

Original Research



Major concerns regarding food services based on news media reports during the COVID-19 outbreak using the topic modeling approach

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ABSTRACT

BACKGROUND/OBJECTIVES: Coronavirus disease 2019 (COVID-19) cases were first reported in December 2019, in China, and an increasing number of cases have since been detected all over the world. The purpose of this study was to collect significant news media reports on food services during the COVID-19 crisis and identify public communication and significant concerns regarding COVID-19 for suggesting future directions for the food industry and services.

SUBJECTS/METHODS: News articles pertaining to food services were extracted from the home pages of major news media websites such as BBC, CNN, and Fox News between March 2020 and February 2021. The retrieved data was sorted and analyzed using Python software.

RESULTS: The results of text analytics were presented in the format of the topic label and category for individual topics. The food and health category presented the effects of the COVID-19 pandemic on food and health, such as an increase in delivery services. The policy category was indicative of a change in government policy. The lifestyle change category addressed topics such as an increase in social media usage.

CONCLUSIONS: This study is the first to analyze major news media (*i.e.*, BBC, CNN, and Fox News) data related to food services in the context of the COVID-19 pandemic. Text analytics research on the food services domain revealed different categories such as food and health, policy, and lifestyle change. Therefore, this study contributes to the body of knowledge on food services research, through the use of text analytics to elicit findings from media sources.

Keywords: COVID-19; food services; news media; text analytics; topic modeling

INTRODUCTION

The coronavirus disease 2019, known as COVID-19, started in Wuhan, Hubei Province, China in December 2019 and rapidly spread across China and subsequently to other countries. The World Health Organization (WHO) declared the disease to be a pandemic on March 11, 2020 [1]. With most businesses fully or partially closed following government restrictions, the COVID-19 outbreak led to major disruptions to the global economy and a severe crisis in the tourism and hospitality industry [2]. According to the latest UN World Tourism Organization

Conflict of Interest

The authors declare no potential conflicts of interests.

Author Contributions

Conceptualization: Kim CS, Kim N; Formal analysis: Kim T, Kim N; Investigation: Kim T, Kim N; Methodology: Kim N, Kim CS; Supervision: Kim CS, Kim N; Writing - original draft: Yoon H, Kim T; Writing - review & editing: Yoon H, Kim CS, Kim N.

(UNWTO) Barometer, the COVID-19 pandemic has had an extreme negative impact globally. For example, international tourist arrivals severely declined 74% in 2020, compared to the 2019 figures, which represents an assessed loss of USD 1.3 trillion in export revenue [3]. The COVID-19 outbreak has had a significant negative impact on the food services industry in many countries.

COVID-19 has resulted in unexpected stress on the food services industry, creating a variety of immediate challenges. The fast spread of COVID-19 and the imposition of government restrictions have dramatically altered consumption patterns. The pandemic has led to a radical shift in consumer demand away from restaurants, food services, and other types of “food away from home” towards food consumed at home, necessitating important changes in the way food supply chains operate [4]. As the COVID-19 pandemic gathered pace, sales of “food away from home” (consumed in hotels, restaurants, catering, and cafés) collapsed. According to the data of the OpenTable global network, restaurant reservations declined sharply in mid-March 2020 and fell to practically zero as lockdowns were enforced, as shown in Fig. 1 [4,5].

Simultaneously retail demand for food dramatically increased, particularly sales of frozen and packaged foods soared after the COVID-19 outbreak in the United States, compared to the previous year (Fig. 2).

Also, in the second half of March 2020, weekly sales of frozen foods were 63% higher than the year before in France, while sales of packaged foods were 56% higher than 2019 in Germany. Similar trends were observed in other countries too. Following this initial spike, the consumer demand for fresh, frozen, or packaged foods has been approximately 15% to 20% higher than usual [6]. The COVID-19 pandemic has caused a significant consumer demand change. For instance, the “food away from home” category typically accounts for 33% of the consumption of protein foods, including among other items, meat, seafood, and eggs, 32% of vegetables, 31% of cereals, 25% of dairy, and 10% of fruits in the United States [7].

In addition to the shift in consumer demand, COVID-19 has disrupted the food services industry, due to the social distancing rules and lockdown measures imposed to prevent the

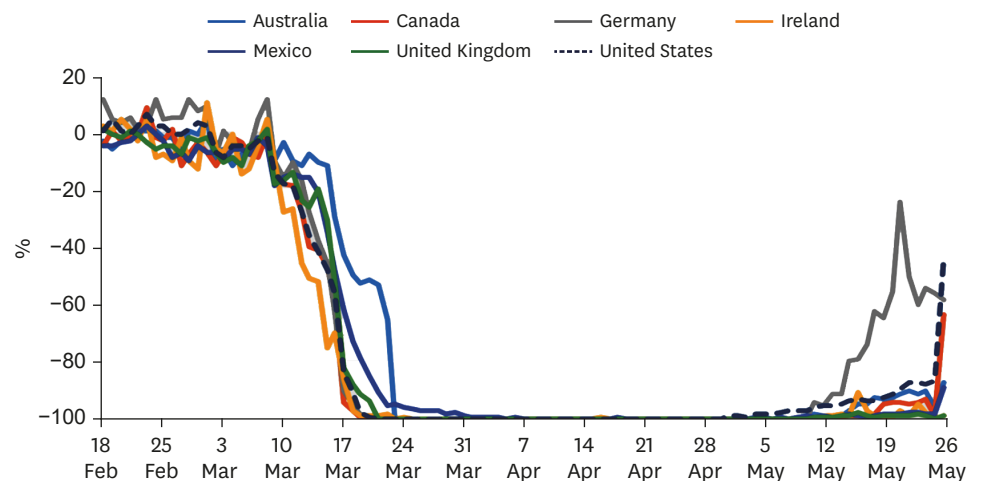


Fig. 1. Restaurant reservations collapsed after COVID-19 globally. Data includes online reservations, phone reservations, and walk-ins at restaurants on the OpenTable network; estimates are based on a sample of approximately 20000 restaurants. Percentage change in daily restaurant reservations compared to the previous year. Source: OpenTable.com.

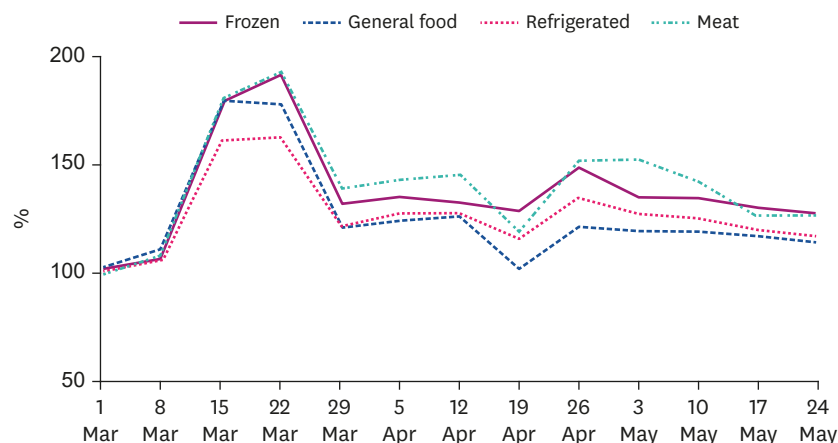


Fig. 2. Retail food demand soared after COVID-19 in the United States. The IRI CPG Demand Index measures weekly changes in consumer purchases (in dollar terms) relative to the same period in the previous year. Demand index for the United States, same period last year = 100. Source: IRI, <https://advantage.iriworldwide.com/Engineering/covid19/>. CPG, consumer packaged goods.

spread of the coronavirus. The food industry has also been subjected to supply-side shocks, including business closures, job loss, and labor shortages [8]. For example, the food and beverages sector accounted for 60% of the jobs lost in March 2020 in the United States [6,7]. Due to the disruption to the food services industry, significant attention has been focused on the industry's resilience [8,9].

Many previous studies have investigated the media coverage of pandemics such as severe acute respiratory syndrome (SARS) and the Middle East respiratory syndrome (MERS) [10-12]. During a pandemic, communication of information to the affected populations is important. In particular, information from government and public health authorities is critical to decision-making by policymakers and practitioners and to taking actions to combat current diseases [9]. For example, Americans seek and receive disparate information from various sources (*e.g.*, television, radio, newspapers, and social media); the US national news is perceived to be the most reliable information source among these [13]. Accordingly, information from the national news can play an essential role in providing guidance to consumers and protecting public health as well as the food services businesses during the pandemic.

COVID-19 is the most disruptive international crisis dominating news media. Surprisingly, the United States and the United Kingdom have suffered severely from the COVID-19 pandemic and have experienced much higher infection and mortality rates compared to the other members of the G7 group of developed countries [14-16]. This severe crisis has reinforced the need for a reliable source that can provide information and educate the population [16]. The COVID-19 pandemic has noticeably increased news consumption from mainstream media compared to online and social media [17]. BBC News is the most widely watched information source in the United Kingdom [17], and CNN and Fox News are the 2 largest US news outlets. This study, therefore, focused on these three news media groups. In this context, this paper explores the patterns of communication about food services on news media during the COVID-19 pandemic. Analyzing such data could help policymakers and practitioners in the food services industry to take into consideration public needs and concerns. Based on the findings, this current study suggests implications for the food services industry and policies that are relevant to the pandemic response.

SUBJECTS AND METHODS

Analytics process

This study utilized online news articles as data sources for text analytics. Excel and Python were used for pre-processing the unstructured data from the databases employed. Text analytics using Python was performed in 2 steps: 1) Data collection and 2) Topic modeling. In data collection, the keywords related to food services were selected by research in the context of COVID-19. Then the online news articles were crawled by the Python software. In topic modeling, this study performed the data pre-processing and topic modeling with the Latent Dirichlet Allocation (LDA) algorithm using Python to analyze the food services topic trends over the last 12 months. The topic analytics extracted 15 topics. **Fig. 3** represents the overall analytics process [18,19].

Data collection

This paper used homepage news articles to extract items related to food services in the context of COVID-19 from major news media sources such as BBC, CNN, and Fox News from March 2020 to February 2021. The news articles were crawled based on the keywords shown in **Table 1** using the Python software. Initially, two professors in the hospitality and food services and a professor in the information and technology department discussed and selected initial keywords. Then a professor with over 25 years of experience in food services reviewed and finalized the keywords for this study. Finally, the data were sorted and analyzed using Python software in March 2021.

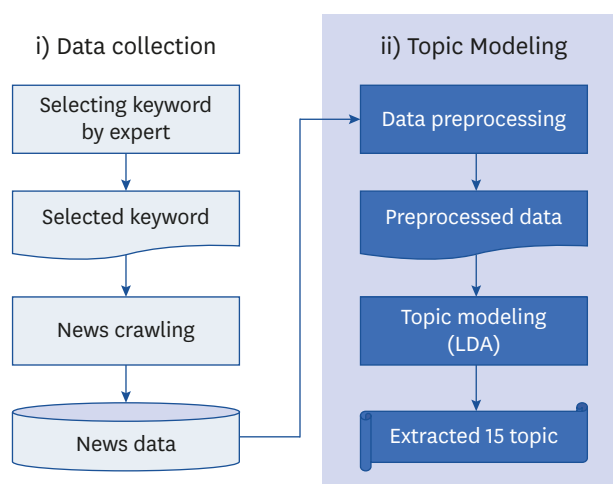


Fig. 3. The overall process of selection of keyword by expert.

Table 1. Keywords related to food services

No	Keywords	No	Keywords
1	Immune	11	Plant based food
2	Health	12	Alternative food
3	Untact	13	Localization
4	Delivery	14	Low or non
5	Takeout	15	Fermented food
6	Food safety	16	Anti-aging
7	Organic food	17	Easy eat-snack bar
8	Non-perishable food	18	Stress less
9	Sustainable food	19	Deep sleep
10	Food Security		

In detail, a news article crawler was custom designed for each media company because of the differing structure of web pages. The crawler consists of two subsystems: a Link Collection System that collected individual news links, and an Individual News Collection System that collected text and metadata utilizing the links. The Python Selenium dynamic web crawling tool was used to build the Link Collection System, and Python's LXML to construct the News Collection System. A total of 8,936 articles (CNN: 7,258, Fox: 1,445, BBC: 233) related to COVID-19 and food services were collected, with 19 keywords selected after an expert review of the output of each of the 3 crawlers.

RESULTS

Topic modeling

The topic analytics phase consisted of 2 processes—the data pre-processing and a topic modeling process. In the data pre-processing process phase, the Natural Language Toolkit (NLTK) package was utilized for special character removal, terminology processing, and tokenizing. The first step in the data pre-processing process was to remove special characters from the documents. In addition, words with a length of 3 or fewer letters were removed, and term processing was carried out to remove the words “a”, “the”, “is”, “this”, etc. from the topic. In addition, words such as “Covid” and “Coronavirus” were added to the redundant dictionary of terms because they appear in all the documents. Subsequently, the document was divided into token units and lemmatizing changed the plural and past forms of the word into the original words. Finally, part of speech (POS) tagging was performed to extract keywords with clear topics, and only nouns and verbs were used for analysis.

Topic modeling was performed using the pre-processed data. Python's Gensim for topic modeling was utilized, and a total of 15 news topics were extracted through Gensim's LDA technique (see the **Appendix 1**). The results are depicted in **Fig. 4** as a visualization of the topics. **Fig. 4A** indicates the distance between the 15 topics extracted—*COVID-19 guidance for schools*, *COVID-19 treatment*, and *health safety*, *Food delivery services*, *Government task force on health*, *COVID-19 treatment and health care*, *the Health risk of COVID-19*, *Social distancing for people's health*, *Policy responses to COVID-19*, *Political debate on mask-wearing*, *Impact of COVID-19 on politics*, *COVID-19*



Fig. 4. Visualization of topic modeling.

and CHINA, Work and financial support, Government policy, Health care lifestyle changes during the COVID-19 pandemic, and Leisure lifestyle changes during COVID-19 pandemic. **Fig. 4B** represents the frequency of the top 10 keywords in topic 4 which represents food delivery services.

As shown in **Table 2**, the results of text analytics were presented in the format of the topic label and category for individual topics. The food and health category presents the changes that are taking place in this category due to COVID-19, such as an increase in delivery services. The policy category is indicative of a change in government policy. Finally, the lifestyle change category addresses topics such as an increase in social media usage.

Topic trends

As shown in **Fig. 5A**, topic trends show the monthly trend of categories. As per the overall trends, the highest interest of the population appeared to be focused on food and health. During the US presidential elections, interest in the policy category increased relatively and has been gradually declining since the election. The lifestyle changes category attracted the lowest level of interest.

However, **Fig. 5D** shows that lifestyle topics such as health care received significant attention in the early stages of the COVID-19 outbreak, and the leisure activity has also changed in daily life. The following illustrations from **Fig. 5B-D** show the monthly trends of topics for each category.

Word cloud analysis

Fig. 6 represents the word cloud by topic. The word cloud was drawn based on word frequency and the significant words extracted, with a mask on the image represented by the category. For example, **Fig. 6A** is a topic in the food and health category where words related to food delivery services appear. The factors such as food, business, company, restaurant, delivery, order, etc., appear prominently in **Fig. 6A**, attesting to their importance. **Fig. 6B** is a topic on policy and shows a political word, and the factors such as resident election, senate, Biden, Trump, health, etc. appeared prominently. **Fig. 6C** is a topic on lifestyle change, with words about the leisure lifestyle changes under the influence of COVID-19. The factors people, player, game, life, etc., appeared prominently in **Fig. 6C**. The details are shown in **Appendix 2**.

Table 2. Results of topic modeling

Topic No.	Topic label	Category
Topic_1	COVID-19 guidance for schools	FOOD & HEALTH
Topic_3	COVID-19 treatments on health safety	FOOD & HEALTH
Topic_4	Food delivery services	FOOD & HEALTH
Topic_6	Government task force on health	FOOD & HEALTH
Topic_8	COVID-19 treatments on health care	FOOD & HEALTH
Topic_9	Health risk of COVID-19	FOOD & HEALTH
Topic_12	Social distancing for people health	FOOD & HEALTH
Topic_2	Policy responses to COVID-19	POLICY
Topic_7	Political debate on mask-wearing	POLICY
Topic_10	Impact of COVID-19 on politics	POLICY
Topic_13	COVID-19 and CHINA	POLICY
Topic_14	Work and financial support	POLICY
Topic_15	Government policy	POLICY
Topic_5	Health care lifestyle changes during COVID-19 pandemic	LIFESTYLE CHANGE
Topic_11	Leisure lifestyle changes during COVID-19 pandemic	LIFESTYLE CHANGE

Food service issues during COVID-19 pandemic

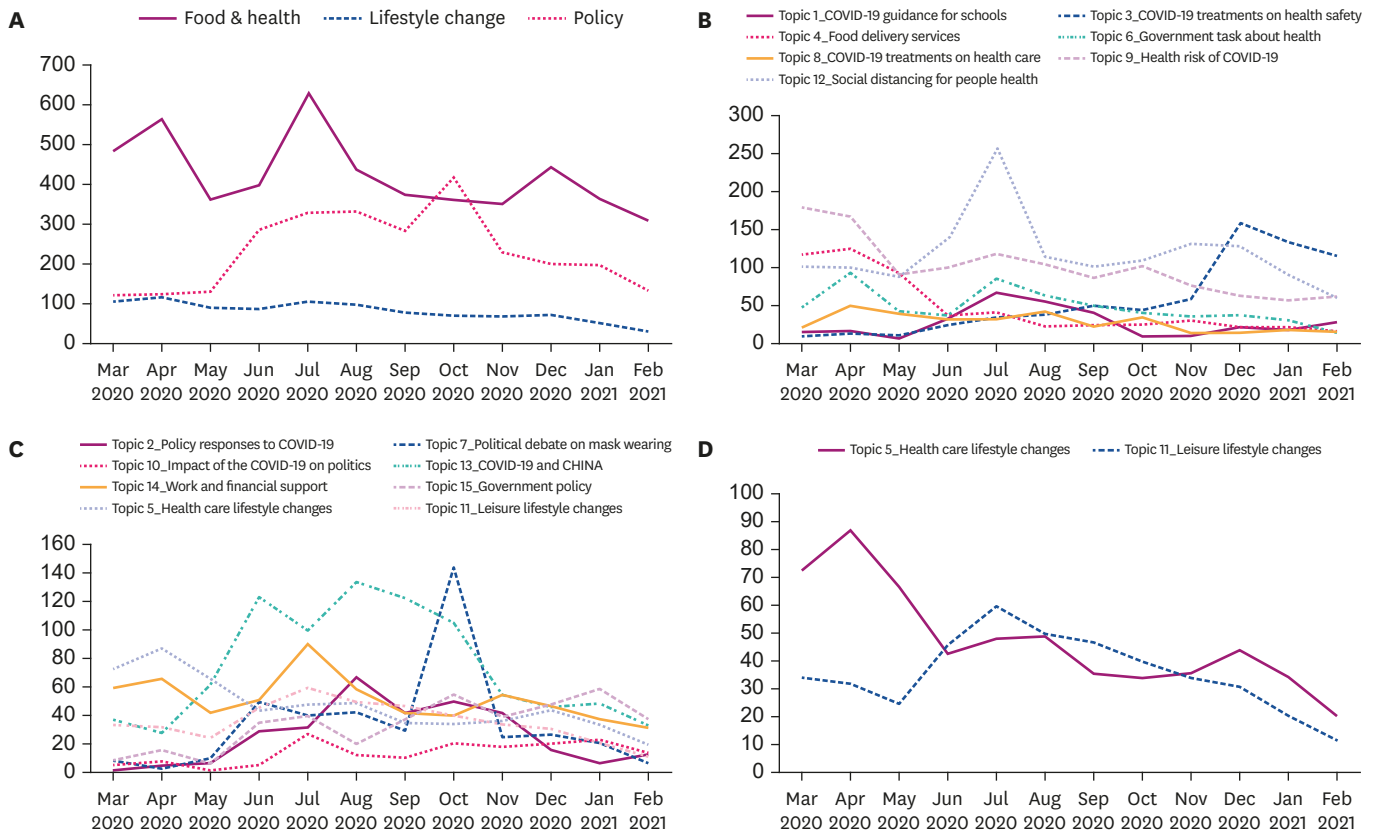


Fig. 5. Topic trends. (A) Category trends, (B) Food & health trends, (C) Policy trends, and (D) Lifestyle change trends. The X-axis represents the month, Y-axis represents the number of articles included in the topic category.



Fig. 6. Word cloud by topic. (A) Topic 4: Food delivery services, (B) Topic 10: Impact of the COVID-19 on politics, and (C) Topic 11: Leisure lifestyle changes.

DISCUSSION

The COVID-19 pandemic has aroused great public attention and concern in every sector, including food services worldwide. This paper investigated the food services domain of influential news media (BBC, CNN, and Fox News) from March 2020 and February 2021 to acquire food services related information published during the COVID-19 crisis. Analyzing the data showed that the topics in food services that drew the attention of the mass media

could be divided into three categories: food and health, policy, and lifestyle change. Topic modeling could provide an alternative and comprehensive perspective to examine the relationship between the COVID-19 outbreak and significant media reports in the food services field.

First, the findings indicate that the keywords related to the food and health category occurred more frequently than keywords related to the categories of policy and lifestyle change during the COVID-19 outbreak. Our results show that the mass media has produced and conveyed health safety and treatment information by paying attention to the COVID-19 infection, risks, social distancing, and government rules. This supports the previous research findings that the food services sector is very vulnerable and has been significantly harmed by the impact of the pandemic. Hence, safety information and preventive measures are critical to ensure food and health safety [20,21]. Therefore, food services providers and researchers should consider health and safety issues and take better precautionary measures to ensure the well-being of consumers and employees during/after the COVID-19 pandemic.

Additionally, the results show that the food delivery services topic was covered prominently. After the COVID-19 pandemic, the volume and types of takeaway or delivery foods have dramatically increased with the shutdown of restaurants and eating/drinking facilities [22]. Also, the coronavirus has caused intense fear regarding the provision and receipt of services involving human contact. Food services providers have adapted to the considerable changes caused by the spread of the virus and put in place new business models such as takeaway, delivery, drive-through, etc., thus minimizing human contact.

Lastly, the findings suggest that the area of food services is considerably influenced by government policy and lifestyle. Some of the major topics of food services were observed to be related to government policy and lifestyle changes in this analysis. Food services involve widespread human interaction as consumers meet at various touchpoints. The rules of the social distancing practice, wearing a mask, no human interaction, and personal hygiene have severely affected the behavior of consumers and practitioners in the food services sector. Thus, practitioners need to have new health and safety protocols and guidelines in place for meeting customers' heightened expectations regarding hygiene and health safety compared to the pre-COVID-19 era.

This study contributes to the body of knowledge on food services information and trends during the COVID-19 crisis by using text analytics to elicit findings from media sources. However, the study has several limitations. First, we included influential news articles from BBC, CNN, and Fox News regarding food services during the COVID-19 crisis, but this only covers print articles. Therefore, future research needs to consider the new video social media platforms such as TikTok and YouTube which convey information through images and short videos. Additionally, this paper only considered select information sources of a few countries and covered the period since the outbreak. Thus, future research needs to also consider online social media in food services to compare various types of information sources. Also, further investigation may be conducted between the Western and Eastern cultures or different cultural groups for providing cross-cultural implications in the available information on food services.

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Appendix 1. Topic



