT OF COVID-19 ON SALES IN GROCERY RETAIL STORES

Despite concerns over potential shrinking of consumption due to the impact of COVID-19, the grocery sales of retailers rather increased as food consumption shifts from eat-out to home cooking. The POS (point of sales) data below shows that food sales in the retail channels increased in January 2020. However, the increase in sales could be the seasonal effect of the Lunar New Year holidays.

The volatility of food sales is within 5% range except for the periods of Thanksgiving and Lunar New Year holidays. Food sales increased in the second week of September 2019 which is Thanksgiving holiday period (part A in Figure 4). Some people bought food a week in advance because it was Friday on Thanksgiving day. Thanksgiving period in 2018 falls on the 4th week of September, but food sales shows a huge leap on the coming holiday week (3rd week of September) because Thanksgiving day in 2018 was on Monday (part B Figure 4). Food sales have not changed significantly since Thanksgiving period in 2019 until the second week of January of the following year. But in the fourth week of January, food sales increased again (part D in Figure 4). The Lunar New Year holiday in 2019 was the first week of February, but since the start of the holiday was Monday, food sales increased significantly in the previous week (part E in Figure 4).

The increase in food sales from the 3rd week of February in 2020 appears to be influenced by COVID-19 (part G in Figure 4). During this period, food sales increased 11.0% year-on-year, followed by 15.9 % year-on-year increase in the 4th week. This is the time when the 31st Super-spreader, known to have contacted 166 people in Seoul and Daegu,

was reported through the media. Also, it is the time when the government has elevated its alert to the "serious" stage. We suspect that the increase in food sales during this period is due to the fact that most of the people refrained from outside activities to avoid contact with others, converting their demand from eat-out to home-cooking.

Unit: million KRW

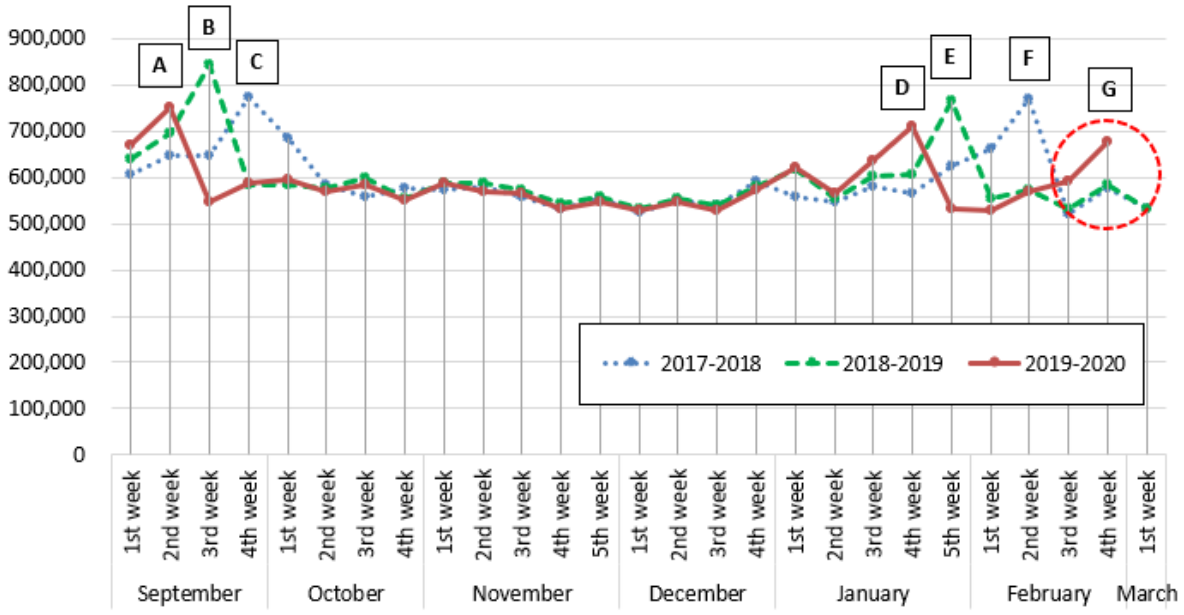

Figure 4. Retail food sales by week

Note: The data includes the online sales by hypermarkets.
Source: Nielsen Korea.

Even though the grocery sales increased, the frequency of purchases in the offline grocery stores decreased. 33.0% of the respondents of the online survey 'greatly reduced' their visits to grocery stores and 43.4% of respondents 'slightly reduced' their visits. The proportion of the respondents who said that they 'slightly increased' or 'greatly increased' their visits were only 5.2% and 2.1% respectively (Figure 5). In addition, the average purchase cycle after COVID-19 became longer than before the outbreak COVID-19. Before the COVID-19 outbreak, the proportion of respondents who visit grocery store by 2~3 times per week was about 41.7 % but after the outbreak, it decreased to 18.2 %. In contrast, the proportion of respondents who visit grocery store less than once a week increased after COVID-19 (Figure 6). An increase in grocery sales in spite of the decrease in frequency of the customers' visits shows that the amount of purchase at once has increased to refrain from going out.

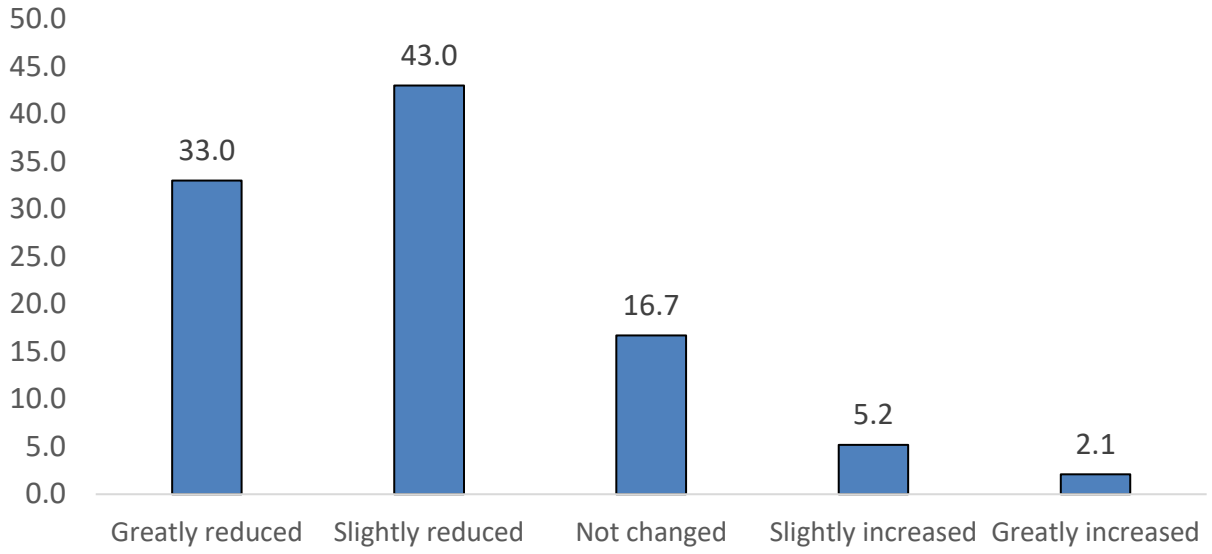

Figure 5. Respondent rates by the degree of change in frequency of offline grocery shopping after COVID-19 outbreak (Q. How has your frequency of offline grocery shopping changed after the outbreak of COVID-19?)

Source: KREI online consumer survey (n=1,000).

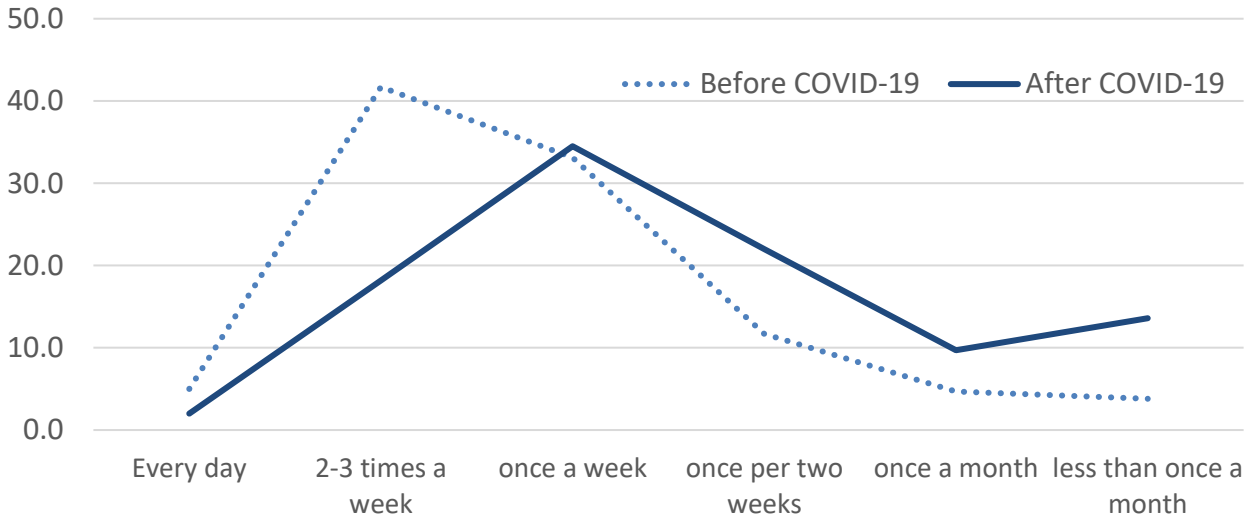

Figure 6. Comparison of offline grocery shopping cycles before and after COVID-19

Source: KREI online consumer survey (n=1,000).

Looking at the effect of the characteristics of the respondent on the result, the frequency of visit decreases as they are reluctant to contact other people. Also, even after controlling for the tendency to avoid contact with others, respondents with preschool children at home seems to reduce their visit frequency (Table 6). This suggests that these groups reduced their visit to offline grocery stores for some reason other than the reluctance to contact other people; for instance, as childcare facilities are closed after the outbreak of COVID-19, the amount of time they have to take care of children themselves increases, so the time spent on offline grocery shopping may have been reduced.

Table 6. Factors which affect on the change in frequency of offline shopping

Explanatory variables		Model 1	Model 2	Model 3
Degree of RTC		-0.734*** (0.059)	-0.700*** (0.06)	-0.692*** (0.061)
Female		0.185 (0.159)	0.290 (0.166)	0.218 (0.172)
Age		-0.005 (0.007)	-0.006 (0.007)	-0.003 (0.007)
Income		0.010 (0.024)	0.026 (0.025)	0.027 (0.025)
Have COVID-19 Cases within the residential town		-0.189 (0.135)	-0.170 (0.136)	-0.056 (0.147)
Single person household			0.201 (0.171)	0.161 (0.173)
Children in the household	pre-school children		-0.744*** (0.212)	-0.792*** (0.215)
	elementary school children		0.025 (0.175)	0.078 (0.178)
	middle school and high school children		-0.166 (0.166)	-0.245 (0.169)
Region (Base=Gangwon)	Seoul			0.223 (0.406)
	Busan			-0.279 (0.764)
	Daegu			-0.257 (0.476)
	Incheon			-0.114 (0.471)
	Gwangju			0.011 (0.519)
	Daejeon			-0.185 (0.524)
	Ulsan			0.071 (0.467)
	Gyeong-gi			-0.138 (0.399)
	Northern Chungcheong			0.572 (0.529)
	Southern Chungcheong			-0.273 (0.496)
	Northern Jeolla			0.426 (0.479)
	Southern Jeolla			0.561 (0.492)
	Northern Gyeongsang			-0.025 (0.487)
	Southern Gyeongsang			-0.035 (0.421)
	Jeju			-0.761 (0.725)
	Sejong			-1.093 (0.888)
Rural				0.300 (0.178)
cut1		-5.475	-5.205	-4.974

cut2	-3.298	-2.997	-2.729
cut3	-1.751	-1.441	-1.158
cut4	-0.434	-0.125	0.162
Pseudo R^2	0.070	0.077	0.085
N	1,000	1,000	1,000
Log likelihood	-1174.57	-1165.54	-1155.22
d.f.	9	13	30
AIC	2367.13	2357.077	2370.447
BIC	2411.3	2420.877	2517.679

Note 1. The data in this analysis is retrieved from KREI online consumer survey (n=1,000)
2. The number in parenthesis refers to the standard error of each coefficients.
3. *: significant in 5%, **: significant in 2.5%, ***: significant in 1%

COVID-19 made winners and losers in offline grocery retail channel; our research shows that several types of offline channels had increased its grocery sales, while hypermarkets lose its sales after COVID-19. We suspect that consumers who are reluctant to contact the others increased their purchases through retail stores near their residence to minimize the time to contact other people.

In the survey we conducted, 243 respondents out of 1,000 answered that they changed their offline grocery store to another type of store under the influence of COVID-19 (Figure 7). Looking at individual characteristics, the more people who try to avoid contact with other people and the younger they are, the more likely that they are to change the offline grocery channel (Table 7).

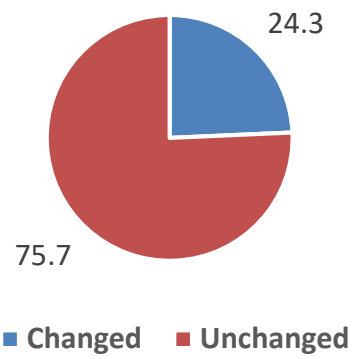

Figure 7. Respondent rates by each answer (Q. Have you changed where you buy groceries offline after the outbreak of COVID-19?)
Source: KREI online consumer survey (n=1,000).

Table 7. Factors which affect on the change in place to buy groceries offline

Explanatory variables		Model 1	Model 2	Model 3
Degree of RTC		0.435***	0.427***	0.435***
		(0.088)	(0.089)	(0.091)
Female		0.420	0.410	0.415
		(0.219)	(0.227)	(0.233)
Age		-0.029***	-0.026***	-0.029***
		(0.009)	(0.009)	(0.01)
Income		0.046	0.046	0.038
		(0.029)	(0.03)	(0.031)
Have COVID-19 Cases within the residential town		-0.106	-0.120	-0.225
		(0.173)	(0.174)	(0.187)
Single person household			0.098	0.102
			(0.224)	(0.229)
Children in the household	pre-school children		0.139	0.178
			(0.239)	(0.244)

	elementary school children		0.227 (0.203)	0.166 (0.208)
	middle school and high school children		-0.050 (0.21)	0.003 (0.215)
Region (Base=Gangwon)	Seoul			2.143* (1.046)
	Busan			2.887* (1.321)
	Daegu			1.948 (1.081)
	Incheon			1.725 (1.1)
	Gwangju			1.620 (1.148)
	Daejeon			1.994 (1.133)
	Ulsan			2.314* (1.081)
	Gyeong-gi			2.284* (1.04)
	Northern Chungcheong			2.399* (1.115)
	Southern Chungcheong			2.016 (1.107)
	Northern Jeolla			1.351 (1.162)
	Southern Jeolla			2.021 (1.119)
	Northern Gyeongsang			2.56** (1.083)
	Southern Gyeongsang			2.355* (1.054)
	Jeju			2.908** (1.28)
	Sejong			1.673 (1.509)
Rural				-0.303 (0.232)
constant		-3.133*** (0.656)	-3.277*** (0.737)	-5.164*** (1.282)
Pseudo R^2		0.040	0.042	0.062
N		1,000	1,000	1,000
Log likelihood		-532.085	-531.193	-520.426
d.f.		6	10	27
AIC		1,076.171	1,082.386	1,094.853
BIC		1,105.617	1,131.464	1,227.362

Note 1. The data in this analysis is retrieved from KREI online consumer survey (n=1,000)
2. The number in parenthesis refers to the standard error of each coefficients.
3. *: significant in 5%, **: significant in 2.5%, ***: significant in 1%

More than half of respondents who changed their offline shopping place seem to have switched their shopping place from hypermarket to other retail channels. Among the 243 respondents who changed their shopping places, 160 of them usually visited hypermarket for groceries before the outbreak of COVID-19. However, the number of respondents who usually visits the same place for grocery shopping decreases to 31 after the outbreak of COVID-19. In contrast, the number of respondents who visits neighborhood grocery stores, chain-type large grocery stores or convenience stores which are located near residential areas increases after the outbreak of COVID-19 (Table 8). Three stores types which show decrease in the number of responses in our survey (hypermarkets, conventional markets and

department stores), are considered as crowded places where a lot of consumers gather within a limited space. It is reasonable to judge that the people who avoid to contact others have changed their grocery stores to visit after the outbreak of COVID-19.

Table 8. Types of offline grocery stores respondents mostly visit (Q. If you have changed the offline places you usually shop for groceries, from where to where did you change?)

Store type	Before the outbreak of COVID-19 (A)	After the outbreak of COVID-19 (B)	(B-A)
Neighborhood grocery store	32	116	84
Chain-type large grocery store	25	47	22
Hypermarket	160	31	-129
Conventional market	18	8	-10
Department store	3	1	-2
Organic food store	3	15	12
Convenience store	2	25	23
Total	243	243	

Source: KREI online consumer survey (n=1,000).

While the offline grocery market is experiencing a huge upheaval, the online market appears to have benefited from COVID-19. According to the survey, 56.6 % of respondents increased their frequency in online grocery shopping after COVID-19, and the average cycle of online grocery shopping became shorter after COVID-19 outbreak. Furthermore, the proportion of respondents who do not shop for groceries online at all decreases from 12.4% to 10.9%, implying that some consumers have newly entered to online grocery market after the COVID-19 outbreak (Figure 8 and 9). Looking at individual characteristics, the more people who avoid contact with others, the younger they are, the higher income they earn, or as they have elementary school children at home, the more they tend to buy groceries online more often (Table 9).

Unit: %

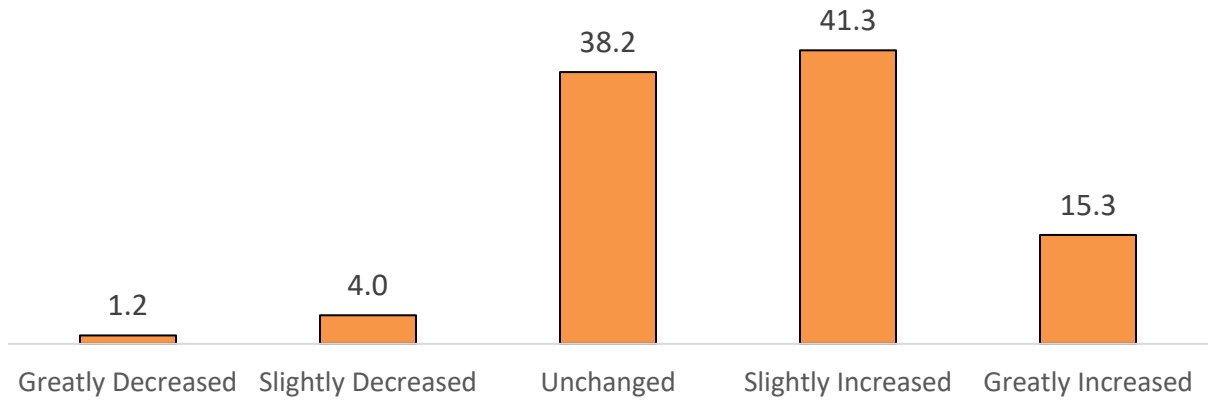

Figure 8. Respondent rates by the degree of changes in the frequency of online grocery shopping after COVID-19 outbreak (Q. How has your frequency of online grocery shopping changed after the outbreak of COVID-19?)

Source: KREI online consumer survey (n=1,000).

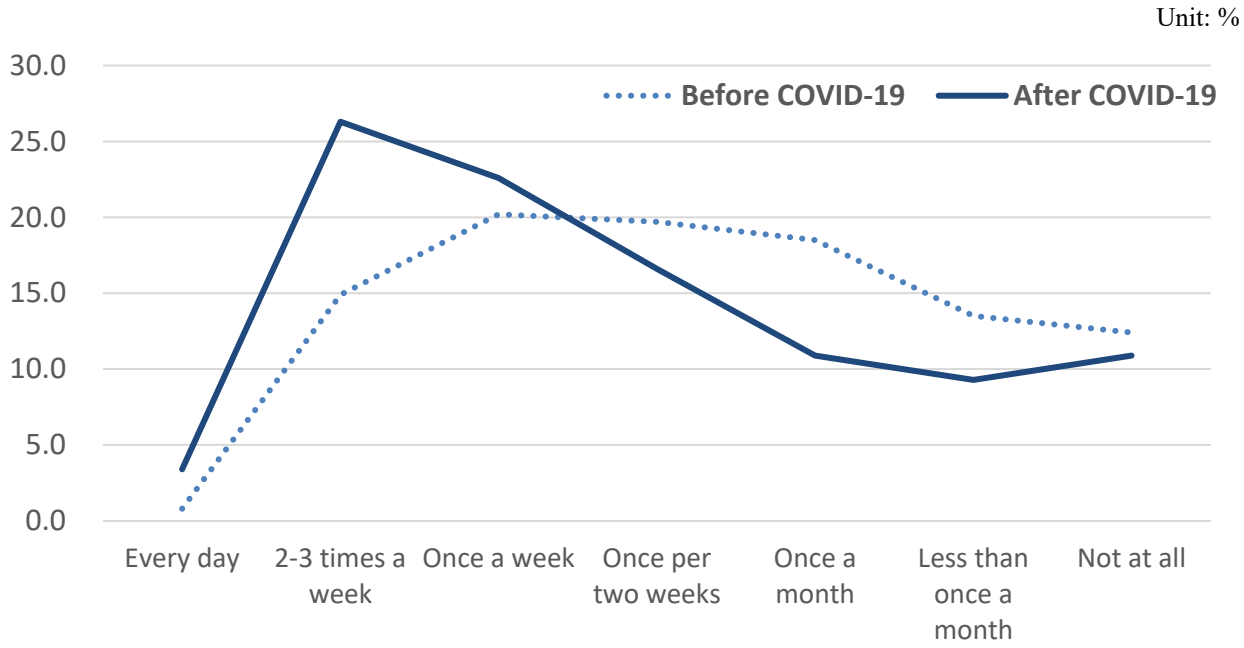

Figure 9. Comparison of frequency in online grocery shopping before and after COVID-19
Source: KREI online consumer survey (n=1,000).

Table 9. Factors which affect on the change in frequency of online shopping

Explanatory variables		Model 1	Model 2	Model 3
Degree of RTC		0.376*** (0.057)	0.366*** (0.058)	0.368*** (0.06)
Female		0.306 (0.162)	0.322 (0.169)	0.242 (0.174)
Age		-0.03*** (0.007)	-0.023*** (0.007)	-0.024*** (0.008)
Income		0.096*** (0.026)	0.103*** (0.028)	0.092*** (0.028)
Have COVID-19 Cases within the residential town		0.299* (0.138)	0.294* (0.138)	0.208 (0.149)
Single person household			0.367* (0.176)	0.39* (0.179)
Children in the household	pre-school children		0.377 (0.206)	0.425* (0.208)
	elementary school children		0.49*** (0.171)	0.47*** (0.174)
	middle school and high school children		0.066 (0.165)	0.089 (0.168)
Region (Base=Gangwon)	Seoul			0.862* (0.41)
	Busan			1.116 (0.838)
	Daegu			1.136** (0.467)
	Incheon			0.660 (0.473)
	Gwangju			0.879 (0.515)

	Daejeon			0.485 (0.52)
	Ulsan			0.590 (0.47)
	Gyeong-gi			0.854* (0.403)
	Northern Chungcheong			0.388 (0.528)
	Southern Chungcheong			1.492*** (0.501)
	Northern Jeolla			0.149 (0.499)
	Southern Jeolla			0.507 (0.51)
	Northern Gyeongsang			0.471 (0.488)
	Southern Gyeongsang			0.532 (0.428)
	Jeju			0.549 (0.728)
	Sejong			0.777 (0.797)
Rural				-0.260 (0.182)
cut1		-2.657	-2.120	-1.717
cut2		-1.143	-0.605	-0.196
cut3		1.640	2.187	2.639
cut4		3.745	4.321	4.809
Pseudo R^2		0.037	0.043	0.054
N		1,000	1,000	1,000
Log likelihood		-1,157.205	-1150.116	-1,137.58
d.f.		9	13	30
AIC		2,332.411	2,326.231	2,335.16
BIC		2,376.58	2,390.032	2,482.392

Note 1. The data in this analysis is retrieved from KREI online consumer survey (n=1,000)
2. The number in parenthesis refers to the standard error of each coefficients.
3. *: significant in 5%, **: significant in 2.5%, ***: significant in 1%

There is a sales data which supports the implication of our survey. According to the data offered by Nielsen Korea, the proportion of hypermarket's sales in food retail channel was 24.3 %, decreased by 4.8 % points compared to the previous month. On the other hand, small- to large-sized private stores which refers to the neighborhood grocery stores in our survey and convenience stores increased their proportion in sales compared to the previous month (Table 10).

Table 10. The proportion of each retail channel in food sales, 2020

Unit: %

Denominator	Food sales channel		Share (%, Jan)	Share (%, Feb)	Change in share (%)
Retail Foods	Hypermarket sales	Online	3.1	4.1	+ 1.0
		Offline	26.0	20.2	- 5.8
		Total	29.1	24.3	- 4.8
	Chain-type large grocery store		9.4	10.4	+ 1.0
	Agricultural cooperatives		8.2	8.3	+ 0.1
	Convenience stores		24.1	24.7	+ 0.6
	Private large-sized stores		17.1	19.5	+ 2.4
	Private medium-sized stores		8.3	9.0	+ 0.7

	Private small-sized stores	3.7	3.9	+ 0.2
Hypermarkets	Online	10.8	16.9	+ 6.1
	Offline	89.2	83.1	- 6.1

Source: Nielsen Korea.
Note: The data does not contain the online grocery sales from online stores in Korea except the online sales by hypermarket companies.

In order to find out whether food consumption behavior changed due to the outbreak of COVID-19 will continue after the end of the pandemic, we conducted a survey on consumers (n=891) who have purchased online food during the pandemic crisis. More than half (371 out of 566) of the respondents who said they increased their online food consumption after the outbreak of COVID-19 responded that they are willing to maintain or increase the current consumption level even after the end of the COVID-19 outbreak (Figure 9 and Table 11).

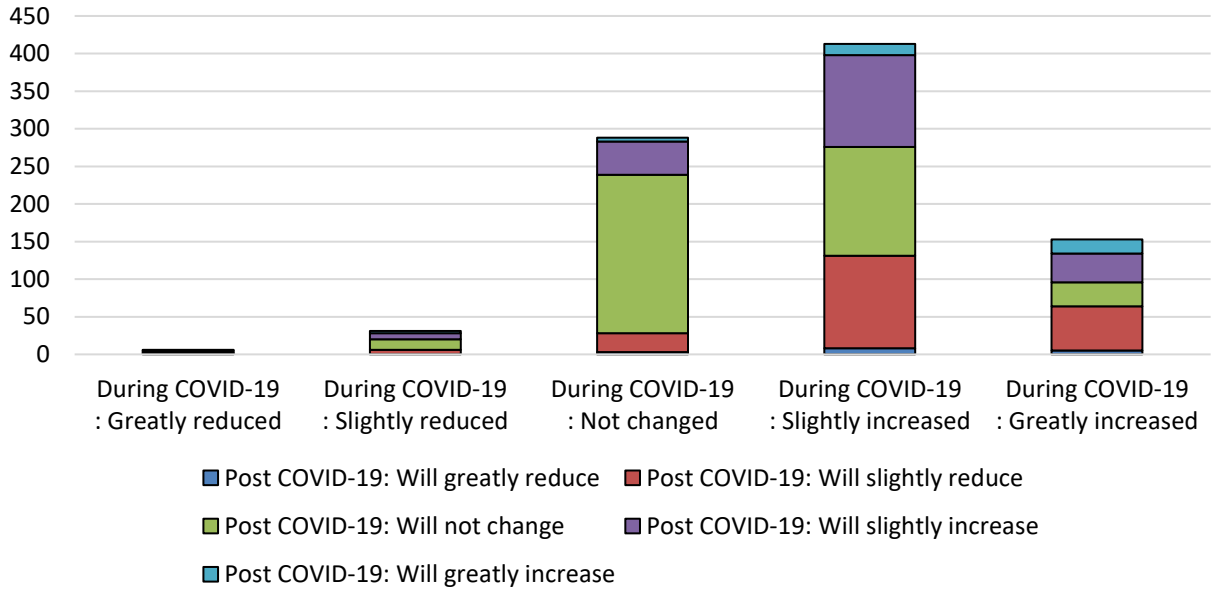

Figure 9. Intention to change online grocery purchase frequency after the end of COVID-19 crisis, compared to the current status (Q. How will you change the frequency of online grocery shopping compared to a current level when the COVID-19 crisis is over?)
Source: KREI online consumer survey (n=891).

Table 11. (continued)

During COVID-19	Post COVID-19					Total
	Will greatly reduce	Will slightly reduce	Will not change	Will slightly increase	Will greatly increase	
Greatly reduced	1	0	2	2	1	6
Slightly reduced	0	6	14	8	3	31
Not changed	3	25	211	44	5	288
Slightly increased	8	123	145	122	15	413
Greatly increased	5	59	32	38	19	153
Total	17	213	404	214	43	891

Source: KREI online consumer survey (n=891).
Note: colored cells refers to the number of respondents who said they increased their online food consumption after the outbreak of COVID-19 responded that they are willing to maintain or increase the current consumption level even after the end of the COVID-19 outbreak

CHANGES IN EAT-OUT AND DELIVERY OR TAKE-OUT BEHAVIOR

In the situation of the infectious disease spread, it is expected that there have been changes in the consumption patterns of eat-out (EO) and delivery or takeout services (D/TS) by consumers who want to minimize face-to-face contact. Consumers reduce their visits to restaurants while using D/TS more frequently to minimize face-to face contact.

Our survey result shows that the impact of COVID-19 is clear in decreasing the frequency of eat-outs, while the effect is not clear in increasing frequency of D/TS use. In the survey, 81.0 % of respondents said that they decreased their number of eat-outs after the COVID-19 outbreak. For D/TS, 39.4 % of respondents said they slightly increased the number of deliveries/take-out uses. However, the answer 'greatly increased' have only 5.5% in its response rate which is lower than the rate of 'greatly decreased (7.4%)' or 'slightly decreased (11.9%)' (Figure 9).

Unit: %

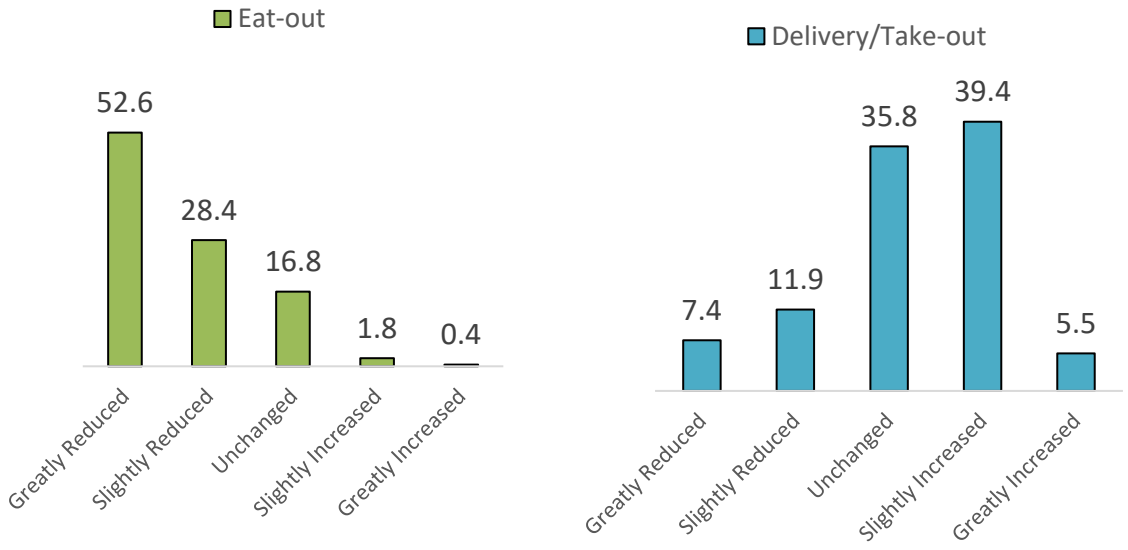

Figure 9. Respondent rates by the degree of changes in the frequency of eat-out or D/TS usage (Q. How have the frequency of eat-out with your household members and eating at home with delivery or take-out food changed since the outbreak of COVID-19?)

Source: KREI online consumer survey (n=1,000).

The response rate in the frequency of eat-outs are high in order once a week (26.1%), 2-3 times a week (23.2%), and once every two weeks (15.5%) before the COVID-19 outbreak. However, the answer 'less than once every 2-3 months' is highest after the disease outbreak (Figure 10). In the case of delivery or take-out service usage, the survey result shows polarizing pattern in response after the COVID-19 outbreak. Prior to COVID-19, response rates to D/TS cycles are high in order of 'once a week (31.0%)', '2-3 times per week (19.6%)', and 'once every two weeks (18.4%).' After COVID-19 occurrence, the order of the response rate are reversed by '2~3 times a week (27.7%)' and then 'once a week (21.4%).' 15.2 % of respondents answered 'less than once every 2-3 months' increasing 5.7 % from the previous result (Figure 11).

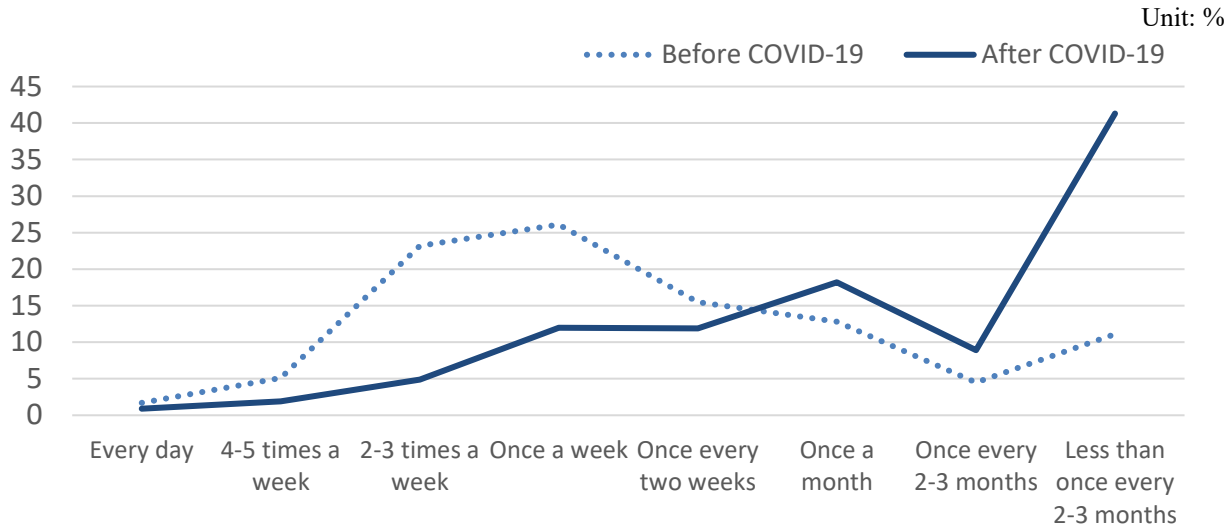

Figure 10. Changes in eat-out cycles before and after COVID-19

Source: KREI online consumer survey (n=1,000).

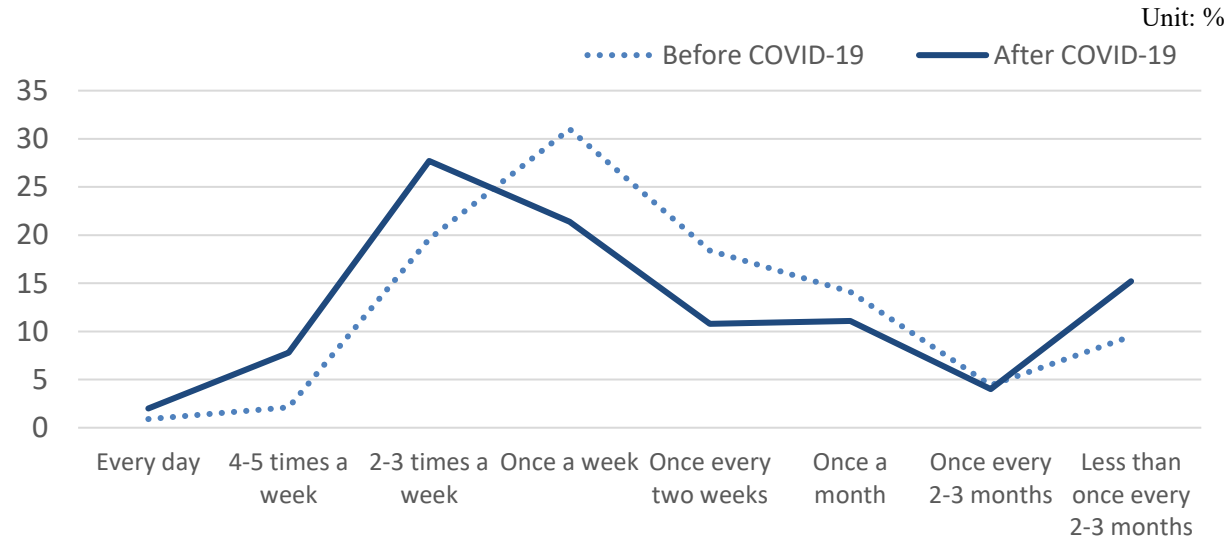

Figure 11. Comparison of delivery/take-out service usage cycles before and after the COVID-19 outbreak

Source: KREI online consumer survey (n=1,000).

Ordered logit analysis reveals that the intention to avoid contact with others has an clear effect on eat-out consumption. The greater the tendency to avoid contact with other people, the less likely they are to eat out. Also, single-person households tend to continue eat-out after the outbreak of COVID-19 compared to the other households (Table 11).

On the other hand, contrary to the original expectation, the intention to reduce contact with other people did not have a significant impact on the change in delivery or take-out use after the outbreak of COVID-19. Rather, D/TS usage appears to be only affected by age and some regional variables: Gangwon and rural where D/TSs are less accessible compared to the other area (Table 12).

Table 11. Factors which affect on the change in frequency of eat-out

Explanatory variables		Model 1	Model 2	Model 3
Degree of RTC		-0.564***	-0.517***	-0.493***
		(0.059)	(0.06)	(0.061)
Female		-0.4**	-0.153	-0.204
		(0.165)	(0.174)	(0.18)
Age		-0.014*	-0.008	-0.008
		(0.007)	(0.008)	(0.008)
Income		-0.057**	-0.020	-0.026
		(0.025)	(0.025)	(0.026)
Have COVID-19 Cases within the residential town		-0.312*	-0.275	-0.151
		(0.139)	(0.141)	(0.153)
Single person household			0.708***	0.691***
			(0.181)	(0.185)
Children in the household	pre-school children		-0.447	-0.503*
			(0.232)	(0.235)
	elementary school children		-0.369	-0.326
			(0.191)	(0.195)
	middle school and high school children		-0.036	-0.068
			(0.174)	(0.178)
Region (Base=Gangwon)	Seoul			0.442
				(0.435)
	Busan			-2.487
				(1.291)
	Daegu			-0.333
				(0.52)
	Incheon			0.347
				(0.506)
	Gwangju			-0.360
				(0.579)
	Daejeon			0.206
				(0.561)
	Ulsan			-0.145
				(0.51)
	Gyeong-gi			0.348
				(0.427)
	Northern Chungcheong			0.323
				(0.547)
	Southern Chungcheong			0.198
				(0.527)
	Northern Jeolla			1.433***
				(0.509)
	Southern Jeolla			0.921
				(0.523)
	Northern Gyeongsang			-0.458
				(0.539)
	Southern Gyeongsang			0.315
				(0.45)
	Jeju			0.424
				(0.769)
	Sejong			0.419
				(0.789)
Rural				0.023
				(0.186)
cut1		-4.817	-3.824	-3.390

cut2	-3.291	-2.255	-1.773
cut3	-0.797	0.277	0.806
cut4	0.931	2.012	2.543
Pseudo R^2	0.064	0.081	0.100
N	1,000	1,000	1,000
Log likelihood	-1,019.304	-1,001.25	-981.12
d.f.	9	13	30
AIC	2,056.608	2,028.501	2,022.248
BIC	2,100.778	2,092.302	2,169.481

Note 1. The data in this analysis is retrieved from KREI online consumer survey (n=1,000)
2. The number in parenthesis refers to the standard error of each coefficients.
3. *: significant in 5%, **: significant in 2.5%, ***: significant in 1%

Table 12. Factors which affect on the change in frequency of delivery/take-out food service usage

Explanatory variables		Model 1	Model 2	Model 3
Degree of RTC		0.054	0.042	0.086
		(0.055)	(0.055)	(0.057)
Female		0.184	0.137	0.030
		(0.156)	(0.163)	(0.168)
Age		-0.029***	-0.029***	-0.034***
		(0.007)	(0.007)	(0.007)
Income		0.058**	0.05*	0.041
		(0.024)	(0.025)	(0.026)
Have COVID-19 Cases within the residential town		0.069	0.053	-0.096
		(0.132)	(0.132)	(0.143)
Single person household			0.045	0.005
			(0.169)	(0.174)
Children in the household	pre-school children		0.130	0.160
			(0.206)	(0.208)
	elementary school children		0.294	0.241
			(0.171)	(0.173)
	middle school and high school children		0.239	0.314
			(0.163)	(0.165)
Region (Base=Gangwon)	Seoul			1.142***
				(0.422)
	Busan			2.205**
				(0.855)
	Daegu			0.539
				(0.481)
	Incheon			0.707
				(0.479)
	Gwangju			1.442***
				(0.535)
	Daejeon			0.768
				(0.536)
	Ulsan			0.472
				(0.484)
	Gyeong-gi			0.772
				(0.414)
	Northern Chungcheong			0.804
				(0.518)
	Southern Chungcheong			0.633
				(0.506)
	Northern Jeolla			1.059*
				(0.494)
	Southern Jeolla			0.667

				(0.505)
	Northern Gyeongsang			0.601 (0.487)
	Southern Gyeongsang			0.992** (0.436)
	Jeju			1.031 (0.714)
	Sejong			0.880 (0.736)
Rural				-0.453** (0.175)
cut1		-3.022	-3.044	-2.511
cut2		-1.917	-1.937	-1.385
cut3		-0.252	-0.265	0.328
cut4		2.423	2.420	3.059
Pseudo R^2		0.010	0.012	0.025
N		1,000	1,000	1,000
Log likelihood		-1,327.418	-1,324.071	-1,306.116
d.f.		9	13	30
AIC		2,672.835	2,674.142	2,672.231
BIC		2,717.005	2,737.943	2,819.464

Note 1. The data in this analysis is retrieved from KREI online consumer survey (n=1,000)
2. The number in parenthesis refers to the standard error of each coefficients.
3. *: significant in 5%, **: significant in 2.5%, ***: significant in 1%

After the end of COVID-19 crisis, many consumers are expected to return to their previous EO and D/TS consumption patterns, but some are not. According to our survey, out of 1,000 respondents, 182 respondents said that the frequency of eating out after the end of the crisis would be less frequent than before the outbreak of pandemic, and 231 consumers said it will be more frequent. Also, 149 respondents answered that D/TS consumption will be less frequent, while 162 consumers answered it will be more frequent.

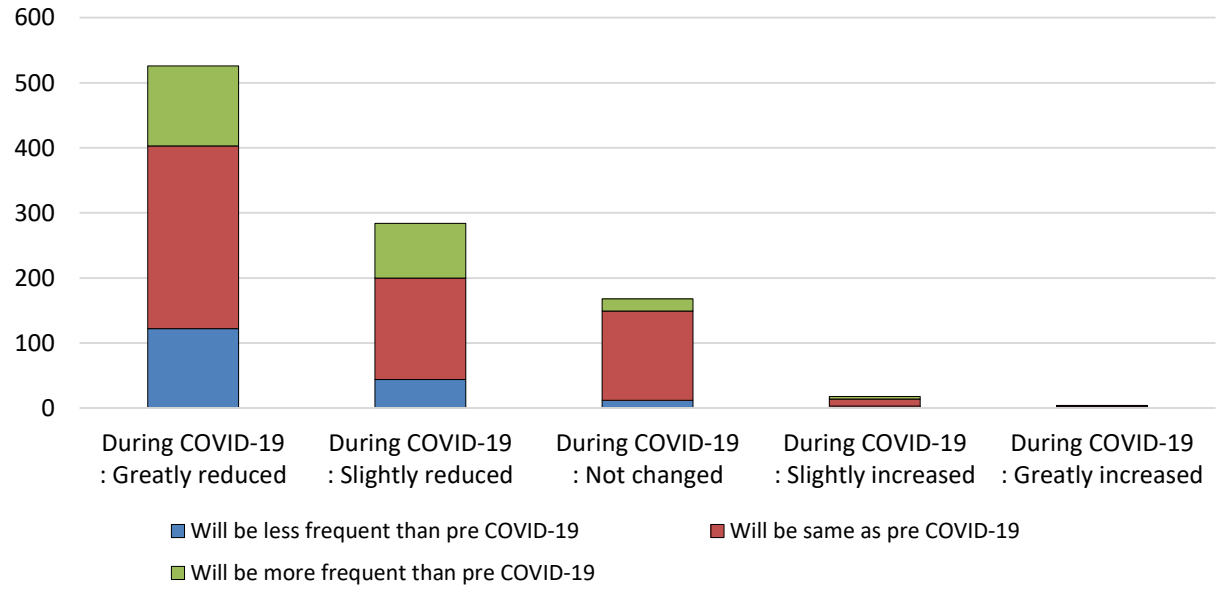

Figure 13. Intention to change EO frequency after the end of COVID-19 crisis, compared to the status before the outbreak of COVID-19 (Q. When the COVID-19 crisis is over, how will you change the frequency of eat-out compared to the level before the outbreak?)
Source: KREI online consumer survey (n=1,000).

Table 14. (continued)

During COVID-19	Post COVID-19			Total
	Will be less frequent than pre COVID-19	Will be same as pre COVID-19	Will be more frequent than pre COVID-19	
Greatly reduced	122	281	123	526
Slightly reduced	44	156	84	284
Not changed	12	137	19	168
Slightly increased	3	11	4	18
Greatly increased	1	2	1	4
Total	182	587	231	1,000

Source: KREI online consumer survey (n=1,000).

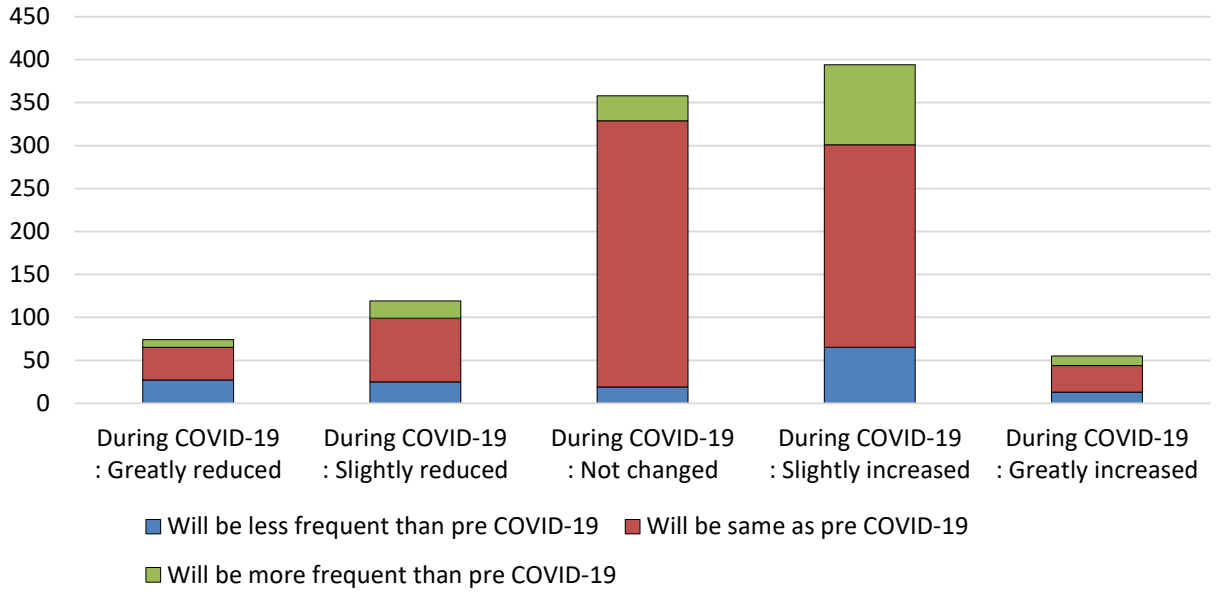

Figure 14. Intention to change D/TS usage frequency after the end of COVID-19 crisis, compared to the status before the outbreak of COVID-19 (Q. When the COVID-19 crisis is over, how will you change the frequency of delivery or take-out service usage compared to the level before the outbreak?)

Source: KREI online consumer survey (n=1,000).

Table 15. (continued)

During COVID-19	Post COVID-19			Total
	Will be less frequent than pre COVID-19	Will be same as pre COVID-19	Will be more frequent than pre COVID-19	
Greatly reduced	27	38	9	74
Slightly reduced	25	74	20	119
Not changed	19	310	29	358
Slightly increased	65	236	93	394
Greatly increased	13	31	11	55
Total	149	689	162	1,000

Source: KREI online consumer survey (n=1,000).

CHANGES IN FOOD CONSUMPTION BY EACH PRODUCT

Overall response results show that the consumption of HMR, other processed foods, and eggs have increased overall after COVID-19 (Tables 13, 14 and Figure 12). For the other food groups, respondents who answered that consumption in the offline sector decreased after COVID-19 are relatively dominant, while those who answered that consumption through online increased are relatively dominant. From these results, we suspect that online consumption has increased since the outbreak of COVID-19 regardless of food groups, and in particular, online consumption of HMR and other processed foods has increased significantly compared to the other food groups.

Table 13. Respondent rates by the degree of changes in the amount of offline grocery purchases by each item (Q. How has the amount of offline grocery purchases changed by item in your household after the outbreak of COVID-19?)

Food type		Change in purchasing amount via offline (A)							
		Greatly reduced (1)	2	3	Not changed (4)	5	6	Greatly Increased (7)	Score (7 point-Likert scale)
Non-processed	Grains	6.7	3.7	7.2	70.4	6.7	2.9	2.4	3.85
	Vegetables	5.6	8.8	18.2	44.0	14.1	6.5	2.8	3.83
	Fruits	7.1	9.5	17.7	38.8	17.2	7.6	2.1	3.81
	Meats	6.7	8.2	13.7	42.2	16.8	9.1	3.3	3.95
	Seafoods	11.3	10.9	23.5	45.6	6.2	2.0	0.5	3.33
	Eggs	5.1	4.5	10.4	49.6	15.3	11.4	3.7	4.15
	Nuts	11.3	9.2	14.2	57.0	5.7	2.0	0.6	3.45
Processed	Kimchi	8.4	5.9	11.2	64.1	6.2	3.0	1.2	3.68
	Other side dishes	9.3	10.7	16.2	43.3	12.3	6.3	1.9	3.65
	Milk products	6.7	6.3	14.1	48.2	15.0	7.4	2.3	3.90
	Drinks	7.0	9.0	14.2	47.6	12.6	6.7	2.9	3.82
	Functional foods	9.6	5.4	9.4	49.5	14.9	7.5	3.7	3.92
	HMR	9.3	7.5	11.5	35.2	18.7	12.3	5.5	4.05
	Other processed foods	7.9	9.1	12.2	38.4	15.4	11.0	6.0	4.01

Table 14. Respondent rates by the degree of changes in the amount of offline grocery purchases by each item (Q. How has the amount of online grocery purchases changed by item in your household after the outbreak of COVID-19?)

Food type		Change in purchasing amount via online (B)							
		Greatly reduced (1)	2	3	Not changed (4)	5	6	Greatly Increased (7)	Score (7 point-Likert scale)
Non-processed	Grains	0.4	0.8	2.0	68.1	16.2	6.5	5.9	4.42
	Vegetables	1.5	1.9	5.4	55.3	22.3	9.2	4.4	4.40
	Fruits	1.8	2.7	5.4	49.6	25.6	10.2	4.7	4.44
	Meats	2.1	1.5	6.2	57.4	17.7	10.2	4.9	4.37
	Seafoods	3.8	3.3	9.4	64.2	10.9	5.8	2.6	4.03
	Eggs	1.7	1.2	5.2	66.4	12.7	8.4	4.4	4.30
	Nuts	2.7	3.3	7.0	64.1	13.5	6.1	3.5	4.14
Processed	Kimchi	2.7	1.5	4.2	71.6	11.2	5.4	3.5	4.17
	Other side dishes	2.4	1.9	6.1	53.8	22.1	9.4	4.4	4.37
	Milk products	2.0	1.2	3.7	58.8	19.4	10.3	4.5	4.41
	Drinks	2.4	2.4	5.6	50.6	20.1	11.9	7.1	4.48
	Functional foods	1.6	2.5	3.9	55.1	18.6	10.0	8.3	4.50
	HMR	1.9	1.6	4.4	35.7	26.6	18.7	11.1	4.84
	Other processed foods	1.6	1.8	4.6	36.6	27.4	18.1	10.0	4.81

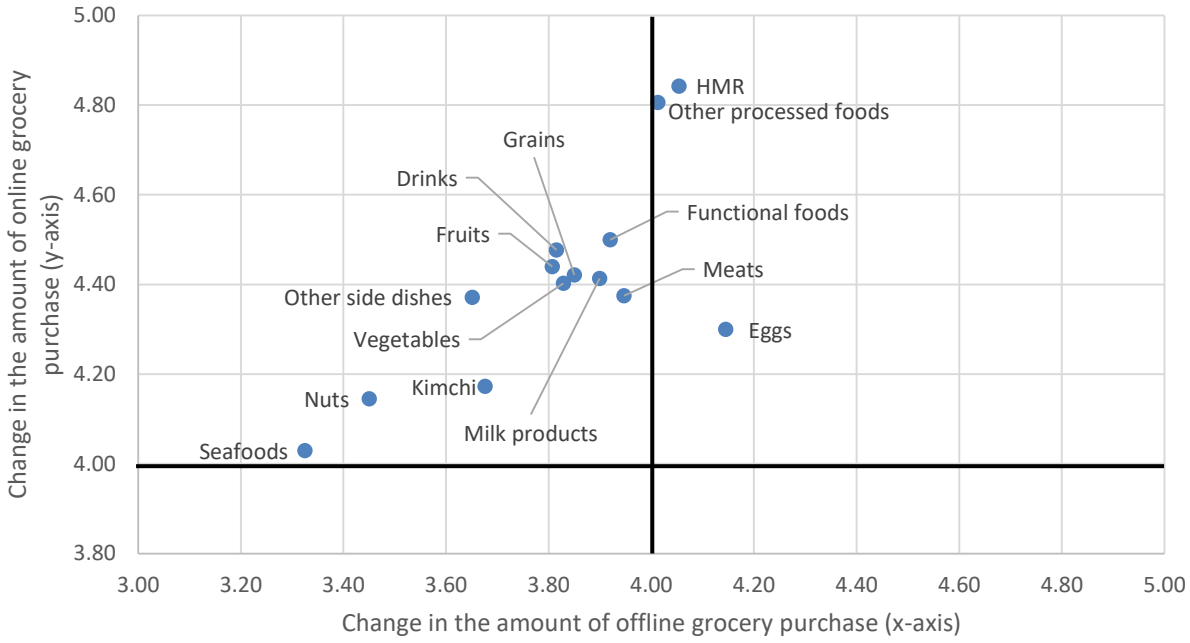

Figure 12. Change in purchasing amount via online and offline by each item

Source: KREI online consumer survey (n=1,000).
Note: The score for each category is a summary of the response results by averaging the scores between 1 and 7 on the Likert scale for each response.

We tried to investigate the effect of RTC on the purchase volume of each item by each channel through ordered logit analysis. The analysis results show that as RTC is severe, the offline purchase volume of some items such as vegetables, fruits, seafoods, and nuts decreases, while the online purchase volume of most items except nuts increases.[3] In addition, the result shows that the online consumption after COVID-19 in the food group including vegetables, fruits, meats, and all kinds of processed foods except kimchi tends to increase as the age decreases (tables 15, 16). In particular, the online consumption of HMR and other processed foods increases even more among single-person households with a younger age. These types of food are known to be easier to prepare and store than other types of food, and are highly preferred by the younger generation and single-person households (Kim, Lee and Lee, 2018; Hwang and Choe, 2016; Brunner, van der Horst and Siegrist, 2010).

[3] In the ordered logit analysis for each item, models 1 – 3 were applied to check the robustness of the degree of avoidance of contact with other people. However, we present only model 3 in this chapter because the variable is confirmed to be robust in most cases except for some items. If the corresponding variable is not robust, it is separately indicated below the table.

Table 15. Factors which affect on the change in the amount of offline grocery purchase by each item

Explanatory variables		Non-processed foods						
		Grains	Vegetables	Fruits	Meats	Seafoods	Eggs	Nuts
Degree of RTC		-0.142* [a]	-0.189***	-0.167***	-0.084	-0.201***	-0.059	-0.214***
		(0.066)	(0.056)	(0.055)	(0.055)	(0.058)	(0.057)	(0.061)
Female		0.312	0.134	0.258	0.331*	0.444***	0.241	0.185
		(0.192)	(0.162)	(0.162)	(0.165)	(0.165)	(0.172)	(0.177)
Age		0.005	-0.001	-0.008	-0.012	-0.006	0.003	0.001
		(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Income		0.009	0.012	0.020	0.066***	0.034	0.011	0.050
		(0.029)	(0.024)	(0.024)	(0.025)	(0.025)	(0.025)	(0.026)
Have COVID-19 Cases within the residential town		-0.001	0.057	0.014	0.139	0.008	-0.066	0.166
		(0.169)	(0.141)	(0.14)	(0.139)	(0.143)	(0.143)	(0.15)
Single person household		-0.036	0.038	0.035	0.071	-0.023	-0.227	0.216
		(0.196)	(0.169)	(0.168)	(0.17)	(0.173)	(0.174)	(0.187)
Children in the household	pre-school children	-0.074	-0.053	-0.203	-0.282	-0.481**	-0.042	-0.416*
		(0.241)	(0.203)	(0.199)	(0.202)	(0.199)	(0.205)	(0.205)
	elementary school children	0.146	0.232	-0.039	-0.070	0.052	-0.032	-0.026
		(0.206)	(0.171)	(0.168)	(0.169)	(0.17)	(0.174)	(0.174)
	middle school and high school children	-0.012	-0.162	-0.197	-0.076	-0.228	-0.229	-0.438**
		(0.195)	(0.162)	(0.159)	(0.162)	(0.163)	(0.166)	(0.169)
Region (Base=Gangwon)	Seoul	-0.382	-0.539	-0.381	-0.385	-0.068	0.071	-0.553
		(0.479)	(0.409)	(0.418)	(0.398)	(0.418)	(0.392)	(0.476)
	Busan	0.187	-0.719	-0.671	-0.102	-1.133	-0.499	0.829
		(1.024)	(0.754)	(0.778)	(0.758)	(0.756)	(0.774)	(0.866)
	Daegu	0.489	-0.122	-0.444	-0.135	-0.067	0.084	-0.854
		(0.55)	(0.466)	(0.474)	(0.462)	(0.475)	(0.452)	(0.523)
	Incheon	-0.837	-0.913	-1.013*	-0.669	-0.520	-0.580	-1.15*
		(0.54)	(0.467)	(0.473)	(0.453)	(0.477)	(0.456)	(0.527)
	Gwangju	0.252	-0.422	-0.522	-0.218	0.147	0.252	-1.27*
		(0.604)	(0.523)	(0.525)	(0.517)	(0.538)	(0.503)	(0.566)
	Daejeon	-0.150	-0.600	-0.767	-0.492	-0.285	-0.719	-1.317**
		(0.614)	(0.523)	(0.515)	(0.502)	(0.526)	(0.509)	(0.57)
	Ulsan	0.482	-0.488	-0.751	-0.521	-0.468	0.185	-0.925
		(0.549)	(0.468)	(0.469)	(0.457)	(0.466)	(0.449)	(0.529)
	Gyeong-gi	-0.198	-0.907**	-0.842*	-0.723	-0.160	-0.323	-1.137**
		(0.471)	(0.403)	(0.412)	(0.391)	(0.41)	(0.385)	(0.468)
	Northern Chungcheong	-0.582	-0.756	-0.476	-0.365	-0.294	-0.037	-0.668
		(0.594)	(0.498)	(0.504)	(0.497)	(0.51)	(0.5)	(0.575)

Explanatory variables		Non-processed foods						
		Grains	Vegetables	Fruits	Meats	Seafoods	Eggs	Nuts
	Southern Chungcheong	-0.206	-0.289	-0.580	-0.735	-0.309	-0.110	-1.44**
		(0.584)	(0.495)	(0.5)	(0.484)	(0.507)	(0.48)	(0.559)
	Northern Jeolla	-0.522	-0.843	-0.521	-0.347	0.572	-0.473	-0.481
		(0.558)	(0.477)	(0.49)	(0.471)	(0.502)	(0.472)	(0.554)
	Southern Jeolla	-0.183	-0.507	-0.425	-0.484	0.505	0.077	-0.318
		(0.598)	(0.496)	(0.504)	(0.498)	(0.518)	(0.483)	(0.577)
	Northern Gyeongsang	0.126	-1.169**	-0.999*	-0.931*	-0.846	-0.769	-1.252**
		(0.565)	(0.491)	(0.494)	(0.471)	(0.496)	(0.475)	(0.549)
	Southern Gyeongsang	-0.466	-0.684	-0.678	-0.680	-0.342	-0.454	-1.121**
		(0.495)	(0.423)	(0.432)	(0.411)	(0.433)	(0.409)	(0.488)
	Jeju	-0.726	-0.367	-0.945	-1.357	-0.084	-0.671	-0.799
		(0.804)	(0.715)	(0.681)	(0.708)	(0.689)	(0.681)	(0.785)
	Sejong	-1.812*	-2.399***	-2.688***	-2.086**	-0.572	-2.418***	-2.497***
		(0.851)	(0.782)	(0.801)	(0.837)	(0.833)	(0.816)	(0.865)
Rural		0.342	0.135	0.116	0.39**	0.183	0.183	0.197
		(0.204)	(0.172)	(0.171)	(0.173)	(0.175)	(0.177)	(0.181)
cut1		-3.254	-4.542	-4.371	-3.565	-3.341	-3.333	-3.896
cut2		-2.769	-3.481	-3.393	-2.657	-2.507	-2.635	-3.166
cut3		-2.145	-2.393	-2.393	-1.807	-1.377	-1.754	-2.403
cut4		1.510	-0.425	-0.689	0.049	1.231	0.532	0.800
cut5		2.414	0.679	0.557	1.137	2.555	1.443	2.042
cut6		3.243	1.954	2.173	2.569	4.190	2.983	3.533
Pseudo R^2		0.016	0.012	0.013	0.012	0.019	0.014	0.027
N		1,000	1,000	1,000	1,000	1,000	1,000	1,000
Log likelihood		-1,095.39	-1,581.48	-1,642.98	-1,632.78	-1,435.66	-1,510.11	-1,300.07
d.f.		32	32	32	32	32	32	32
AIC		2,254.77	3,226.96	3,349.97	3,329.60	2,935.32	3,084.21	2,664.13
BIC		2,411.82	3,384.01	3,507.02	3,486.61	3,092.37	3,241.26	2,821.18

Note 1. The data in this analysis is retrieved from KREI online consumer survey (n=1,000).

2. The number in parenthesis refers to the standard error of each coefficients.

3. 'Degree of RTC' is not robust in grain (a) and drinks (b).

4. *: significant in 5%, **: significant in 2.5%, ***: significant in 1%

(continued)

Explanatory variables		Processed foods						
		Kimchi	Other side dishes	Milk products	Drinks	Functional foods	HMR	Other processed foods
Degree of RTC		-0.065 (0.062)	-0.208*** (0.055)	-0.190*** (0.056)	-0.111* [b] (0.055)	-0.051 (0.056)	-0.077 (0.053)	-0.026 (0.053)
Female		0.112 (0.183)	0.131 (0.164)	0.236 (0.168)	0.039 (0.166)	0.361* (0.168)	0.205 (0.163)	0.187 (0.162)
Age		0.013 (0.008)	-0.013 (0.007)	-0.007 (0.007)	-0.026*** (0.007)	-0.003 (0.007)	-0.027*** (0.007)	-0.016** (0.007)
Income		0.009 (0.027)	-0.005 (0.024)	0.041 (0.025)	-0.005 (0.024)	-0.003 (0.025)	0.000 (0.024)	-0.036 (0.023)
Have COVID-19 Cases within the residential town		0.038 (0.157)	-0.005 (0.142)	0.003 (0.142)	0.132 (0.143)	-0.012 (0.146)	0.127 (0.139)	-0.102 (0.139)
Single person household		0.219 (0.192)	0.170 (0.169)	-0.036 (0.174)	0.267 (0.173)	0.117 (0.174)	0.372* (0.167)	0.166 (0.167)
Children in the household	pre-school children	-0.332 (0.216)	0.008 (0.206)	-0.096 (0.206)	-0.042 (0.209)	-0.279 (0.205)	-0.264 (0.2)	-0.212 (0.199)
	elementary school children	0.166 (0.188)	0.147 (0.172)	0.211 (0.174)	-0.104 (0.173)	-0.114 (0.173)	0.221 (0.168)	0.309 (0.173)
	middle school and high school children	-0.249 (0.179)	-0.280 (0.16)	-0.168 (0.163)	0.151 (0.165)	-0.254 (0.169)	0.208 (0.16)	0.001 (0.163)
Region (Base=Gangwon)	Seoul	0.014 (0.44)	0.056 (0.393)	-0.092 (0.401)	-0.014 (0.398)	0.104 (0.426)	0.163 (0.377)	0.086 (0.382)
	Busan	-0.516 (0.825)	-0.240 (0.754)	-1.142 (0.762)	-0.345 (0.758)	-0.325 (0.808)	-0.646 (0.758)	-0.335 (0.722)
	Daegu	0.044 (0.504)	0.427 (0.458)	0.307 (0.461)	0.397 (0.46)	0.065 (0.478)	0.408 (0.434)	0.490 (0.441)
	Incheon	-0.364 (0.505)	-0.498 (0.457)	-0.485 (0.462)	-0.243 (0.459)	-0.398 (0.485)	-0.512 (0.433)	-0.318 (0.445)
	Gwangju	0.010 (0.56)	-0.135 (0.504)	-0.040 (0.517)	-0.096 (0.505)	0.134 (0.529)	0.176 (0.478)	0.412 (0.491)
	Daejeon	-0.530 (0.556)	-0.246 (0.507)	-0.066 (0.518)	-0.506 (0.522)	-0.650 (0.53)	-0.463 (0.483)	-0.400 (0.486)
	Ulsan	0.038 (0.517)	0.718 (0.455)	0.098 (0.462)	-0.208 (0.457)	0.269 (0.486)	0.407 (0.44)	0.414 (0.449)
	Gyeong-gi	-0.174 (0.432)	-0.259 (0.385)	-0.415 (0.395)	-0.051 (0.39)	-0.123 (0.419)	0.064 (0.37)	-0.097 (0.375)

Explanatory variables		Processed foods						
		Kimchi	Other side dishes	Milk products	Drinks	Functional foods	HMR	Other processed foods
	Northern Chungcheong	0.014	0.137	0.128	-0.233	0.202	0.154	-0.132
		(0.566)	(0.489)	(0.503)	(0.502)	(0.52)	(0.484)	(0.494)
	Southern Chungcheong	-0.623	-0.262	-0.398	-0.405	-0.163	0.098	0.337
		(0.534)	(0.479)	(0.489)	(0.501)	(0.532)	(0.495)	(0.484)
	Northern Jeolla	-0.230	0.155	-0.281	0.033	0.273	-0.112	-0.210
		(0.521)	(0.46)	(0.479)	(0.477)	(0.49)	(0.446)	(0.453)
	Southern Jeolla	-0.122	0.278	0.121	-0.008	0.130	-0.016	0.068
		(0.547)	(0.49)	(0.49)	(0.501)	(0.516)	(0.472)	(0.474)
	Northern Gyeongsang	-0.254	-0.790	-0.909	-0.372	-0.508	-0.487	-0.518
		(0.52)	(0.473)	(0.48)	(0.468)	(0.493)	(0.449)	(0.465)
	Southern Gyeongsang	-0.572	-0.280	-0.588	-0.561	-0.474	-0.051	-0.270
		(0.455)	(0.407)	(0.415)	(0.412)	(0.439)	(0.392)	(0.398)
	Jeju	0.851	0.069	-0.693	-0.791	-0.793	-0.242	-0.268
		(0.769)	(0.695)	(0.682)	(0.668)	(0.677)	(0.679)	(0.69)
	Sejong	-1.475	-1.778*	-1.865*	-1.477	-1.683*	-1.511	-1.762*
		(0.854)	(0.812)	(0.862)	(0.932)	(0.848)	(0.824)	(0.816)
Rural		0.266	0.035	0.222	0.443**	0.106	0.183	0.033
		(0.194)	(0.171)	(0.176)	(0.178)	(0.176)	(0.169)	(0.171)
cut1		-2.225	-4.204	-4.020	-4.329	-2.624	-3.564	-3.425
cut2		-1.619	-3.283	-3.275	-3.384	-2.104	-2.874	-2.544
cut3		-0.888	-2.425	-2.333	-2.537	-1.481	-2.178	-1.827
cut4		2.412	-0.417	-0.146	-0.354	0.752	-0.624	-0.153
cut5		3.394	0.660	0.991	0.660	1.794	0.385	0.718
cut6		4.677	2.199	2.516	1.945	2.990	1.728	1.904
Pseudo R^2		0.011	0.019	0.015	0.017	0.012	0.018	0.012
N		1,000	1,000	1,000	1,000	1,000	1,000	1,000
Log likelihood		-1,222.52	-1,593.03	-1,523.58	-1,550.64	-1,534.02	-1,731.33	-1,720.89
d.f.		32	32	32	32	32	32	32
AIC		2,509.04	3,250.06	3,111.15	3,165.27	3,132.04	3,526.67	3,505.78
BIC		2,666.09	3,407.11	3,268.20	3,322.32	3,289.09	3,683.72	3,662.83

Note 1. The data in this analysis is retrieved from KREI online consumer survey (n=1,000).

2. The number in parenthesis refers to the standard error of each coefficients.

3. 'Degree of RTC' is not robust in grain (a) and drinks (b).

4. *: significant in 5%, **: significant in 2.5%, ***: significant in 1%

Table 16. Factors which affect on the change in the amount of online grocery purchase by each item

Explanatory variables		Non-processed foods						
		Grains	Vegetables	Fruits	Meats	Seafoods	Eggs	Nuts
Degree of RTC		0.152*	0.256***	0.199***	0.215***	0.172***	0.339***	0.143* [a]
		(0.074)	(0.063)	(0.062)	(0.064)	(0.066)	(0.071)	(0.067)
Female		0.422	0.563***	0.354	-0.042	-0.038	0.202	0.032
		(0.219)	(0.192)	(0.184)	(0.19)	(0.2)	(0.206)	(0.202)
Age		-0.009	-0.029***	-0.022***	-0.031***	-0.015	-0.019*	-0.014
		(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Income		0.043	0.042	0.063*	0.066**	0.071**	0.041	0.098***
		(0.032)	(0.029)	(0.029)	(0.029)	(0.031)	(0.034)	(0.03)
Have COVID-19 Cases within the residential town		0.256	-0.017	0.240	0.289	0.568***	0.150	0.385*
		(0.182)	(0.162)	(0.16)	(0.165)	(0.173)	(0.177)	(0.174)
Single person household		0.264	0.325	-0.016	0.099	-0.037	0.142	0.274
		(0.221)	(0.193)	(0.19)	(0.197)	(0.205)	(0.212)	(0.208)
Children in the household	pre-school children	0.072	0.248	0.425*	0.279	-0.007	0.240	0.259
		(0.235)	(0.214)	(0.209)	(0.21)	(0.232)	(0.224)	(0.227)
	elementary school children	0.713***	0.191	0.226	0.365*	0.137	0.370	0.057
		(0.191)	(0.184)	(0.18)	(0.183)	(0.193)	(0.194)	(0.194)
	middle school and high school children	0.210	0.028	0.068	-0.086	-0.047	-0.358	0.335
		(0.194)	(0.184)	(0.179)	(0.187)	(0.19)	(0.2)	(0.192)
Region (Base=Gangwon)	Seoul	-0.016	0.839	-0.027	0.338	0.469	0.385	0.460
		(0.569)	(0.525)	(0.495)	(0.51)	(0.543)	(0.533)	(0.525)
	Busan	0.029	1.755*	0.425	0.540	0.559	0.113	0.512
		(1.094)	(0.879)	(0.893)	(0.922)	(1.023)	(0.914)	(1.045)
	Daegu	0.240	0.589	-0.148	0.509	0.029	0.354	0.679
		(0.617)	(0.58)	(0.55)	(0.565)	(0.606)	(0.593)	(0.584)
	Incheon	0.431	1.263*	0.440	0.733	0.187	0.246	1.018
		(0.625)	(0.583)	(0.55)	(0.566)	(0.606)	(0.603)	(0.59)
	Gwangju	0.083	0.772	0.403	0.597	1.104	0.295	1.241*
		(0.669)	(0.631)	(0.597)	(0.605)	(0.646)	(0.645)	(0.63)
	Daejeon	0.099	0.905	0.113	0.758	0.483	0.697	0.494
		(0.685)	(0.631)	(0.607)	(0.626)	(0.66)	(0.653)	(0.65)
	Ulsan	0.061	0.660	-0.509	0.006	0.104	0.558	-0.258
		(0.621)	(0.583)	(0.552)	(0.576)	(0.604)	(0.593)	(0.584)
	Gyeong-gi	-0.035	0.785	0.005	0.286	0.766	0.282	0.495
		(0.561)	(0.518)	(0.49)	(0.504)	(0.537)	(0.525)	(0.519)
		-0.764	0.468	-0.112	0.198	0.160	-0.031	-0.027

Explanatory variables		Non-processed foods						
		Grains	Vegetables	Fruits	Meats	Seafoods	Eggs	Nuts
	Northern Chungcheong	(0.733)	(0.627)	(0.603)	(0.619)	(0.662)	(0.665)	(0.652)
	Southern Chungcheong	0.581 (0.653)	0.628 (0.619)	-0.429 (0.592)	0.032 (0.617)	0.332 (0.643)	-0.212 (0.64)	0.029 (0.621)
	Northern Jeolla	-0.519 (0.7)	0.790 (0.611)	-0.119 (0.584)	0.222 (0.611)	0.366 (0.638)	-0.136 (0.654)	0.746 (0.628)
	Southern Jeolla	-0.156 (0.688)	0.724 (0.618)	-0.326 (0.603)	-0.228 (0.608)	0.332 (0.635)	-0.476 (0.644)	0.794 (0.635)
	Northern Gyeongsang	0.082 (0.648)	0.989 (0.595)	-0.235 (0.566)	0.303 (0.582)	-0.086 (0.618)	0.061 (0.614)	0.265 (0.603)
	Southern Gyeongsang	0.090 (0.591)	0.593 (0.547)	0.084 (0.518)	0.234 (0.534)	0.517 (0.567)	-0.156 (0.561)	0.651 (0.548)
	Jeju	-1.429 (0.988)	-0.617 (0.843)	-0.855 (0.807)	0.252 (0.829)	0.433 (0.861)	-0.655 (0.884)	0.398 (0.888)
	Sejong	0.645 (0.99)	1.852* (0.867)	1.663* (0.838)	0.351 (0.964)	1.433 (0.915)	0.928 (0.94)	2.677*** (0.884)
Rural		-0.054 (0.219)	0.154 (0.196)	0.252 (0.193)	0.042 (0.198)	0.355 (0.203)	-0.103 (0.213)	0.345 (0.204)
cut1		-3.994	-2.415	-2.920	-3.015	-1.646	-2.260	-1.857
cut2		-2.974	-1.554	-1.971	-2.476	-0.989	-1.689	-1.026
cut3		-1.979	-0.527	-1.116	-1.393	-0.016	-0.591	-0.159
cut4		2.517	2.553	1.596	1.696	3.181	3.146	3.097
cut5		3.596	3.885	3.025	2.753	4.168	4.034	4.183
cut6		4.432	5.145	4.332	4.015	5.430	5.230	5.289
Pseudo R^2		0.029	0.028	0.026	0.026	0.022	0.033	0.023
N		891	891	891	891	891	891	891
Log likelihood		-902.422	-1137.92	-1215.65	-1147.98	-1085.04	-994.616	-1075.69
d.f.		32	32	32	32	32	32	32
AIC		1,868.855	2,339.83	2,495.30	2,359.95	2,234.08	2,053.23	2,215.39
BIC		2,022.20	2,493.19	2,648.65	2,513.31	2,387.434	2,206.59	2,368.74

Note 1. The data in this analysis is retrieved from KREI online consumer survey (n=1,000).

2. The number in parenthesis refers to the standard error of each coefficients.

3. 'Degree of RTC' is not robust in nuts (a).

4. *: significant in 5%, **: significant in 2.5%, ***: significant in 1%

(continued)

Explanatory variables		Processed foods						
		Kimchi	Other side dishes	Milk products	Drinks	Functional foods	HMR	Other processed foods
Degree of RTC		0.276***	0.229***	0.148*	0.227***	0.369***	0.321***	0.319***
		(0.073)	(0.064)	(0.066)	(0.063)	(0.066)	(0.061)	(0.062)
Female		0.048	0.002	0.359	0.137	0.256	0.406*	0.414**
		(0.213)	(0.188)	(0.194)	(0.185)	(0.193)	(0.18)	(0.181)
Age		0.001	-0.021**	-0.025***	-0.049***	-0.021**	-0.037***	-0.031***
		(0.009)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
Income		0.002	0.046	0.037	0.022	0.054	0.045	0.011
		(0.033)	(0.03)	(0.031)	(0.03)	(0.03)	(0.028)	(0.028)
Have COVID-19 Cases within the residential town		0.033	0.179	0.106	0.261	-0.003	0.281	0.262
		(0.184)	(0.163)	(0.165)	(0.159)	(0.163)	(0.156)	(0.155)
Single person household		0.383	0.137	0.187	0.249	-0.033	0.463**	0.419*
		(0.221)	(0.196)	(0.203)	(0.193)	(0.198)	(0.186)	(0.188)
Children in the household	pre-school children	-0.225	0.252	0.434*	0.42*	-0.135	-0.027	0.186
		(0.251)	(0.214)	(0.214)	(0.205)	(0.217)	(0.205)	(0.203)
	elementary school children	0.49**	0.511***	0.377*	0.366*	0.227	0.668***	0.68***
		(0.207)	(0.181)	(0.184)	(0.179)	(0.181)	(0.173)	(0.172)
	middle school and high school children	0.185	-0.300	0.056	0.206	0.226	0.243	0.355*
		(0.204)	(0.179)	(0.186)	(0.177)	(0.179)	(0.17)	(0.17)
Region (Base=Gangwon)	Seoul	0.462	0.349	0.481	0.727	0.274	0.630	0.708
		(0.576)	(0.492)	(0.508)	(0.502)	(0.512)	(0.479)	(0.468)
	Busan	-0.484	1.451	1.200	0.545	-0.344	1.003	0.831
		(1.061)	(0.903)	(0.865)	(1.023)	(0.913)	(0.815)	(0.87)
	Daegu	0.127	0.362	0.974	0.883	-0.021	1.138*	1.18**
		(0.642)	(0.544)	(0.558)	(0.558)	(0.562)	(0.53)	(0.518)
	Incheon	0.567	0.288	0.183	0.887	0.602	0.185	0.706
		(0.647)	(0.555)	(0.573)	(0.556)	(0.57)	(0.536)	(0.53)
	Gwangju	0.614	0.602	1.014	1.492**	0.379	0.975	1.209*
		(0.692)	(0.581)	(0.603)	(0.596)	(0.611)	(0.564)	(0.552)
	Daejeon	0.879	0.331	0.473	1.101	-0.354	0.788	0.993
		(0.701)	(0.607)	(0.635)	(0.601)	(0.634)	(0.593)	(0.582)
	Ulsan	0.312	0.236	0.623	0.455	0.159	0.714	0.573
		(0.645)	(0.545)	(0.562)	(0.559)	(0.581)	(0.536)	(0.53)
	Gyeong-gi	0.644	0.180	0.565	1.023*	0.365	0.695	0.630
		(0.568)	(0.486)	(0.501)	(0.497)	(0.505)	(0.474)	(0.463)

Explanatory variables		Processed foods						
		Kimchi	Other side dishes	Milk products	Drinks	Functional foods	HMR	Other processed foods
	Northern Chungcheong	0.123	0.205	0.364	0.629	0.115	0.343	0.025
		(0.724)	(0.606)	(0.62)	(0.611)	(0.633)	(0.592)	(0.589)
	Southern Chungcheong	0.063	0.604	0.540	1.157	0.277	0.689	1.147*
		(0.685)	(0.584)	(0.609)	(0.595)	(0.594)	(0.574)	(0.564)
	Northern Jeolla	-0.035	-0.160	0.429	0.808	0.457	-0.087	0.134
		(0.69)	(0.593)	(0.618)	(0.605)	(0.604)	(0.577)	(0.574)
	Southern Jeolla	0.220	0.454	0.418	1.031	0.488	0.561	0.137
		(0.688)	(0.592)	(0.607)	(0.6)	(0.606)	(0.589)	(0.585)
	Northern Gyeongsang	0.491	0.178	0.466	0.513	0.114	0.417	0.772
		(0.646)	(0.566)	(0.591)	(0.581)	(0.583)	(0.546)	(0.535)
	Southern Gyeongsang	0.140	0.209	0.322	0.757	0.299	0.473	0.769
		(0.602)	(0.516)	(0.531)	(0.525)	(0.535)	(0.498)	(0.49)
	Jeju	0.358	-0.014	0.279	0.043	-0.294	0.912	1.585*
		(0.926)	(0.837)	(0.872)	(0.842)	(0.827)	(0.81)	(0.768)
	Sejong	0.998	1.254	1.314	1.155	0.611	0.737	0.948
		(0.937)	(0.896)	(0.877)	(0.919)	(0.908)	(0.828)	(0.833)
Rural		0.238	0.208	0.001	0.209	0.082	0.263	0.197
		(0.22)	(0.195)	(0.2)	(0.191)	(0.194)	(0.185)	(0.185)
cut1		-1.227	-2.526	-2.871	-3.114	-2.112	-2.056	-2.036
cut2		-0.777	-1.912	-2.378	-2.383	-1.133	-1.435	-1.250
cut3		-0.033	-0.954	-1.573	-1.506	-0.402	-0.561	-0.326
cut4		3.889	1.899	1.779	1.299	2.741	1.791	2.047
cut5		4.862	3.206	2.918	2.385	3.747	3.017	3.328
cut6		5.868	4.493	4.261	3.568	4.682	4.331	4.671
Pseudo R^2		0.019	0.022	0.021	0.038	0.027	0.040	0.040
N		891	891	891	891	891	891	891
Log likelihood		-917.576	-1,185.81	-1,098.17	-1,238.83	-1,181.14	-1,330.65	-1,318.69
d.f.		32	32	32	32	32	32	32
AIC		1,899.15	2,435.61	2,260.35	2,541.66	2,426.28	2,725.30	2,701.39
BIC		2,052.51	2,588.97	2,413.70	2,695.016	2,579.64	2,878.65	2,854.74

Note 1. The data in this analysis is retrieved from KREI online consumer survey (n=1,000).
2. The number in parenthesis refers to the standard error of each coefficients.
3. 'Degree of RTC' is not robust in nuts (a).
4. *: significant in 5%, **: significant in 2.5%, ***: significant in 1%

DISCUSSION AND CONCLUSION

This study tried to examine how the change in consumption behavior caused by COVID-19 affected the food industry in South Korea. The study reveals that a tendency to minimize face-to-face contact appeared among consumers as a preventive measure in response to COVID-19. In particular, this tendency seems to be exacerbated when a confirmed case occurs near the place of residence, when there are more than a single person as household member, and when there are preschool children among the members. The tendency to minimize face-to-face contact seems to have affected food consumption behavior in several ways. First, it is analyzed that the more a person is reluctant to face-to-face contact, the more consumers increase their grocery consumption while decreasing their eating out consumption. In addition, consumers who avoid face-to-face contact reduce the number of visits to offline stores, and prefer to order online, or drop by neighborhood stores rather than hyper markets when they shop for groceries.

The results of this study give simple and clear implications to the changes in the food market after COVID-19; the various changes in the food market currently identified can be explained as a result of the consumer's intention to avoid contact with others. Therefore, in order for some food businesses facing difficulties after the outbreak of COVID-19 to recover their sales, it is necessary for them to reduce the consumers' anxiety about infections. To do so, these food businesses need to not only comply with government guidelines to prevent the spread of infectious diseases, but also instill the image of restaurants that are safe from infectious diseases to consumers. In addition, the government should implement a certification system for stores that comply with the government quarantine guidelines and have no COVID-19 cases in their stores.

Contrary to what has been claimed by various media and previous studies, the tendency to reduce face-to-face contact does not seem to affect the change in delivery/takeout service usage. The increase in delivery/takeout service use after the outbreak of COVID-19 seems more appropriate to explain the government's quarantine policy that prohibits eating in restaurants or the convenience of the service rather than the tendency to reduce face-to-face contact.

If the government's quarantine policy is a major variable that can explain the increase in demand for delivery/takeout services, the current expansion of the delivery/takeout service market is likely to end as soon as the government's quarantine policy is relaxed. On the other hand, if the convenience of delivery/takeout services is a major factor, the current increased demand is highly likely to continue even after the end of COVID-19. This study does not address which factors may explain the increase in demand for delivery/takeout services. The reasons for the increase in delivery/takeout services need to be studied in other researches.

Finally, in this study, what kind of changes occurred in purchasing by item in the offline and online sectors after the outbreak of COVID-19 is examined. The result of the analysis shows that offline purchases are expected to decrease in most food groups except for HMR, other processed foods, and eggs, while online food purchases are expected to increase overall. In particular, it is very suggestive that the amount of food purchases online increases according to the degree of avoidance of contact with others even after controlling for the age variable; not only young people in their 20s and 30s who used to shop online, but also middle-aged people in their 40s and 50s seem to be entering the online food market.

It is not certain whether the change in consumer food consumption behavior will continue for a long time after the end of the COVID-19 pandemic, but that this pandemic seems to act as a positive opportunity for online channels as well as delivery and takeout services. Our findings suggest that changes in food consumption behavior caused by COVID-19 are likely to persist among some consumer segments even after the end of COVID-19 crisis. In particular, there is a possibility that consumers who previously did not use online channel will become loyal customers in the future due to the positive experiences they have experienced from the online shopping during the crisis (Irani and Andjarwati, 2020; Lim and Ting, 2012).

The dramatic change in food consumption behavior of consumers is expected to have a major impact on the food distribution value chain, damaging a large number of industries and people working in the industry. As there are signs that COVID-19 will be prolonged, the government needs to promote comprehensive and timely support policies for these industries. In addition, guidelines for the government policy in the situation of pandemic crisis should be presented to quickly respond to changes in food consumption behavior.

Our research framework has limitation in elaborating the entire processes in alternating consumer behaviors in the period of novel epidemic crisis; in addition to RTC, other preventive measures may have led to changes in food consumption behavior. These 'unexplained' preventive measures can be a factor that can explain the differences by consumer characteristics that exist even after the degree of RTC is controlled in the analysis. For example, consumers who have increased health concerns after the COVID-19 outbreak may have reduced their consumption of processed foods or the use of delivery/take-out services more than the other consumers (Hesham, Riadh and Sihem, 2021; Savarese *et al*., 2021). Research that reveals these preventive measures will help to predict changes in consumer food consumption behavior due to the future pandemic and come up with a plan to respond to it.

REFERENCES

Allcott, H., Boxell, L., Conway, J. C., Ferguson, B. A., Gentzkow, M., & Goldman, B. (2020). What explains temporal and geographic variation in the early US coronavirus pandemic? (No. w27965). National Bureau of Economic Research.

Bartik, A. W., Bertrand, M., Lin, F., Rothstein, J., & Unrath, M. (2020). Measuring the labor market at the onset of the COVID-19 crisis (No. w27613). National Bureau of Economic Research.

Benthin, A., Slovic, P., Moran, P., Severson, H., Mertz, C. K., & Gerrard, M. (1995). Adolescent health-threatening and health-enhancing behaviors: A study of word association and imagery. Journal of Adolescent Health, 17(3), 143-152.

Brunner, T. A., Van der Horst, K., & Siegrist, M. (2010). Convenience food products. Drivers for consumption. Appetite, 55(3), 498-506.

Chakraborty, S. (2020). How risk perceptions, not evidence, have driven harmful policies on COVID-19. European Journal of Risk Regulation, 11(2), 236-239.

Chenarides, L., Grebitus, C., Lusk, J. L., & Printezis, I. (2021). Food consumption behavior during the COVID-19 pandemic. Agribusiness, 37(1), 44-81.

Cinelli, M., Quattrociocchi, W., Galeazzi, A., Valensise, C. M., Brugnoli, E., Schmidt, A. L., ... & Scala, A. (2020). The COVID-19 social media infodemic. Scientific Reports, 10(1), 1-10.

Dube, K., Nhamo, G., & Chikodzi, D. (2021). COVID-19 cripples global restaurant and hospitality industry. Current Issues in Tourism, 24(11), 1487-1490.

Edwards, W. (1954). The theory of decision making. Psychological bulletin, 51(4), 380.

Fishbein, M., & Ajzen, I. (1977). Belief, attitude, intention, and behavior: An introduction to theory and research. Philosophy and Rhetoric, 10(2).

Haroon, O., & Rizvi, S. A. R. (2020). COVID-19: Media coverage and financial markets behavior—A sectoral inquiry. Journal of Behavioral and Experimental Finance, 27, 100343.

Hwang, Y., & Choe, Y. C. (2016). A comparison of convenience food consumption among different income levels in South Korea. Agribusiness and Information Management, 8(2), 16-21.

Iriani, S. S., & Andjarwati, A. L. (2020). Analysis of perceived usefulness, perceived ease of use, and perceived risk toward online shopping in the era of Covid-19 pandemic. Systematic Reviews in Pharmacy, 11(12), 313-320.

Jang W. C. (2021, March 24). Hygiene and safety should be prioritized over financial support for the restaurant business. *Shin-A Ilbo*. http://www.shinailbo.co.kr/news/articleView.html?idxno=1391504

Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. Health education quarterly, 11(1), 1-47.

Ju J. O. (2020, November 1). Will the number of restaurant customers increase if the dining out coupons are released?. *Gyeongnam Newspaper*. http://www.knnews.co.kr/news/articleView.php?idxno=1336816

Kachanoff, F. J., Bigman, Y. E., Kapsaskis, K., & Gray, K. (2021). Measuring realistic and symbolic threats of COVID-19 and their unique impacts on well-being and adherence to public health behaviors. Social Psychological and Personality Science, 12(5), 603-616.

Kartari, A., Özen, A.E., Correia, A., Wen, J., Kozak, M. (2021). Impacts of COVID-19 on changing patterns of household food consumption: An intercultural study of three countries. International Journal of Gastronomy and Food Science. doi: https://doi.org/10.1016/j.ijgfs.2021.100420.

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., ... & Ratick, S. (1988). The social amplification of risk: A conceptual framework. Risk analysis, 8(2), 177-187.

Kim, S., Lee, K., & Lee, Y. (2018). Selection attributes of home meal replacement by food-related lifestyles of single-person households in South Korea. Food Quality and Preference, 66, 44-51.

Kraus, N. N., & Slovic, P. (1988). Taxonomic analysis of perceived risk: Modeling individual and group perceptions within homogeneous hazard domains. Risk analysis, 8(3), 435-455.

Kunreuther, H., Easterling, D., Desvousges, W., & Slovic, P. (1990). Public attitudes toward siting a high-level nuclear waste repository in Nevada. Risk analysis, 10(4), 469-484.

Lim, W. M., & Ting, D. H. (2012). E-shopping: an Analysis of the Technology Acceptance Model. Modern Applied Science, 6(4), 49.

Lindell, M. K., & Perry, R. W. (2012). The protective action decision model: theoretical modifications and additional evidence. Risk Analysis: An International Journal, 32(4), 616-632.

Peng, N., & Chen, A. (2021). Consumers' luxury restaurant reservation session abandonment behavior during the COVID-19 pandemic: The influence of luxury restaurant attachment, emotional ambivalence, and luxury consumption goals. International Journal of Hospitality Management, 94, 102891.

Paek S.J. (2015.06.24). MERS has increased consumption of tomatoes and red ginseng. *The Korean economy*. Webpage: https://www.hankyung.com/politics/article/201506243583C

Presti, G., Mchugh, L., Gloster, A., Karekla, M., & Hayes, S. C. (2020). The dynamics of fear at the time of covid-19: a contextual behavioral science perspective. Clinical Neuropsychiatry, 17(2).

Rosenstock, I. M. (1974). The health belief model and preventive health behavior. Health education monographs, 2(4), 354-386.

Savarese, M., Castellini, G., Morelli, L., & Graffigna, G. (2021). COVID-19 disease and nutritional choices: How will the pandemic reconfigure our food psychology and habits? A case study of the Italian population. Nutrition, Metabolism and Cardiovascular Diseases, 31(2), 399-402.

Slovic, P., Kraus, N. N., Lappe, H., Letzel, H., & Malmfors, T. (1989). Risk perception of prescription drugs: Report on a survey in Sweden. In The perception and management of drug safety risks (pp. 90-111). Springer, Berlin, Heidelberg.

Slovic, P., Lichtenstein, S., & Fischhoff, B. (1984). Modeling the societal impact of fatal accidents. Management Science, 30(4), 464-474.

Slovic, P., MacGregor, D., & Kraus, N. N. (1987). Perception of risk from automobile safety defects. Accident Analysis & Prevention, 19(5), 359-373.

Son J.B. (2020.02.18). Consumers who packed health functional food after a month from COVID-19 outbreak...MERS learning effect?. *NEWSIS.* Webpage: https://newsis.com/view/?id=NISX20200218_0000922376

Sung, Y. K., & King, B. (2021). Restaurant preventive behaviors and the role of media during a pandemic. International Journal of Hospitality Management, 95, 102906.

van der Pligt, J. (1996). Risk perception and self-protective behavior. European Psychologist, 1(1), 34-43.

van Dijck, J., & Alinejad, D. (2020). Social media and trust in scientific expertise: Debating the Covid-19 pandemic in the Netherlands. Social Media+ Society, 6(4), 2056305120981057.

Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The risk perception paradox—implications for governance and communication of natural hazards. Risk analysis, 33(6), 1049-1065.

Yoon J.Y. (2021, July 17). Social distancing, minimum wage hike drive small businesses to brink. The Korea Times. https://www.koreatimes.co.kr/www/biz/2021/07/602_312257.html

Zwanka, R. J., & Buff, C. (2021). COVID-19 generation: A conceptual framework of the consumer behavioral shifts to be caused by the COVID-19 pandemic. Journal of International Consumer Marketing, 33(1), 58-67.