

## ARTICLE

# Emergency food supplies and food security in Wuhan and Nanjing, China, during the COVID-19 pandemic: Evidence from a field survey

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## Abstract

**Motivation:** Detailed empirical work on the impact of the COVID-19 pandemic on food security is scant. Local management of food security has received little attention.

**Purpose:** This article describes emergency food policies in Wuhan and Nanjing, China during lockdown in 2020 and their implications for household food security in the two cities.

**Methods and approach:** Policy documents and background data describe the emergency measures. Online surveys of residents of two Chinese cities were used to gauge household food security.

**Findings:** Despite the determined efforts of provincial and city governments to ensure that food reached people who were locked down in Wuhan, or subject to restrictions on movement in Nanjing, households experienced some decline in food security. Most households found they could not access their preferred foods. But a minority of households did not get enough to eat.

Government had contingency plans for the pandemic that ensured that most people had sufficient, if not preferred, food. But not all households were fully covered.

**Policy implications:** A more resilient system of food distribution is needed, including a relatively closed and independent home delivery system. Grassroots organizations such as residential community committees, property management organizations, and spontaneous volunteer groups need to be brought into the management of emergency food provision.

## KEYWORDS

COVID-19, food access, food insecurity

## 1 | INTRODUCTION

There is a general consensus that COVID-19 has had a profoundly negative impact on food security, despite the overall resilience of international and internal food supply chains (Clapp & Moseley, 2020; Galanakis, 2020; Laborde et al., 2020; Reardon et al., 2020; Reardon & Swinnen, 2020; Workie et al., 2020; Zurayk, 2020).

The Committee on World Food Security has even suggested that the world now faces a “twin pandemic” of COVID-19 and food and nutrition insecurity (Clapp et al., 2020). The impacts are being especially felt at the sub-national level in towns and cities where economic activity has been curtailed, unemployment has grown, and incomes and purchasing power have consequently declined in both the formal and informal sectors (Ben Hassen et al., 2020; Corburn et al., 2020; Farrell et al., 2020; Iheme et al., 2020; Ruszczyk et al., 2020; Zidouemba et al., 2020). Globally, communities that depend on migrant remittances for livelihoods and food purchase have particularly suffered (Diao & Wang, 2020; Gupta et al., 2021; Orozco, 2020; Sirkeci, 2020). It is also clear that public health policies to control the spread of infection have directly impacted on urban food systems in various ways including through temporary or permanent closure of food retail outlets such as public markets, supermarkets, and street food vendors; restrictions on consumer physical access to food through lockdowns, quarantines, and stay-at-home orders; and the absence or presence of effective food emergency preparedness strategies (Arndt et al., 2020; Cardwell & Ghazalian, 2020; Crush & Si, 2020; Darma et al., 2020; Mishra & Rampal, 2020; Woertz, 2020).

This article focuses on the latter issue by examining the nature and effectiveness of food emergency/contingency planning and the emergency measures put in place in China in the first phase of the pandemic.

Over the past two decades, there have been increasing calls for more attention to food emergency/contingency planning, as the impact of environmental or socio-political disruptions on food security is much more severe than conventionally assumed (Kinsey et al., 2019). Previous studies of food management response during periods of sudden crisis or disasters caused by natural hazards tend to focus on the immediate efforts of governments and international agencies to ensure food availability through continuity of production and food access through emergency food aid and distribution (Douglas, 2009; Pingali et al., 2005; Skees, 2000; Wentworth, 2020). The oldest proactive preparedness strategy involves the building of food reserves (Fraser et al., 2015; Kinsey et al., 2019; Lassa et al., 2019; Smith & Lawrence, 2018). Countries such as Ethiopia, for example, established a food security reserve system as early as 1982 in response to persistent drought and famine (Jones, 1994). More recently, in the aftermath of the 2008 world food crisis, some Asian governments have improved and strengthened their emergency food reserve system, not simply with disaster risk reduction in mind but also as a buffer for price shocks, climate change, and food trade disruptions (Belesky, 2014; Lassa et al., 2019). In addition to national food reserves, countries like Germany have called for citizens to store enough food and water to last for about 10 days (Gerhold et al., 2019). In countries such as the USA (Kinsey et al., 2019) and Australia (Smith & Lawrence, 2018), food is not commonly incorporated into emergency response planning, leading some to advocate community-level food stockpiling (Berger, 2019).

Understanding the nature and root causes of food system vulnerability is a prerequisite for effective disaster preparedness and management (Jackson et al., 2020). While there have been some studies of food supply chain resilience and vulnerability, they tend to focus more on conceptual and definitional issues (Béné, 2020; Tendall et al., 2015; Umar et al., 2017). There have also been some studies of the volume and types of items commonly included in food reserves (Estrada et al., 2016; Wien & Sabaté, 2015), but the piecemeal integration of food reserves into disaster preparedness planning complicates the management of food access during actual emergencies.

Several challenges have to be overcome for effective relief. First, physical access to food outlets is critical during an emergency, and it is now standard practice to establish one or more distribution centres for emergency food relief after a disaster (Colon-Ramos et al., 2019). However, this is only effective if people are able to access these centres. Extreme emergencies, transport disruption, or quarantine measures (as in COVID-19 lockdowns) may limit or completely block people's physical access to distribution centres.

Second, the need for vertical co-operation and horizontal collaboration is essential (Smith & Lawrence, 2018). Vertical co-operation includes co-operation between central, local, and other levels of government; and horizontal collaboration includes public, private, and civic actors (Smith & Lawrence, 2018).

Third, the allocation of responsibilities is another challenge in emergency food management. Complementing governmental emergency food supplies, charitable emergency food provision has often filled the gaps in public provision such as in the US, the UK, and Canada (Lambie-Mumford, 2013).

Empirical studies of emergency food management policy have tended to focus on disasters such as flooding (Smith & Lawrence, 2018), hurricanes (Colon-Ramos et al., 2019), and other extreme climate events (Lassa et al., 2019). With the notable exception of work on food policy responses to the ongoing global HIV and AIDS pandemic (Crush et al., 2011; Ivers et al., 2009; Kadiyala & Gillespie, 2004; Loevinsohn & Gillespie, 2003), limited attention has been paid to the local food security management implications of an infectious disease pandemic. Huff et al. (2015) did find that the US food system was woefully underprepared for a future pandemic. And Ekici et al. (2014) provide a simulation model for food distribution planning during a severe influenza pandemic. Rapid response investigations of food security policy responses to COVID-19 are beginning to emerge (Aday & Aday, 2020; Akseer et al., 2020; Arndt et al., 2020; Mishra & Rampal, 2020). However, more systematic research on food management policies and responses to COVID-19 are clearly necessary for a fuller understanding of both the effectiveness of pre-existing preparedness planning and the implementation of emergency food policies during the pandemic.

In this respect, the Chinese case is of particular relevance not simply because it is the first place where food systems were put under severe strain by the COVID-19 pandemic but also because planning for and responding to the challenge of food insecurity was an early and central feature of the Chinese response, offering clear lessons for other areas of the world still in the grip of the pandemic (Crush & Si, 2020; Fan, 2020; Pu & Zhong, 2020; Wang et al., 2020; Yu et al., 2020). This paper focuses on the city of Wuhan and the neighbouring city of Nanjing. These two cities adopted different strategies to control and prevent the spread of COVID-19. Wuhan, for example, implemented a strict lockdown policy which prohibited movement of the populace in and out of the city and required residents to remain at home for an extended period. Nanjing adopted a less strict “first-order” quarantine response, including intensified virus testing, reduction of gatherings, and asking residents to stay home. As this article makes clear, these different strategies had different implications for food access and food system management. By comparing policy responses in Wuhan and Nanjing, this article makes clear that the suite of responses to COVID-19 varied with the type and severity of the measures taken to contain the spread of the virus. Both cities had pre-coronavirus food security contingency plans in place. However, COVID-19 was an unprecedented challenge and the confinement of millions of people in residential communities was an unprecedented policy response. As a result, additional strategies and resources were mobilized to deal with the sudden disruption of mobility and the established food system. The question is whether these measures ensured continued access to food, whether there were gaps between food security challenges and contingency response, and what lessons can be drawn for urban food system management.

Food security is commonly defined as follows:

Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996).

The four pillars or dimensions of food security are food availability, accessibility, utilization, and stability of the first three pillars (FAO, 2008). These pillars enable the impacts of the epidemic and policy responses to be observed and analysed. Food availability and access are the two key aspects of food insecurity in an emergency context (Smith & Lawrence, 2018). Food accessibility includes economic and physical access (FAO, 2008). Economic access to food or food affordability is often measured as the ratio of the food cost of a household relative to its income (Lee et al., 2013). Food prices and household income are the determinants of food affordability as prices or income loss or both lead to decreases in household food affordability. Food production, stock, and trade are the three main aspects determining food availability (FAO, 2008). Those factors influencing food preparation and feeding practices determine food utilization (FAO, 2008), including energy provision for cooking and clean water for drinking.

## 2 | METHODOLOGY

Wuhan, the capital city of Hubei province, is located at the middle reaches of the Yangtze River and is divided into 13 districts (county-level administrative units). The administrative area of Wuhan is 8,569 km<sup>2</sup> with 2,976 km<sup>2</sup> of farmland (or about 35%) in 2016. There were 10.9 million residents of whom 8.5 million had local household registration in 2017 (Wuhan Statistics Bureau, 2018). Wuhan is where the COVID-19 coronavirus was first detected in China. The total official number of people with COVID-19 in the city by April 10, 2020, was 50,008 (National Health Commission of China, 2020). Nanjing is the capital city of Jiangsu province, located at the lower reaches of Yangtze River, 500 km to the north-east of Wuhan, and made up of 11 districts. The administrative area of Nanjing is 6,587 km<sup>2</sup> with 2,355.8 square km of farmland (about 36%) in 2018. The total population was 8.44 million, including 6.97 million of residents with local household registration in 2018 (Nanjing Statistics Bureau, 2019). The cumulative number of infected persons was officially less than 100 by April 10, 2020 (Nanjing Municipal Government, 2020).

Because of the lockdown of Wuhan and the residential quarantine in Nanjing, a face-to-face survey was not possible. Instead, an online questionnaire was developed and posted on the online survey platform Wenjuanxing (at <https://www.wjx.cn/>) from March 24–31, 2020. Respondents in the two cities were recruited through social media. An unexpectedly large number of responses was received. In total, the questionnaire link was opened 6,409 times, and 2,363 people completed the survey. Of these, 1,445 were in Nanjing and 918 were in Wuhan. In cleaning the data, cases with a survey response time of less than 150 seconds were dropped, leaving 1,822 usable responses (796 from Wuhan and 1,026 from Nanjing). For the analysis in this article we also draw on the results of an earlier random citywide survey about household food security in Nanjing, conducted in July 2015, with 1,210 households by the Hungry Cities Partnership (Si & Zhong, 2018). To measure levels of household food security, we used the Household Food Insecurity Access Scale (HFIAS) and the Household Food Insecurity Access Prevalence (HFIAP) indicator, two international cross-cultural metrics developed by the Food and Nutrition Technical Assistance (FANTA) project (Coates et al., 2007; Swindale & Bilinsky, 2006).

There are some limitations to the data reported in this study. As the questionnaire survey of household food security was conducted through online self-reporting rather than on-site interview, the survey was not based on random sampling. A study of food security of households using emergency food assistance in the US indicated that there existed over-reporting of food security among programme participants (Heflin & Olson, 2017). This is possible here, too, given that the survey results indicated a very high level of anxiety about food shortage while the percentage of households that actually ran out of food was much lower (see Section 7).

To investigate the development and implementation of food emergency policy, we collected and reviewed a selection of policy documents from government websites. The documents are pertinent to food security and emergency response, and most have been developed since the COVID-19 outbreak. These policy documents come from websites of the central government, Hubei Provincial Government, Jiangsu Provincial Government, Wuhan Municipal Government, and Nanjing Municipal Government. In addition to those websites, we collected information and some data from newspaper websites, such as the number of public markets in operation during the epidemic outbreak. "Public markets" (*nongmao shichang* in Chinese) are markets designed for anyone (commonly vendors in urban area and some farmers in rural area) to sell fresh vegetables, fruits, meat, and aquatic products. These markets are publicly or privately owned (Zhong et al., 2019).

## 3 | INSTITUTIONAL FRAMEWORK FOR EMERGENCY FOOD SUPPLY IN CHINA

After the severe acute respiratory syndrome (SARS) outbreak in 2003, contingency plans for daily necessities including food were established for every level of government in China. At the central government level, there

are three sets of regulations pertinent to food contingency management, relating to grain and non-grain food, respectively. The non-grain food contingency management policy was first issued by the Ministry of Commerce in 2003 in the form of Contingency Management of Daily Necessities (CMDN) regulations. In 2011, the Ministry amended the CMDN, establishing the current regulatory structure of non-grain food contingency management for meat, vegetables, eggs, and dairy products. The plan specifies four grades of response to cope with emergency situations—roughly corresponding to national, provincial, prefectural, and countywide emergencies. Regulations about grain and cooking oil contingency management were issued by the State Council in 2005, labelled the State Grain Contingency Plan. In 2006, the Ministry of Commerce issued the Central Regulation of Frozen Meat Reserve policy. These sets of regulations form the institutional framework for the central and provincial governments' role in ensuring food supply in emergency conditions.

Broadly speaking, emergency food management in China has four components: food reserve management, contingency plan formulation, food price and sales monitoring, and contingency plan activation. Food reserves are an important part of food contingency management, with seven food types commonly included: grain, cooking oil, meat, vegetables, eggs, sugar, and tea (Table 1). These food items are held in reserve by different levels of government. Grain and cooking oil are reserved from county-level all the way up to the central government. Vegetables, sugar, and eggs are reserved by prefectural and county-level governments only (Table 1). There are also three kinds of contingency plan: a grain contingency plan, meat contingency plan, and daily necessities contingency plan. A contingency response can be triggered by the following types of events: disasters (such as earthquakes, mud slides, and floods), emergency public health events, animal, or plant epidemics, a war, or terrorist attack (Ministry of Commerce of China, 2011).

The third component of emergency food management concerns food price and sales monitoring. A rapid increase in food prices or sudden food shortages can trigger the implementation of a food contingency plan. There are seven main types of contingency food price measures (Ministry of Commerce of China, 2011): (1) stabilizing food supply and price by intensifying market information release; (2) encouraging food enterprises to release their stock and speeding food procurement to increase food supply; (3) transferring food from other regions; (4) releasing government food reserves; (5) organizing rapid food imports; (6) limiting the total amount for sale, potentially implementing food rationing; and (7) expropriating food and supplying it to the public. When a contingency plan is activated, releasing food reserves is one potential contingency measure, but it is not always triggered.

With the implementation of the lockdown in Wuhan on January 23, 2020, central government food contingency measures for the city were activated in two parts: (a) ensuring the food supply from other regions to Wuhan,

TABLE 1 Food reserve system in China

Food item	Department in charge	Level of Government			
		Central	Provincial	Prefectural	County-level
Grain	Grain administration	√	√	√	√
Cooking oil	Grain administration	√	√	√	√
Meat	Commerce administration	√	√	√	
Vegetable	Commerce administration			√	√
Eggs	Commerce administration			√	√
Sugar	Commerce administration			√	√
Border-sale tea	Commerce administration	√	√	√	√

Note: √ indicates that there is a reserve established and managed at the corresponding government level. There are five levels of administrative regions in China, including central, provincial, prefectural, county, and township level. The focus of this article is the prefectural level.

Source: Authors' compilation, based on pertinent laws and regulations.

and (b) food distribution inside Wuhan. Central government took responsibility for ensuring the supply of food to Wuhan and the Ministry of Commerce established a working team on January 23 to co-ordinate the supply of food to the city from nearby provinces. The central government reserved 10,000 tons of frozen meat for Wuhan on February 3, and 60,000 tons of vegetables were stored in nearby provinces for the Wuhan market (21st Century Business Herald, 2020). A Joint Mechanism for Ensuring Food Supply Among Nine Provinces (including Hubei, Anhui, Jiangxi, Shandong, Henan, Hunan, Yunnan, Guangxi and Chongqing) was established on January 23 and formally announced on February 17. The Joint Mechanism assigned nine provinces the task of ensuring the supply of non-grain food and grains to Wuhan, including vegetables, meat, eggs, milk, cooking oil, rice, wheat flour, and instant food (Ministry of Commerce of China, 2020). Similar measures were not needed in Nanjing where the epidemic and disruption of urban food supply chains were less serious.

#### 4 | COVID-19 EMERGENCY FOOD POLICIES IN WUHAN

Prior to the COVID-19 pandemic, contingency food policies existed at the city level. In 2016, the Wuhan Municipal Government issued a Contingency Plan for Daily Necessities and Refined Oil. The Wuhan Municipal Commerce Bureau (part of the Wuhan Municipal Government) also issued a contingency implementation plan. Daily necessities defined by the two plans include grains, cooking oil, meat, eggs, vegetables, salt, sugar, bottled drinking water, instant noodles, and sanitary products. The contingency measures include information disclosure, enterprise procedure responses, interregional co-ordination, releasing food reserves, and establishing temporary commercial food sites. The two plans also allocated the responsibilities between government departments and state-controlled companies. In particular, the implementation plan identified roles for four companies in food contingency action (Table 2). The involvement of state-controlled and privatized companies demonstrates the social responsibility of state-controlled supermarket companies to increase the speed and reliability of any contingency response.

However, the lockdown policies to contain the COVID-19 epidemic dramatically changed the city's food system and household physical access to food outlets. Min et al. (2020) report that over half of the food suppliers open for business between January 23, 2020, and February 23, 2020, did not have enough food sources compared to the same period in previous years, while food suppliers' revenue decreased by 83% compared to the same period in previous years. From January 23 to February 29, Wuhan's restriction policies escalated from closure of all public transportation, to no private vehicles without a special permit, then to partial confinement

TABLE 2 Companies with special roles in food contingency planning in Wuhan

Company	Ownership structure	Number of shops (or food items)
Wuhan Department Store Group Co., Ltd.	State-controlled by Wuhan Government (49.53%)	About 50 supermarket shops at Wuhan <sup>a</sup>
Zhongbai Holdings Group Co., Ltd.	State-controlled by Wuhan Government (49.23%)	76 supermarket shops in 2018 <sup>b</sup>
Wuhan Zhongshang Commercial Group Co., Ltd	Change from state-controlled by Wuhan Government to privately owned in 2019	21 supermarket shops <sup>c</sup>
Wuhan Non-staple Food Reserve Company	State-controlled company	Responsible for the reserve of pork, beef and mutton, and sugar <sup>a</sup>

Source: <sup>a</sup>Data from online database Tianyancha.com, the most commonly used database for business information in China.

<sup>b</sup>Baoqi Institution, & Wuhan Commercial Observation (2019).

<sup>c</sup>Zhongshang Commercial Group (n.d.).

of residential communities (neighbourhoods), and finally to complete confinement of residential communities on February 14 (Table 3). Most urban households in China live in gated residential communities, which are relatively easy to lock down. Any ungated communities were gated using construction hoardings. The lockdown policies also closed public markets temporarily from January 30. Partial residential enclosure was announced on February 11, 2020, which allowed one person per household to go out of their residence to buy food once every three days. After a week, the policy escalated to complete enclosure.

With complete lockdown of residential communities, people were prohibited from leaving their apartment buildings at all and had no direct access to their everyday food outlets. Wuhan's food distribution system was temporarily restructured with the objective of ensuring food accessibility for over 8 million residents in complete lockdown. A food provision policy called "community group buying" was put in place from February 17 to March 19 (Table 3). This policy involved four methods of food access (Hanyang District Government, 2020): (a) online food buying where individual households bought food from an online retailer and picked up the food at a designated spot within the enclosed residential community; (b) group buying from supermarkets where residential or neighbourhood committees acted as food purchasing agents, collected the consumers' orders, then bought food from supermarkets and used government-allocated delivery services; (c) buying directly from producers; and (d) the allocation of food donations

TABLE 3 Timeline emergency food policies in Wuhan

Date	Emergency food policies	Market
January 23, 2020	Mechanism of jointly ensuring the food supply among nine provinces	●■
January 24, 2020		●■
January 25, 2020 (Spring Festival)	Central government established working team ensuring Wuhan food supply	●■
January 26, 2020		●■
January 30, 2020	Closure of public markets More than 90% were closed	●■
February 8, 2020	Reopening 14 public markets	○■
February 11, 2020	Limiting times for buying food One person per household allowed out every three days	○■
February 14, 2020	Abolishing regulation of one person per household allowed out every three days	○■
February 17, 2020	Community group buying policy - Online food buying - Group buying provided by supermarkets - Group buying provided by producers of produce - Food donation to low-income people	○■
February 19, 2020	Supermarkets only accept community group buying	○□
February 23, 2020	Policy to recruit food delivery volunteers	○□
February 29, 2020	Special offer and allowance - CNY 10 for 10 half kg of vegetable - CNY 10 for 1 half kg of pork - CNY 300–500 allowance to low-income household	○□
March 19, 2020	Restarting of public markets and other food stores Where residential communities without epidemic risk	●□
March 22, 2020	Supermarkets return to accepting individual shopping	●■

Note: ● public markets in business ○ public markets not in business; ■ supermarket accepting individual shopping □ supermarket only accepting community group buying.

Source: Compiled by authors based on Wuhan Municipal Government website.

with priority given to low-income households, especially those households enrolled in the Minimum Livelihood Guarantee (*dibaohu*) Programme implemented in urban areas since the 1990s (Kakwani et al., 2019).

Community group buying faced two challenges. First, there was limited capacity for transporting food from supermarkets or producers to residential communities. Second, there was a shortage of labour for rapidly distributing food to buyers. The Wuhan government used buses and requisitioned some private vehicles to address the first challenge (Doe, 2020). Paid and unpaid volunteers were recruited to address the second challenge. Volunteers were issued permits to leave and return to gated communities, but mainly stayed away from their homes in hotels to reduce the risk of transmission to their families and communities. Community group buying was implemented citywide until March 19, 2020, when public markets and other food stores were allowed to reopen in areas where residential communities were classified as “communities without epidemic risk” (defined as having no confirmed, suspected, or close-contact cases and no fever cases for a minimum of 14 days).

## 5 | COVID-19 EMERGENCY FOOD POLICIES IN NANJING

Four regulations and two contingency plans formed the pre-COVID institutional framework of emergency food supply management in Nanjing. The regulations included the Nanjing Regulation on Emergency Requisition Daily Necessities, the Nanjing Regulation on Grain Reserves, the Nanjing Regulation on Vegetable Reserve, and the Nanjing Regulation on Meat Reserves. The contingency plans were the Nanjing Contingency Plan for Daily Necessities and the Nanjing Contingency Plan for Grain, both released in 2018. The food reserves are operated by state-owned and privately owned food companies (Table 4). Emergency situations are classified into four grades, mainly determined by the rate of food price increase and the number of days without stock. The first grade is the most urgent and the fourth the least.

Nanjing did not implement a complete lockdown policy, primarily because there were many fewer cases of COVID-19. Three main measures were implemented to control spread: reducing people’s mobility, restricting gatherings, and postponing the date for resuming work after the Chinese New Year holiday (excluding government sectors) (Table 5). The critical difference with Wuhan is that the enclosure of residential communities was partial rather than complete. Residents were permitted to leave their residential communities (neighbourhood) to buy food. Nanjing also implemented special regulations on transportation, including compulsory body temperature checks upon entry or

TABLE 4 Quota of food reserves in Nanjing

Food item	Reserve quota	Reserve organization
Grain <sup>a</sup>	More than 3 months’ demand	Nanjing Grain Company <sup>c</sup> (state-owned)
Cooking oil <sup>a</sup>	7,000 tonnes	Nanjing Grain Company <sup>c</sup> (state-owned)
Frozen pork <sup>b</sup>	1,800 tonnes	Jiangsu Foodstuff Group Co., Ltd.
Frozen beef	100 tonnes	Yurun Holding Group Co., Ltd.
Pigs	30,000 pigs (equivalent to 1,500 tonnes of pork)	BGX Logistics Development (Group) Co., Ltd. Tianhuan Food Group Co., Ltd.
Cattle	600 cattle	Lvliuju Food Company <sup>c</sup> (Privately owned)
Vegetable	Only in Winter: 3,000 tons (in storehouse), 10,000 tons (on field)	Zhongcai Wholesale Market <sup>c,d</sup> (state-controlled)

Source: <sup>a</sup>Nanjing Municipal Government (2015)

<sup>b</sup>Nanjing Municipal Government (2018)

<sup>c</sup>Nanjing Municipal Bureau of Commerce (2017)

<sup>d</sup>Zhang (2016)



TABLE 5 Timeline of emergency food policies in Nanjing

Date	Emergency food policies of Nanjing	Number of "public markets" in business
January 23	Daily sterilizing of public markets	All
January 26	Intensification of sterilization efforts in public markets - Reaffirming prohibition on sales of live poultry and wild animals within public markets and supermarkets	0
January 28	No work/business resumption before February 9, 2020 (Usually, the first six days of the lunar calendar are holidays in China) Commerce Bureau's plan of public markets' business resumption on January 29	Ditto
January 29	Guideline for sterilizing public markets Issued by Jiangsu Provincial Commerce Department District governments issued guideline for public market epidemic prevention	112
January 30	--	159
January 31	Intensification of food price surveillance and inspection Epidemic prevention for supermarkets, public markets and catering industry - Requirement for business resumption - Epidemic prevention measures for business time Policy encouraging vegetable production Issued by Jiangsu Provincial Agriculture Department	189
February 1	Stabilizing supply and price of grain and cooking oil Issued by Jiangsu Provincial Food and Strategic Reserves Administration	227
February 2	Policy of no dine-in - The date of this policy varies by urban district	240
February 3	--	258
February 4	Special policy of food retailing - Allowing public markets and supermarkets to continue operations - Everyone must wear mask and do a temperature check when entering public markets and supermarkets - periodically sterilizing public markets and supermarkets	--
February 5	Policy for no-contact food delivery Issued by Jiangsu Administration for Market Regulation	--
February 7	--	283
February 10	Extension of the policy of no work/business resumption for catering industry (The dates of policy extensions vary by district)	293
February 11	--	301
February 17	Policies for non-grain food production and supply - Rent reduction: for food businesses, exemption from paying one month's rent; halving rent for two months (for state-owned property) - Subsidy: subsidizing online sales - Tax reduction for food production Crowd control - 1.5 metres physical distancing while shopping - Crowd control within public markets and supermarket	
February 18	--	309
February 20	Must do temperature check when enter public markets and supermarkets	--

(Continues)

TABLE 5 (Continued)

Date	Emergency food policies of Nanjing	Number of "public markets" in business
February 24	Policy of work resumption for catering industry	311
March 3	Policy of resuming dine-in at restaurants	--
March 21	No longer doing temperature checks when entering public markets and supermarkets	All

Note: All supermarket shops stayed open. Traditionally, all public markets close for the Chinese New Year holiday including from the afternoon of January 24, 2020 (the last day of 2019 on lunar calendar) to January 29, 2020. "--" refers to no statistics figures or no policy/measures issued.

Source: Compiled by authors based on Nanjing Municipal Government website.

exit from the city, as well as a pass permit policy and stay-at-home order (Table 5). The pass permit policy in Wuhan prohibited people without a special permit from driving a vehicle. In comparison, the pass permit policy in Nanjing placed no restrictions on vehicles and persons issued with a permit for activities such as food transport.

Emergency food policies implemented in Nanjing between January 23 and March 28 focused on supporting food retailing operations and preventing the spread of the virus through food distribution. Public markets and supermarkets were excluded from the restrictions on work resumption in order to enable these food outlets to continue to operate. Usually, during the Chinese New Year holiday, supermarkets keep operating and public markets close. However, food retailing capacity in the markets was limited after the holiday by the fact that more than half of the food vendors in public markets in Nanjing are migrants to the city (Zhong et al., 2019). Normally, most of these vendors go back to their hometown for the holiday and return to work a week later. In 2020, however, they were required to self-isolate for two weeks when they returned to Nanjing and some food vendors could not, or were reluctant to, return to Nanjing because of the quarantine requirements and travel restrictions.

To ensure that the markets resumed operations, governments at the city and district level issued plans and policies for epidemic control. These included intensification of sterilization efforts in marketplaces, crowd control, and reducing business hours (Table 5). The number of public markets that reopened gradually increased from 112 on January 29 to 311 on February 24, and finally on March 21, 2020, all public markets in Nanjing resumed operations (Table 5). All supermarkets remained open throughout. The Nanjing government also supported the operations of restaurants. As online selling of cooked food needed a permit from the county-level Administration of Market Regulation, the administration transferred face-to-face application submissions to online submissions, ensuring that restaurants received permits for online selling rapidly.

Three types of temporary auxiliary food security policy were also implemented (Zhong & Scott, 2020). First, shops selling food were permitted to enlarge their scope; for instance, fruit shops without a permit for selling vegetables were allowed to do so. Second, restaurants and food vendors were permitted to sell food in open spaces, such as in small plazas in front of residential neighbourhoods. Third, convenience stores were permitted to sell fresh vegetables and meat. All these policies were designed to ensure Nanjing households' access to fresh produce and cooked food.

## 6 | COMPARING ALTERNATIVE MODELS OF COVID-19 EMERGENCY RESPONSE

Both Wuhan and Nanjing mobilized existing contingency policies to try and ensure physical food access. However, the scope and intensity of the pandemic response also demanded new and innovative food system management responses. Here, the two cities took different approaches: i.e. the community group buying method in Wuhan and the retail recovery method in Nanjing (Table 6). In Wuhan, the implementation of a complete lockdown policy

TABLE 6 Comparison of food policies between Wuhan and Nanjing

Policy groups	Wuhan (community group buying strategy)	Nanjing (retail recovery strategy)
Quarantine	<ul style="list-style-type: none"> <li>• Lockdown</li> <li>• Stay home; not allowed outside</li> <li>• No physical access to food outlets</li> </ul>	<ul style="list-style-type: none"> <li>• No lockdown</li> <li>• Stay home; must wear a mask when going out</li> </ul>
Production	Work/business resumption of food/agriculture production since early February	Ensuring agricultural production and facilitating the transportation of agricultural inputs
Stock	Released food reserves	Increased food reserves
Trade	<ul style="list-style-type: none"> <li>• Central government responsible for food supply from outside Wuhan</li> <li>• Mechanism of jointly ensuring food supply among nine provinces</li> </ul>	
Price	<ul style="list-style-type: none"> <li>• Making supermarket/retailing companies such as Wushang, Zhongbai, Zhongshang, Walmart, Carrefour, and Wuhan rural e-commerce to contain food prices no higher than that in previous year</li> <li>• Publishing information of food price</li> <li>• Providing special-price (low price, reduced-price) food since March 3</li> </ul>	Intensifying food price monitoring
Income	<ul style="list-style-type: none"> <li>• CNY 300–500 allowance for low-income households</li> <li>• Food donation from farmers and others allocated to low-income households first</li> </ul>	<ul style="list-style-type: none"> <li>• Implementing consumer price subsidy policies and low-income households receiving a food price subsidy</li> <li>• Special allowance (cash and/or food) to those households and individuals that fall below minimum living standards</li> </ul>
Access to markets	<ul style="list-style-type: none"> <li>• Community group buying</li> <li>• Food delivery volunteers</li> </ul>	<ul style="list-style-type: none"> <li>• Intensifying epidemic prevention inside markets</li> <li>• Ensuring public market reopening</li> <li>• Contact-free food and produce delivery</li> <li>• No dine-in option at restaurants</li> </ul>
Access to water & energy	No cessation of power, gas, or water supply for those in arrears or running out of credit	No cessation of power, gas, or water supply for those in arrears or running out of credit
Feature of policy	<ul style="list-style-type: none"> <li>• Government-led</li> <li>• Vertical co-operation between governments for ensuring food provision</li> <li>• Central government responsible for ensuring supply from outside Wuhan, local government responsible for food distribution</li> <li>• Supermarkets took the leading role</li> </ul>	<ul style="list-style-type: none"> <li>• Market-led method and government-regulated</li> <li>• Local government responsible for ensuring food supply</li> <li>• Highlighting the role of public markets</li> </ul>

Source: Authors' compilation, based on pertinent laws, regulations, and policy documents.

meant that mobility and access to food marketplaces were extremely limited. A community group buying policy was therefore introduced to offset these measures.

The strategy tried to build a contingency food retailing system by including supermarkets, community committees, and property management organizations while excluding and closing public markets. However, this still meant reduced food retail service capacity compared to pre-pandemic times when food retail was provided by supermarkets and public markets combined. To narrow the food retailing capacity gap, Wuhan Municipal Government implemented a policy of recruiting unpaid volunteers to help distribute food that was transported to residential communities. Retail recovery in Nanjing focused on returning the food distribution system to normal as rapidly as possible by reopening public markets and keeping supermarkets in business while preventing food

retailing employees from getting infected. Without a complete lockdown, Nanjing residents were also able to personally access food retail outlets, unlike in Wuhan.

Policy responses in Wuhan and Nanjing also had some similarities. Both developed policies to maintain food affordability, for example, but in different ways. Nanjing intensified its food price monitoring to contain food price increases. The Wuhan Municipal Government provided about 130,000 vulnerable residents with temporary price subsidies from January, which is about CNY 330 (about USD 50) per capita per month (Xu, 2020); especially those households enrolled in the Minimum Livelihood Guarantee (*dibaohu*) Programme, which has been implemented in urban areas since the 1990s (Kakwani et al., 2019). Furthermore, a series of “no stopping service” policies were put in place in both Wuhan and Nanjing, which were implemented as local and then national policies. The policy of “no stopping/shutting off power, gas and water supply for those in arrears or running out of credit” thus ensured that all households had access to power and water for food preparation (Chen, 2020; Chutian City Daily, 2020). The policy of “no stopping internet and mobile phone services for those in arrears or running out of credit” was also put in place for access to online food buying (Wang, 2020).

At the city level, COVID-19 thus prompted the implementation of different control and mitigation strategies. Some of these strategies directly impinged upon core elements of the food system in both cities, especially the distribution and retailing of food and the nature and type of ready access previously enjoyed by millions of city residents.

Three questions arise: first, how were these disruptions, and the emergency policy responses to contain their impact, actually experienced by urban consumers? Second, did these measures impact the food security and food consumption behaviour of consumers? And third, were there differences between Wuhan and Nanjing in these impacts and responses, given the documented differences in policy responses to the pandemic at the local level? These questions are addressed in the next section of the article.

## 7 | HOUSEHOLD FOOD SECURITY DURING COVID-19

To gauge how and how many residents of the two cities actually experienced the various emergency policies and the associated impacts of the pandemic, the online survey respondents were provided with a list of mobility and food-related challenges and asked if they had experienced any since the start of lockdown (Table 7). As expected, the residents of Wuhan reported stricter controls and restrictions than their counterparts in Nanjing. For example, 60% of Wuhan residents experienced restricted access to food retail outlets compared to 34% of Nanjing residents. Also, 38% of Wuhan residents experienced restricted access to online food outlets compared to only 12% of Nanjing residents. There were also significant differences in restrictions on home delivery of food and in the freshness of food. Underlying these differences, and the different levels of general food insecurity, are differences in food price increases and household income. As Table 7 shows, as many as 61% of Wuhan respondents reported food price increases, compared with 35% of Nanjing respondents. In addition, 51% of Wuhan households reported loss of income due to COVID-19, compared to 20% of Nanjing households.

Change in availability and access to preferred foods, and reduced dietary diversity, are other potential consequences of an emergency such as a pandemic. The consumption of particular food items was clearly affected to various degrees by the COVID-19 public health response in both Wuhan and Nanjing. In Wuhan, the percentage of households reporting food item consumption changes ranged from 6% for some food items to 44% for others (Table 8). More than 20% of households experienced a change in the consumption of most food items listed, with the greatest impacts on the consumption of fish (44%), beef and lamb (42%), pork (36%), bean products (34%), fruits (32%), and poultry (29%). Overall levels of change in Nanjing were lower than in Wuhan with the exception of vegetables (22% versus 21% in Wuhan). While fish and meat products and fruits were most affected in Wuhan, vegetables and cereals were also relatively significantly affected in Nanjing.

TABLE 7 Experiences of COVID-19 challenges in Wuhan and Nanjing

Challenges	Wuhan (% Yes)	Nanjing (% Yes)
<b>Physical access</b>		
Restricted mobility	73.9	30.2
Restricted access to public markets and supermarkets	60.2	33.5
Restricted access to online stores	38.2	11.7
Food not fresh	38.1	16.2
Limited food availability and lack of food variety at online stores	34.4	17.2
Limited food availability and lack of food variety at public markets or supermarkets	32.8	26.7
Restricted food delivery to your home	25.6	9.2
<b>Economic access</b>		
Food price increase	60.9	35.1
Loss of income due to the COVID-19 restriction	50.6	20.4
N	796	1,026

Source: Online survey conducted in 2020.

The survey results indicated that overall levels of food insecurity increased in both cities at the height of the pandemic. The pre-COVID household survey in 2015 found very low levels of household food insecurity in Nanjing (Si & Zhong, 2018) (no comparable data exists for Wuhan). The average HFIAS score was only 0.61 (out of a possible 27) and the HFIAP typology showed that 79% of households were food secure, with 5% moderately food insecure and just 2% severely food insecure (Table 9). By comparison, only 31% of households in Nanjing were food secure at the time of the survey, compared with 19% moderately food insecure and 22% severely food insecure. This suggests that there was a significant overall deterioration in food security in the city during the pandemic, with levels of complete food security declining from nearly 80% to just over 30%. While there are no pre-pandemic baseline figures for Wuhan, Table 9 clearly shows that the food security situation during the pandemic was worse than in Nanjing. Only 5% of households reported being food secure compared with 31% in Nanjing, with 38% being severely food insecure, compared to Nanjing's 22%, suggesting that milder public health responses had less serious consequences for household food security.

A common general indicator of a deteriorating food security situation is that a household spends a greater share of its income on food as food prices rise and income potentially falls. Figure 1 shows that in both cities most households spent more on food during the lockdown (82% in Wuhan and 64% in Nanjing). Around half of households in both cities spent up to twice the usual amount on food, with nearly 40% of households in Wuhan spending more than double the usual amount, while in Nanjing the figure was under 15%.

In order to address which aspects of food insecurity were experienced most strongly, Figure 2 shows the responses to the nine frequency-of-occurrence questions that constitute the HFIAP. The food security impacts of the pandemic had both a food quantity dimension (Q1, Q5-9) and a food quality dimension (Q2-4). The results show that food quality (i.e. accessing preferred foods and sufficient variety) was more heavily impacted than food quantity (i.e. accessing enough food to eat). Food insecurity therefore primarily manifested in households not having access to preferred foods (65% in Wuhan, 31% in Nanjing), eating a limited variety of food (66% in Wuhan and 27% in Nanjing), and having to eat unwanted food (40% in Wuhan and 20% in Nanjing). While access to a sufficient quantity of food was less significant, it was by no means non-existent. Levels of concern about not having enough food, for example, were high at 55% in Wuhan and 30% in Nanjing. In practice, around one-quarter of Wuhan households had been forced to eat fewer meals or smaller meals. In Nanjing, by contrast, the figure was only 10%. A smaller percentage of households in both cities experienced an absolute shortage of food at some point (6%

TABLE 8 Impact of COVID-19 measures on household consumption of various food items

Food items	Wuhan (%)	Food items	Nanjing (%)
Fish	44.2	Vegetables	21.8
Beef and lamb	41.8	Pork	20.9
Pork	35.6	Fish	18.0
Bean products	33.8	Cereal	17.9
Fruits	31.7	Beef and lamb	16.1
Poultry	28.8	Poultry	14.4
Nuts	27.6	Fruits	13.5
Milk	25.4	Bean products	9.0
Offal	22.7	Tubers	8.9
Cereal	21.5	Milk	8.1
Vegetables	20.7	Melon	8.0
Beans	20.7	Offal	6.0
Melon	14.3	Beans	5.8
Tubers	13.1	Egg	5.6
Condiments	10.1	Nuts	4.3
Egg	7.9	Condiments	4.1
Oil and butter	6.3	Oil and butter	2.9
Total number of responses	796	Total number of responses	1026

Source: Online survey conducted in 2020.

TABLE 9 Levels of food insecurity in Wuhan and Nanjing

Categories	Wuhan in 2020		Nanjing in 2020		Nanjing in 2015	
	NO.	%	NO.	%	NO.	%
Food secure	41	5.2	315	30.7	929	78.9
Mildly food insecure	124	15.6	297	28.9	162	13.8
Moderately food insecure	329	41.3	192	18.7	62	5.3
Severely food insecure	302	37.9	222	21.6	25	2.1
Total	796	100.0	1026	100.0	1178	100.0

Source: Calculated from Si and Zhong (2018) and the online survey conducted in 2020.

in Wuhan and 5% in Nanjing), went to sleep hungry (11% in Wuhan and 6% in Nanjing), or had no food to eat of any kind (13% in Wuhan and 6% in Nanjing). In general, these results suggest two things: first, that limitations on both food quality and quantity were more serious in Wuhan than in Nanjing. And second, in both cities, policy responses were more successful in addressing the food quantity than the food quality dimensions of food insecurity.

Table 10 provides a more detailed sociodemographic and economic profile of the severely food insecure households. In both cities, severely food insecure households were more likely to be living in rented property than the sample as a whole. Migrant households without hukou (household registration) were also more likely to be severely food insecure. In both cities, however, the type of household did not make a major difference to whether a household was severely food insecure or not. For example, the proportion of severely food insecure

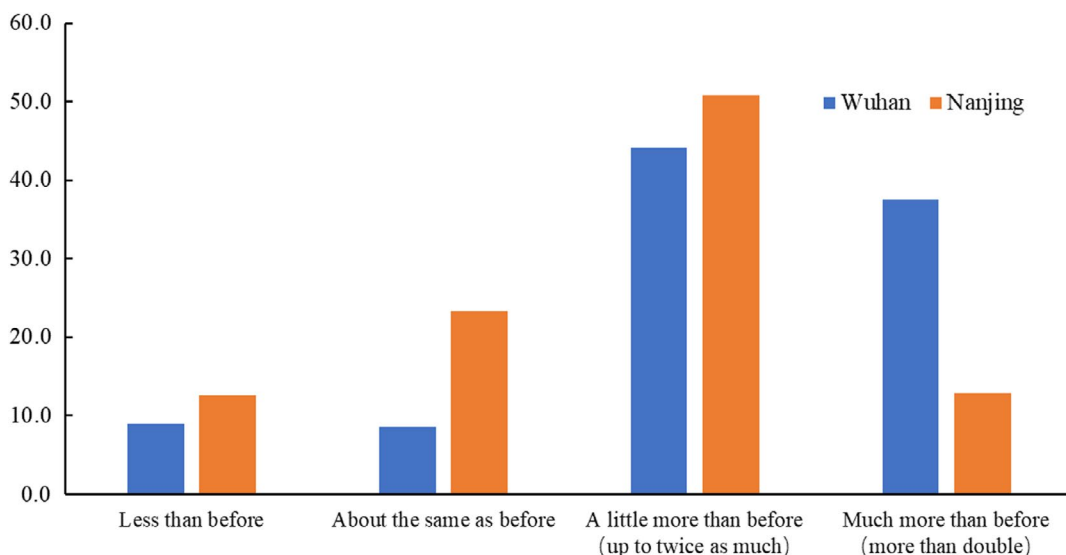


FIGURE 1 Expenditures on food before and during pandemic

Source: based on online survey conducted in 2020.

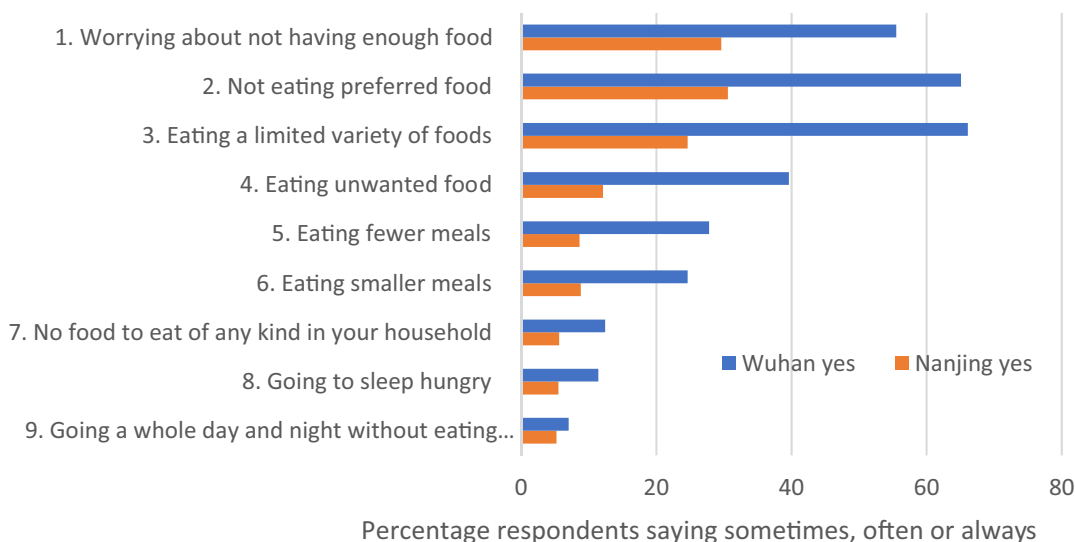


FIGURE 2 Experiences of food insecurity in Nanjing and Wuhan 2020

Note: Never/Rarely responses binned as No; Sometimes/Often/Always responses binned as Yes.

Source: based on online survey conducted in 2020.

female-centred households was very similar to the sample as a whole. In Nanjing, and to a lesser extent Wuhan, there were more male-centred and fewer nuclear (defined as a household with a husband/male partner and a wife/female partner with or without children) and extended family households (defined as a household with a husband/male partner and a wife/female partner and children and other relatives) among the severely food insecure. To understand why these households were particularly food insecure requires further analysis, particularly of factors such as household income. However, the income data collected by the survey was extremely incomplete with many preferring not to answer the question.

TABLE 10 Sociodemographic and economic profile of respondents

Items		Nanjing		Wuhan	
		Severely food insecure households	Total surveyed households	Severely food insecure households	Total surveyed households
Housing property	Owning the property	67.1	75.5	65.2	68.8
	Renting the property	24.8	14.9	11.9	11.1
Hukou (household registration)	Local	63.7	78.8	72.8	76.6
	Non-local	36.3	21.0	22.9	19.4
Household structure	Female-centred	9.9	8.9	6.6	6.0
	Male-centred	16.2	9.2	7.9	6.2
	Nuclear household	36.9	41.5	38.4	42.5
	Extended family household	25.7	32.0	36.4	36.2

Source: Online survey conducted in 2020.

## 8 | CONCLUSIONS

Our study suggests that more attention should be paid to the issue of household food security impacts in every country where strict lockdown measures are implemented to control the spread of the novel coronavirus. Several major findings emerge from this first-ever assessment of the food security impacts of COVID-19 in the Chinese cities of Wuhan and Nanjing.

First, the COVID-19 epidemic and associated public health containment measures caused many households to become more food insecure. In particular, COVID-19 led to a significant increase in the number of severely food insecure households. As many as 95% of surveyed households in Wuhan and 69% in Nanjing reported some degree of food insecurity during the lockdown.

Second, in both cities households reported that food insecurity was experienced more as a decline in the quality and variety of food than in absolute quantity, although the latter was by no means absent.

Third, limitations on food access tended to be more physical in nature than economic, which is consistent with the COVID-19 containment and suppression policy of residential lockdown that placed considerable restrictions on personal mobility and the ability to simply buy one's own food at outlets of choice.

Fourth, households that were in rental accommodation and being non-local (without hukou) tended to be more vulnerable to food insecurity, although the precise reasons why some households became more food insecure than others requires further investigation.

In the context of the unprecedented nature of the public health response to containing the spread of COVID-19 discussed in the article, and the fact that normal access to the necessities of life, such as food, were suddenly and immediately constrained, there was a significant danger that, in the absence of policy interventions, people would go hungry and even starve.

Although contingency plans for the food supply were established for China's cities in the aftermath of the 2003 SARS outbreak, none of these plans were designed to cope with the situation of a citywide lockdown or people having to be homebound. COVID-19 was thus an unprecedented challenge, and confinement of millions of people in residential communities was an unprecedented policy response. Existing food contingency policies in Wuhan and Nanjing therefore had to be adapted to deal with the public health mitigation measures to control the spread and impact of COVID-19. Additional strategies and resources were mobilized in both cities to deal with the sudden disruption of mobility and the food system. Comparing policy responses in Wuhan and Nanjing, it is clear that the suite of responses to COVID-19 varied with the type and severity of the measures taken to contain the spread of the virus and this, in turn, led to different policy responses and food security impacts.



While food contingency plans are common across China, they were insufficient to handle the food emergencies caused by COVID-19. Chinese city governments developed food contingency policies based on their existing food contingency plans and policies and the degree of epidemic impact. Wuhan adopted the “community group buying” method while Nanjing adopted the retail recovery method to ensure physical access to food. Although those policies focused on diverse aspects of food security, including food availability, food utilization, containing food prices, income subsidy, and ensuring physical access to food, there were weaknesses. Government efforts to ensure food availability at the city region level were largely successful by focusing on restoring physical access to food, but COVID-19 led to serious challenges in ensuring household-level access to food as a result of income loss, rising food prices, restrictions on physical access to food outlets, and problems with food distribution. The impaired physical access to food was a more significant challenge than decreased economic access to food.

The major lesson is that a more resilient system of food distribution is needed, including a relatively closed and independent home delivery system. Moreover, government cannot do this on its own. Going forward, grassroots organizations such as residential community committees and property management organizations, and spontaneous volunteer management groups, need to be integrated into contingency food planning.

## DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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