BMC Public Health

RESEARCH

Open Access

Direct and indirect crisis of food security due to COVID-19 emergence in Addis Ababa and Amhara regions, Ethiopia: a lesson for the inevitable pandemics

Daniel Teshome Gebeyehu[1,5*], Leah East[1,2,3], Stuart Wark[4] and Md Shahidul Islam[1]

Abstract

Background COVID-19 caused a significant impact on food security; particularly among low- and middle-income countries. The objective of the current study was to assess both the direct and indirect impact of COVID-19 on individuals' food security in the metropolitan and regional context of Ethiopia.

Methods This project utilized a retrospective study design with a mixed methods approach. It assessed the food insecurity experience of individuals both before and after the emergence of COVID-19 through the Food Insecurity Experience Scale (FIES). Food sellers were interviewed to identify the factors that increased post-COVID-19 emergence food insecurity. Inferential analysis using ordinal logistic regression was undertaken based on the Polytomous Universal Model (PLUM) procedure.

Results The size of the family and the type of work for income generation were statistically associated ($p < 0.05$) with the food security of individuals, both before and after COVID-19 emergence. Location ($p = 0.002$, odds = 0.37), age ($p = 0.002$, odds = 2.57) and educational status ($p = 0.001$, odds = 0.24/) of individuals had a statistically significant effect on the food security of individuals before COVID-19 emergence only. The ordinal value of all FIES indicators increased after COVID-19 emergence compared with pre-pandemic food insecurity. Overall food security of individuals was reduced by 21.5%, with the moderate and severe food insecurity of individuals increasing by 13.1% and 15.9%, respectively. The COVID-19 preventive measures that affected the individuals' food security, in the order of their priority, were: transport bans; food price increment; lockdown measures; job loss; market bans; social distance restrictions; fear of the pandemic; movement restrictions; over-buying; food inaccessibility; and, lack of cash due to bank closure. In addition, pre-existing non-pandemic related natural and man-made disasters played a role in the food security crisis, including drought, war, and desert locust emergence.

Conclusion The COVID-19 pandemic has directly and indirectly affected individuals' food security. Learning from the experiences of COVID-19 may assist governments in preparing for future pandemics. Suggested improvements include forming impact reduction task forces and establishing disease prevention strategies that will not compromise food security.

Keywords Food security crisis, Food insecurity, Impact, Pre-post, COVID-19, Inevitable pandemic

*Correspondence:
Daniel Teshome Gebeyehu
daniel.teshome@wu.edu.et
Full list of author information is available at the end of the article

© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

Introduction

COVID-19, a contagious disease caused by SARS-COV-2, was officially recognized by the World Health Organization (WHO) within a month of its emergence (11 February 2020) [1]. By 11 March 2020, COVID-19 was characterized as a global public health threat [1]. While COVID-19's status as a public health threat was removed after three years, it had substantially affected individuals, countries, and global society regardless of their economic status and geographic location [2–4]. Globally, there were an estimated 770 million cases and over 6.94 million deaths caused by COVID-19 [5]. In addition to its direct health impact, COVID-19 caused, and is continuing to cause, multidimensional crises, including food security. Before the emergence of COVID-19 in 2019, over 820 million individuals were at risk of hunger daily [6], and 250 million individuals were estimated to experience acute hunger by the end of 2020 [7]. The hunger and food insecurity experience then exposed individuals to further disease complications and shortened life expectancy [6].

COVID-19 overwhelmed the food security of many individuals and households in lower- and middle-income countries, such as Ethiopia [7, 8]. Due to interruptions in the food distribution channels, fresh food products became more expensive than long shelf-life food items during the pandemic [9]. Whilst food insecurity due to COVID-19 was noted to affect global society as a whole [10, 11], countries with low resource settings were impacted more severely than higher-income countries [7]. The pandemic impacted, and continued impacting, the food security of individuals both directly by compromising the food production and supply systems, and indirectly by impacting agricultural productivity and import activities. This has further affected individuals dealing with COVID-19 prevention related measures and restrictions, such as job losses, lockdowns, transport bans and movement restrictions [12, 13].

In Ethiopia, food insecurity increased by 11.7% due to the emergence of the pandemic [14]. For example, 32.5% (voluntary) and 7.6% (involuntary) of household members lost their jobs and faced economic crises in Addis Ababa, the capital city of Ethiopia [15]. A study undertaken by Tefera et al. [16] found that urban residents were more food insecure due to COVID-19 than their rural counterparts in Ethiopia. Although food insecurity is generally multifaceted in Ethiopia, due to factors including civil unrest, desert locusts and climate change, COVID-19 emergence has further exacerbated this existing food insecurity [17]. However, while it is known that food insecurity has increased, there was a dearth of research focused on food insecurity immediately pre-pandemic, and it is therefore difficult to directly compare the impact of the pandemic on food security. While there has been research [14–17] conducted on the impact of COVID-19 on food insecurity of individuals and households in different parts of Ethiopia, these studies did not use any pre-pandemic emergence food security measures or data to comparatively examine the pre- and post-pandemic food security situation. The aim of this study was to evaluate the impact of COVID-19 on food security by retrospectively examining food security before COVID-19 and then comparing outcomes after its emergence. It is predicted that this information will be useful for future planning, prioritizing, and allocating food security resources in order to prepare for the next pandemic.

Methods

Study area

So as to gain a diversity of responses, the research was undertaken across a range of regions in Ethiopia. This included a national metropolitan city, Addis Ababa, and three regional locations, Kombolcha, Debre Birhan, and Dessie. According to the Ethiopian Statistical Service [18], the population of the study sites are estimated to be 3,774,000 (Addis Ababa), 257,126 (Dessie), 125,654 (Kombolcha), and 139,724 (Debre Birhan).

Recruitment and study design

Formal ethical clearance for this project was approved by the University of New England (UNE) Human Research Ethics Committee (HREC), with the Wollo University Institutional Research Ethics Review Committee in turn approving the ethics clearance granted by UNE HREC.

Participants were recruited from three markets in the 10 main open-air markets of Addis Ababa (Piasa, Merkato, and Shola) and one main open-air market of each regional city (Robit, Saturday and Thursday Markets). The markets were selected using a random sampling technique using a lottery method. The lottery method involved every possible option being given a numerical value on a bit of paper. All the folded bits of papers were then placed in an opaque container and participants were randomly determined based off their number being selected out of the container.

Shops from different categories of food items (live animals; animal products; cereals; vegetables and fruits; spices; and, packed and processed foods) within these markets were then randomly selected also using this same lottery method. This resulted in six shops (one shop from each food category) from the six open air markets (three open markets of the metropolitan city and one open market of each of the three regional cities), or thirty-six shops in total, being selected for sampling.

The survey commenced on 16 April 2023 and ended 31 June 2023. Potential participants were approached

in the queue to the payment area of each selected shop. The recruitment strategy was to approach every tenth food buyer and ask them to participate. Those food buyers who consented to participate and who were aged over 18 years were surveyed. Institutional ethical approval was granted prior to commencement of the project. To ensure participants' confidentiality and privacy, any personal identifiers like names were not requested. The objective of the research was provided to the participants on initial contact, and participants signed an informed consent letter before the commencement of any data collection.

Two data collectors were assigned to work together; one was allocated to collect the data, and the other was responsible for maintaining the sequence of food buyers. Each individual survey took 20–30 min to be completed. Food sellers were also interviewed to identify COVID-19 associated factors responsible for food security. The number of participants from metropolitan and regional cities was proportional.

The food security experiences of participants in the 12 months before and after the emergence of COVID-19 were assessed using a retrospective study design. The study was based on explanatory sequential design in which the food security crisis identified by quantitative assessment was further clarified using qualitative investigation.

The Fisher's formula, indicated below was used for the sample size calculation.

$$n = \frac{Z^2PQ}{d^2} = \frac{(1.96)^2(0.5)(0.5)}{(0.05)^2} = 384$$

Where:

'n' is the minimum sample size for a statistically significant survey
'Z' is normal deviant at the portion of 95% confidence interval = 1.96
'P' is prevalence of food insecurity during and before COVID-19. Since no previous study had been conducted on the current topic or in the selected study areas, the prevalence rate of 50% of food insecurity prevalence rate was used. Even if it looks high, a 50% prevalence rate was used as per the formula.
Q = 1-P
'd' is margin of error acceptable or measure of precision = 0.05

Furthermore, the Australian Bureau of Statistics (ABS) Sample Size Calculator [19] was used to confirm the correctness of our sample size calculation, and it showed 385 minimum samples. Since the difference between the result of Fisher's formula and ABS was negligible, it was confirmed that our sample size calculation was correct.

Data collection and management

The food security status of food buyers was assessed using the eight-item Food Insecurity Experience Scale (FIES) [20]. FIES measures the food insecurity status by assessing the food access dimension of food security. Using the FIES, participants were asked to recall their experiences 12 months before and after the emergence of COVID-19. The Gallup® World Poll (GWP) Amharic translation of FIES's questions was used during data collection. Each question of the FIES has dichotomous "yes/no" answers (Table 1) and if the respondents either did not know the answer or did not wish to answer the question, their response was marked as not applicable (N/A). In addition to seeking information on their pre-and post-COVID-19 emergence food insecurity status, the demographic variables of participants (location; age; gender; educational status; marital status; living arrangement/family size; and, types of work for income generation) were also sought.

The food sellers were interviewed using semi-structured open-ended interview checklists (see Additional

Table 1 The 8-item food security experience scale (FIES) questions and their short forms

Common description for each question: During 12 months before and after the emergence of COVID-19, was there a time when, because of lack of money or other resources:	Short forms as per Cafiero et al. [21]
Q1: You were worried you would not have enough food to eat?	WORRIED
Q2: You were unable to eat healthy and nutritious food?	HEALTHY
Q3: You ate only a few kinds of foods?	FEWFOODS
Q4: You had to skip a meal?	SKIPPED
Q5: You ate less than you thought you should?	ATELESS
Q6: Your household ran out of food?	RANOUT
Q7: You were hungry but did not eat?	HUNGRY
Q8: You went without eating for a whole day?	WHOLEDAY

file 1), and their responses were recorded using a smartphone audio recorder. This mixed method approach was employed to provide additional nuance to the results attained through the quantitative study by using qualitative investigation.

To facilitate participants in prioritizing the main factors contributing to food insecurity, the proportional piling technique using 100 seed beans was used. Proportional piling is a participatory approach widely used in a various research fields, including epidemiological and infectious disease assessment [22]. In the context of this study, proportional piling was used to investigate the relative contribution of COVID-19 related factors for the individuals' food insecurity. The food sellers were first asked to mention three most important COVID-19 related factors that contributed for the reduction of food security during the pandemic. The factors mentioned by the participants were written on A3 paper. The participants were given 100 seed beans to share across the mentioned factors based on the participant's perceived importance of each of the factors to the food security crisis; the most important factor as perceived by the participant was allocated more beans and less important factors then allocated less beans.

Data analysis

IBM SPSS Version 28 statistical software was used to analyze the quantitative data (food buyers' survey), while textual analysis was used to interpret the interview data arising from the food sellers' interviews (including photos of the proportional piling).

Quantitative analysis

Descriptive statistical analysis using percentages, means, tables, and numbers were applied. Inferential statistics for the analysis of intervariable association and to analyze the effect of predictive (independent) variables on dependent variables was applied using ordinal logistic regression.

The parametric food insecurity estimation was applied using the respondents' raw score and the percentage of each item for the "yes" answers. The raw score can be Zero—Food Secure (the respondent/s answers "no" for all questions) through to Eight—Severely Food Insecure (the respondent/s answers "yes" for all questions). The raw score of respondents was considered an ordinal measure of food insecurity. Based on the Household Food Insecurity Access Scale (HFIAS) [23], food insecurity was categorized as *food secure* with '*no*' answer for all FIES questions, *mild food insecure* with '*yes*' answer for questions from 1 to 4 (WORRIED to SKIPPED), *moderate food insecure* with *'yes'* answer for the 5thquestion (ATELESS) and *severe food insecure* with '*yes*' answer for the questions 6–8 (RANOUT to WHOLEDAY) as a threshold. The food insecurity prevalence of the target population was analyzed using the proportion of the respondents in food secure, mild food insecure, moderate food insecure, and severe food insecure domains. The FIES guideline categorizes the food insecurity status of individuals into moderate and severe only using the 5th (ATELESS) and 8th (WHOLEDAY) items, respectively, and does not measure the food security status of all participants [20]. As a result, HFIAS's guideline was used to group the participants in more inclusive food security categories, with the remaining analysis performed based on the FIES recommendation.

The demographic variables and FIES items were considered independent variables (the cause variable that stands alone or is manipulated in the investigation), and the respondents' food insecurity statuses were taken as dependent variables (the effect variable that was measured in the investigation). The effect of the independent variables on the ordinal dependent variable was analyzed using ordinal logistic regression using the Polytomous Universal Model (PLUM) procedure [24]. A p-value less than 0.05 with the 95% confidence interval was taken as being statistically significant. The difference between the food insecurity status pre- and post- the emergence of COVID-19 was taken as food insecurity due to COVID-19.

Qualitative analysis

The factor prioritization process using proportional piling was captured using smart phone camera recorder. The audio and photo versions of the qualitative data was transcribed to a text version. Since the original data was in Amharic language, the transcribed text was translated to English for final analysis. Both transcribed and translated version of the qualitative data were independently checked and verified by a fluent speaker of both languages (Amharic and English).

The responses of each participant were reviewed during the qualitative analysis of the data in the context of the findings of the quantitative analysis. COVID-19 factors that impacted the food security of individuals and mentioned by the food sellers were listed and prioritized based on the proportional piling result. The total number of factors was calculated as the total number of participants (food sellers) multiplied by three (number of mentioned factors per food seller). One factor can be mentioned multiple times by different respondents and the frequency of factors was expressed in numerical figures. The percentage of beans was calculated from the total number of beans allocated to all participants (number of food sellers times 100 beans). The factor with the highest percentage of beans was prioritized as the most

important factor for diminishing the food security of individuals during COVID-19.

Results

Food buyers' food insecurity assessment

Of the 396 participants, 50% (198) were from a metropolitan city (Addis Ababa) with the remainder evenly split (66) from the three nominated regional cities (Dessie, Kombolcha, and Debre Birhan), giving a final sample of both urban and regional individuals. Participants living in Addis Ababa reported higher levels of food insecurity before the emergence of COVID-19, compared to individuals living in regional cities, with a statistically significant effect: Wald (X^2) = 9.439, *p*-value = 0.002, and odds = 0.37 (CI = 0.2–0.7). Both the living arrangement (family size) and type of work for income generation variables were significantly associated with the food security status of individuals, both before and after the emergence of COVID-19 (Table 2). Before the emergence of the pandemic, individuals aged 41–50 had positive (odds = 2.574) association with their food security status while individualists who were not formally educated had a negative (odds = 0.24) association with their food security status (Table 2).

All eight items of food insecurity experience indicators showed increases post-COVID-19 emergence compared with pre-COVID-19 food insecurity situations. The 69.4% of individuals who were WORRIED about the shortage of food due to lack of money or other resources increased to 91.4% with a 22% increment during post-COVID-19 emergence (Table 3). Higher number of individuals were eating less amount of food during COVID-19 than before the emergence of the pandemic due to the pandemic related food security crisis. The mean food insecurity score after the emergence of COVID-19 (5.32) was higher than the food insecurity score before the pandemic (3.75), which indicates an increase in post-pandemic food insecurity.

Table 2 The frequency of demographic variables and their effect on the food security status of individuals 12 months before and after the emergence of COVID-19 using ordinal logistic regression

Variables	Categories	Numbers (%) (*n* = 396)	Pre-COVID-19 emergence			Post-COVID-19 emergence		
			Wald	*p* value	Odds (95% CL)	Wald	*p* value	Odds (95% CL)
Location	Addis Ababa	198(50)	9.439	0.002	0.37(0.2–0.7)	1.18	0.277	0.72(0.39–1.3)
	Dessie	66(16.7)	0.097	0.756	1.13(0.52–2.45)	0.01	0.919	0.96 (046–1.99)
	Kombolcha	66(16.7)	0.151	0.697	1.16(0.54–2.48)	0.03	0.866	0.94 (0.46–1.91)
	Debre Birhan	66(16.7)	-	-	-	-	-	
Age	18–30	61(15.4)	2.857	0.091	1.93(0.7–4.14)	0.65	0.420	1.36 (0.64–2.87)
	31–40	103(26)	3.686	0.055	1.92(2.45–3.72)	1.49	0.222	1.5 (0.78–2.89)
	41–50	147(37.1)	9.652	0.002	2.574(2.48–4.67)	3.23	0.072	1.72 (0.95–3.12)
	> 50	85(21.5)	-	-	-	-	-	-
Gender	Male	192(48.5)	1.692	0.193	1.37(0.852–2.206)	0.3	0.583	1.14 (0.71–1.83)
	Female	204(51.5)	-	-	-	-	-	-
Education	No formal education	56(14.1)	10.136	0.001	0.24(*0.1–0.58*)	0.1	0.753	0.86 (0.35–2.13)
	Primary school	89(22.5)	0.057	0.810	0.92(*0.46–1.82*)	0.07	0.791	0.91 (0.45–1.85)
	Secondary school	128(32.3)	0.433	0.510	1.23(*0.66–2.25*)	1.23	0.267	1.36 (0.79–2.36)
	Higher Education	123(31.1)	-	-	-	-	-	-
Marital status	Unmarried	117(29.5)	0.535	0.465	0.74(0.33–1.66)	1.84	0.175	0.61 (0.3–1.24)
	Married	203(51.3)	2.337	0.126	0.64(0.36–1.13)	0.89	0.345	0.76 (0.43–1.35)
	Divorced	76(19.2)	-	-	-	-	-	-
Living arrangement	No dependent	133(33.6)	31.249	0.0001	11.53(4.89–27.16)	12.6	0.0001	4.06 (1.87–8.81)
	Couple	59(14.9)	27.832	0.0001	8.96(3.96–20.23)	15.91	0.0001	4.77 (2.21–10.27)
	Have one child	31(7.8)	17.451	0.0001	6.42(2.68–15.37)	5.44	0.02	0.28 (0.1-.82)
	Have 2–4 children	40(10.1)	4.167	0.041	0.42(0.19–0.97)	0.66	0.417	0.7 (0.3–1.65)
	Have 5 + children	133(33.6)	-	-	-	-	-	-
Work for income generation	Government employee	62(15.7)	23.362	0.0001	0.13(*0.06–0.3*)	2.82	0.093	0.53 (0.25–1.11)
	NGO employee	64(16.2)	14.598	0.0001	21.73(*4.48–105.46*)	19.31	0.0001	7.21 (2.99–17.41)
	Casual labourer	61(15.4)	13.057	0.0001	0.25(*0.12–0.53*)	18.02	0.0001	0.19 (0.1-.41)
	Daily labourer	151(38.1)	17.239	0.0001	0.2(*0.1–0.43*)	23.1	0.0001	0.16 (0.07-.33)
	Business owner	58(14.6)	-	-	-	-	-	-

Table 3 The responses of individuals for the food insecurity experience scale (FIES) items, ordinal logistic regression results, and the changes of food security statuses following COVID-19 emergence

Items/Questions	Responses	Pre-COVID-19		Post-COVID-19		Food insecurity increment following COVID-19 in %
		Number (%) ($n=396$)	*p* value (odds)	Number (%) ($n=396$)	*p* value	
WORRIED	Yes	275(69.4)	0.0001	362(91.4)	0.181	22
	No	121(30.6)		34(8.6)		
HEALTHY	Yes	275(69.4)	-	325(82.1)	1.000	12.7
	No	121(30.6)		71(17.9)		
FEWFOODS	Yes	249(62.9)	0.646	304(76.8)	1.000	13.9
	No	147(37.1)		92(23.2)		
SKIPPED	Yes	176(44.4)	0.867	293(74)	1.000	29.6
	No	220(55.6)		103(26)		
ATELESS	Yes	167(42.2)	0.0001	285(72.2)	0.187	30
	No	229(57.8)		110(27.8)		
RANOUT	Yes	122(30.8)	1.000	184(46.5)	1.000	15.7
	No	274(69.2)		212(53.5)		
HUNGRY	Yes	114(28.8)	1.000	180(45.5)	1.000	16.7
	No	282(71.2)		216(54.5)		
WHOLEDAY	Yes	106(26.8)	-	171(43.2)	0.185	16.4
	No	290(73.2)		225(56.8)		

The emergence of COVID-19 saw the overall food security of individuals reduce to just 8.6%, a drop of 21.5% when compared with the pre-COVID-19 food security figure of 30.1% (see Fig. 1 below). This represents a dramatic increase in the food insecurity of individuals following the pandemic when compared to pre-pandemic. In addition to showing the change in overall food security scores, Fig. 1 also includes the more nuanced sub-category measures of food insecurity: 'mild food insecurity'; 'moderate food insecurity'; and 'severe food insecurity'. This data shows that there were increasing trends in the 'moderate' and 'severe' food insecurity categories following the emergence of COVID-19, but a decrease in food insecurity in the 'mild' category. However, as can be seen in the linearity of score increases shown in Fig. 1, it is believed that this apparent inconsistency is likely due to the proportion of individuals moving from lower insecurity categories into higher ones.

Food sellers' view on food insecurity deriving factors

A total of twenty-two food sellers were interviewed to assist in identifying the primary factors contributing to the COVID-19 induced food security crisis. The interviewees nominated twelve different factors that they

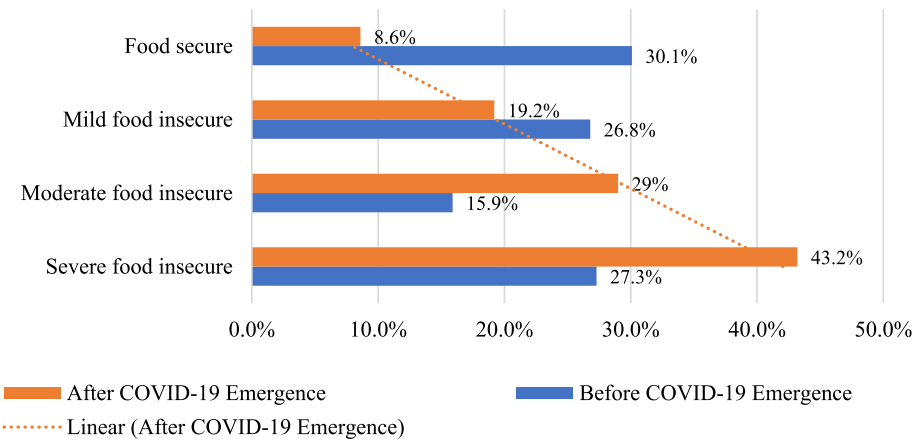

Fig. 1 Food security status of individuals before and after the emergence of COVID-19 and its linearity following COVID-19 emergence

believed impacted the food supply chain and resulted in a food security crisis during the COVID-19 pandemic. These factors come under two themes – Food insecurity: Beginning of COVID-19; and, Food insecurity during COVID-19.

Food insecurity: beginning of COVID-19

Food sellers indicated that the food buying practices of their customers had changed at the beginning of COVID-19 when compared to before COVID-19. The amount of food the food buyers demanded was higher than their daily need as compared with their pre-pandemic experience. The change was not restricted to the amount of food that the customers bought, but also the customers' food preferences were distorted. Unlike the pre-COVID-19, "*consumers were grabbing every food item for preserving enough amount of food for the duration of COVID-19 restrictions"* (food seller from Dessie city). *"Food buyers had invested the money they had saved for several years on food and their overbuying practice resulted food price hike"* (food seller from Kombolcha city). COVID-19 prevention policies of the government led to fear amongst the people; "*everybody was nervous and tried to buy food items over their daily plan"* (food seller from Dessie city). However, it was not only the food buying practices that changed, with other basic day-to-day trends underpinning the stable food supply chain being impacted: *"The food buying behaviour and other day to day normal activities including social activities and transport systems were total changed as compared with the pre-pandemic situation"* (food seller from Dessie city) and *"some consumers were focused on food items with longer shelf life and dry food items like grains, flours, and sugar"* (food seller from Kombolcha city). In addition to the direct impact of COVID-19 pandemic, the measures and restrictions adopted for the prevention of the pandemic indirectly impacted the food supply chain. *"Job losses due to closure of employing industries/institutions, transport bans for both food items and people, and total lockdown without considering what people can eat affected the food supply chain and food security of individuals"* (food seller from Kombolcha city). Food sellers from Kombolcha, Addis Ababa, and Debre Birhan cities all also noted that the food security of people was additionally compromised by civil war, desert locust emergence and drought, but that it was prominently aggravated by COVID-19 emergence.

Food insecurity: beginning of COVID-19 and during COVID-19

The enforcement of COVID-19 related measures was loosened after few months of the pandemic's commencement. The fear of people was reducing, and people were returning to their normal day-to-day activities: "*The disturbed day to day activities was not retained for long, it gradually returned back to normal after 2–3 months of suffering"* (food seller from Kombolcha city). *"If the warnings and announcements from government authorities, individuals, politicians, and spiritual institutions was continued like the beginning of the pandemic, people will be died from hunger, but luckily everybody gradually forgotten the pandemic"* (food sellers from Dessie City). Food sellers in Addis Ababa, Debre Birhan, Kombolcha and Dessie cities all mentioned that when COVID-19 prevention factors like transport bans, lockdowns, movement, and social distance restrictions were reduced, food accessibility and availability started to return towards the situation before COVID-19 emergence.

Food security diminishing factors: identification and prioritization

Eleven of the twelve factors identified by the food sellers through the proportion piling method were related to COVID-19, with the final factor being more general disasters (drought, war, locust). It is acknowledged that these factors are often interlinked and inter-dependent on each other, and that different factors with similar meanings were identified by respondents (Table 4). Prioritization of factors was done using proportional piling technique and indicated in Table 4.

As indicated in Table 4, about half (10 out of 22) of food sellers mentioned that 'transport ban' was the most crucial factor for the food security crisis during the COVID-19 pandemic (Table 4). "*Transport is the way to reach to the food and the way to bring food to us. When transport is closed the food and consumers cannot meet each other"* (food seller from Addis Ababa city). *"It is not always true that consumers and food are in the same place"* (food seller from Debre Birhan city*).* The transport closures due to movement restrictions, lockdowns and other COVID-19 prevention and control related restrictions interrupted the food supply chain. The transport ban created a physical barrier between consumers and food, and as such, the food insecurity due to food inaccessibility increased during COVID-19. Participants also mentioned non-COVID-19 related factors (man-made and natural disasters like war, drought and desert locust emergence) that impacted the food security of individuals during and before the emergence of COVID-19.

Discussion

The purpose of the present study was to assess the impact of COVID-19 on the food security of individuals in Ethiopia, and to identify and prioritize those factors that directly or indirectly contribute to the food security crisis. This study was targeted at investigating the pre- and post-COVID-19 emergence food security situations

Table 4 Prioritization of deriving factors using proportional piling technique

List of factors	Frequency of factors mentioned by food sellers ($n=66$)	Number of beans allocated for the factor ($n=2,200$)	Percentage of beans based on proportional piling ($n=2,200$)	Priority
Transport bans	10	336	15.27	1st
Food price increment	6	252	11.45	2nd
Lockdown measures	7	240	10.91	3rd
Job loss	7	240	10.91	3rd
Market ban	6	234	10.64	4th
Social distance restrictions	9	212	9.64	5th
Natural and manmade disasters like drought, war, and desert locust	6	192	8.73	6th
Over fearing of the pandemic	5	128	5.83	7th
Movement restrictions	4	116	5.27	8th
Over buying	2	92	4.18	9th
Food inaccessibility	2	82	3.73	10th
Lack of cash due to bank closure	2	76	3.45	11th

of individuals using the accessibility dimension of food security.

Demographic characteristics and food insecurity during and pre-COVID-19 emergence

It was identified that, before the emergence of COVID-19, the location of individuals had a statistically significant effect on the food security of individuals. People living in the metropolitan city were more food insecure as compared with those residing in the regional areas. Since regional locations are closer to the food production sites (rural areas) than the metropolitan cities, a possible reason for this difference may be due to the accessibility of food items in the immediate surrounding environment. Comparable to the current finding, previous research findings [25–28] reported that food insecurity of individuals increased in urban residents, net food buyers, and remote area residents. However, even if food insecurity was increased regardless of the participants' residential city (metropolitan or regional), there was no significant association between the location of participants and their post-COVID-19 emergence food security status. This is comparable to the finding of Amare et al. [29] that there was no food insecurity differences among urban and rural residents during the COVID-19 pandemic.

In the present study, individuals aged from 41 to 50 years were statistically more food secure than older persons (> 50 years). However, it is important to note that this finding was only before the emergence of COVID-19. A study conducted in India [30] also found that older persons were more food insecure than adults and younger people due to limited financial income. Another study undertaken in Ethiopia [31] found that the age of individuals had a statistically significant effect on food security status. Yet, in the current study, post-COVID-19 emergence food security of individuals revealed no statistically significant association between the participants' age and their food security status. This may be due to no significant variance in individuals' food security regardless of their age. There was a probability of a significant association between age and food security during the pandemic, but this has been missed due to inadequate statistical power.

Individuals with no formal education were statistically more food insecure as compared with the individuals with higher educational levels, but again this was only before the emergence of COVID-19. It is hypothesized that this may be due to differences in financial income among educated and non-educated individuals. In the Ethiopian context, educated individuals have higher financial income than individuals with no formal education. Like the present finding, the studies conducted in Iran [32] and Ethiopia [31] reported that the education of individuals had a statistically significant effect on the food security status among individuals. The post-COVID-19 food security assessment in the present study indicated that there was no significant association between the individual's educational status and their food security.

Comparing individuals with more than five family members against the dummy variables of living arrangement/family size (no dependent, couple, one child, and 2–4 children) were significantly associated with their food security status, both before and after COVID-19. Since the food demand for large family sizes is higher than the households with a small number of family members, it is not surprising that the food security crisis

increases as the family size increases [31]. Comparable to the current finding, a study conducted in Addis Ababa [33] reported that individuals with more than four family members were severely food insecure as compared with smaller family sizes. All the dummy variables of the variable "work for income generation" (government employee, NGO employee, casual labourer, and daily labourer) had statistically significant effects on the food security of individuals with a reference to the dummy variable of 'private business owners,' both before and after COVID-19, respectively. All types of work other than NGO employees had a negative correlation with the food security status of individuals. This indicates that the NGO employees were more food secure than participants in other types of work. Similar to the current study, Dersoet *al*. [33] confirmed that individuals' work for income generation was significantly associated with food security status. In addition, the studies conducted in Iran [32], four low-income African countries (Ethiopia, Malawi, Nigeria, and Uganda) [28], and India [34] indicated that the work of individuals for income generation had a strong association with their food security status.

Food insecurity prevalence pre- and post-COVID-19 emergence

The food insecurity prevalence of individuals increased in all eight items of food insecurity indicators (Table 3). As an example, before the emergence of COVID-19 30.6% of individuals were not WORRIED about the shortage of food due to lack of money or other resources. This means that 30.6% of individuals were food-secure before the emergence of COVID-19, but this percentage declined to 8.6% during the pandemic. Comparably, the studies conducted in Chile [35], Bangladesh [36], Kenya [9], Uganda [9], Lebanon [37], and the USA [10, 38], confirmed that the food insecurity of individuals was increased by 19%, 30.9%, 38%, 44%, 12%, 15.7%, and 8.4%, respectively due the emergence of COVID-19. Research conducted in India [34] indicated that food insecurity increased by 59%, from 21% before the emergence of COVID-19 to 80% post-COVID-19, significantly higher than the current finding. However, other studies showed lower findings in the current study, such as one that found food security was reduced in the USA by 3.34% due to COVID-19 [39]. It is believed that this variation might be due to differences in socio-demographic factors (population density, geographic location, and religious attitude), government assistance (safety net programs), differences in enforcement of COVID-19 preventive measures, and demand and supply chains of food items in different study sites.

The remaining seven indicators also showed that the respondents' 'yes' answers (food insecurity percentages) increased post-COVID-19 compared with pre-COVID-19. The number of individuals who did not get healthy food, ate fewer amount of foods than usual, skipped their normal meal time, ate less food, ran out of food to eat, were hungry due to lack of food, and could not eat food for the whole day due to lack of money or other resources increased after the emergence of COVID-19 as compared with the food insecurity situations before the emergence of COVID-19. This indicates that individuals were concerned, and experienced lower quality and quantity of food that could be attributed to measures taken to reduce the transmission of COVID-19 and the consequences of the pandemic such as food market closer, job losses, food value chain interruption, and complete lockdowns [25, 26, 28, 29].

The moderate (15.9%) and severe (27.3%) food insecurity status of individuals, before COVID-19 were increased to 29% and 43.2% post-pandemic, respectively. This means that the food insecurity of individuals increased by 13.1% (moderate), and 15.9% (severe) because of COVID-19. A study conducted in Iran [40] showed that the food insecurity of individuals increased by 53.87% (moderate) and 33.3% (severe), higher than the current findings, while research conducted in Indonesia [41] reported an increase of 14.96% in food insecurity was observed due to COVID-19 emergence. Contrary to the moderate and severe food insecurity increments, the number of individuals with mild food insecurity was reduced from 26.8% (pre-COVID-19 emergence) to 19.2% (post-COVID-19 emergence). This means that 7.6% of individuals were shifted to moderate and severe food insecurity levels following COVID-19 occurrence. The emergence of COVID-19 has impacted individuals regardless of their location, age, gender, educational levels, and marital status, and the food insecurity levels have linearly shifted (Fig. 1).

Impetuses for the food security crisis during COVID-19

The qualitative data identified the factors that increased the food buyers' food insecurity after the emergence of COVID-19. Many food sellers mentioned that 'transport bans' were the main cause of food insecurity. Similarly, Kakaei et al. [42] confirmed that COVID-19 prevention measures, such as national and international transport restrictions and lockdown measures, severely impacted the food security of individuals and households. As mentioned by participants in the current study, the food transport system from the production and processing areas to the consumer was obstructed due to measures taken for the prevention of COVID-19.

The food sellers considered that consumers were focused on buying food items with long shelf life, which is contrary to the study conducted in Brazil [43] that

showed consumers were instead seeking easily perishable foods like animal products, vegetables, and bakery products during the lockdown periods. This variance might be due to differences in weather conditions, food storage mechanism, eating cultures, food preferences, and food technologies and accessibility of certain foods in different regions.

Among twelve factors mentioned by food sellers, eleven were COVID-19 induced with only one non-COVID-19 related. This means the food security in the study areas is not only due to COVID-19, but also due to disasters that directly and indirectly impacted the availability, accessibility, usability, and stability of food. Considering COVID-19 impacted the global community, the factors mentioned by food sellers are not likely not unique to Ethiopia, with other studies having similar findings [13, 25, 26, 28, 29, 44–46]. As corroborated by Zhang et al. [17], the pre-existing factors like drought, famine, and war, together with COVID-19, significantly impacted food security. Likewise, a study conducted in the Philippines [47] indicated that even if non-COVID-19 related factors played a role, the COVID-19 prevention restrictions like lockdowns, transport restrictions, inadequate coverage of safety net programs and economic crisis due to job losses caused the country's highest hunger rate in history.

Limitation of the study

The study excluded participants who were not food buyers and sellers during data collection. As a result, it may have not included individuals who were critically food insecure, or, alternatively, who were food secured. Since the data depended on previous food insecurity experiences of food buyers and the food value chain memory of food sellers, the study could be exposed to recall biases. The findings were also gathered from four locations in one area of Ethiopia, and samples in other areas may see different results. This study is based on the FIES questions which uses the food access dimension only. As a result, the study cannot be able to assess the impact of COVID-19 on the remaining three dimensions (food availability, stability, and usability). Since food security is a complex concept that is interlinked with a variety of biological, socio-economic, and political factors, it is not easy to identify the real impact of the pandemic on individuals' food security.

Conclusion

This study assessed individuals' food security crisis due to the emergence of COVID-19 in Ethiopia and the associated factors that caused this crisis. As compared with the pre-pandemic situation, the food security of individuals declined, and COVID-19 prevention factors and other non-pandemic related disasters contributed to food insecurity post-pandemic. The increased food insecurity was associated with the direct and indirect impact of COVID-19 on one or more of the food security dimensions (food availability, accessibility, usability, and stability/sustainability). Measures (lockdown, movement restriction, marketing channel interruption, job loss, economic crises, and obstructions in agricultural products and productivity) taken for the prevention and control of COVID-19 and disasters like drought and desert locust emergence has negatively affected the food value chain. The food security crisis due to COVID-19 can provide some guidance to policymakers, health and food regulators, food suppliers, researchers, and political and government actors to prioritize future disease prevention measures, which is crucial for early preparedness of the inevitable future pandemic/s. In developing countries, which do not have stable safety net programs, the experience of food security might be more catastrophic than the direct health impact of COVID-19. As a result, learning from COVID-19 and being ready for the future pandemics, forming impact reduction task forces, establishing disease prevention strategies that will not compromise food security, and versatile further study on reducing current and future pandemic impacts are recommended.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-22103-w.

Additional file 1. This pdf file contains the semi-structured questionnaire checklist that were used to assess food sellers' views on post-COVID-19 food insecurity increment.

Acknowledgements

The authors appreciated the University of New England for assistances related with the data collectors' expenses. Moreover, the food buyers and food sellers who were participated in the survey and interview of this research project are appreciated for their willingness to participate and their valuable data input.

Authors' contributions

DTG participated in data collection, entry, manipulation, and analysis; result interpretation; manuscript draft writing and editing. SW, LE and MSI has supervised the activities conducted by DTG, revised, and edit the draft manuscript, language, and quality checks; and all authors have participated in reading and final approval of the manuscript.

Funding

Except limited financial assistances (for travel and partial data collectors' fee) from the University of New England, no funding was gained for other activities of this research project. This funder has not a specific role in the conceptualization, design, data collection, analysis, decision to publish, or preparation of the manuscript.

Data availability

The data related with this study is summarized in the result section of the study. If further detail is required, the datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Formal ethical clearance for this project was approved by the University of New England (UNE) Human Research Ethics Committee (HREC) on 25 October 2022. The Wollo University Institutional Research Ethics Review Committee in turn approved the ethics clearance granted by UNE HREC on 21 December 2022.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]School of Health, University of New England, Armidale, NSW, Australia. [2]School of Nursing and Midwifery, University of Southern Queensland, Toowoomba, QLD, Australia. [3]Centre for Health Research, University of Southern Queensland, Toowoomba, QLD, Australia. [4]School of Rural Medicine, University of New England, Armidale, NSW, Australia. [5]School of Veterinary Medicine, Wollo University, Dessie, Ethiopia.

Received: 9 May 2024 Accepted: 26 February 2025
Published online: 04 March 2025

References

1. WHO. Rolling updates on coronavirus disease (COVID-19). 2022. [https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen].
2. Bonotti M, Zech ST. The Human, Economic, Social, and Political Costs of COVID-19. In: Recovering Civility during COVID-19. edn. Singapore: Springer Singapore; 2021. p. 1–36.
3. Auriemma V, Iannaccone C. COVID-19 Pandemic: Socio-Economic Consequences of Social Distancing Measures in Italy. Front Sociol. 2020;5:575791.
4. Gopalan HS, Misra A. COVID-19 pandemic and challenges for socio-economic issues, healthcare and National Health Programs in India. Diabetes Metab Syndr. 2020;14(5):757–9.
5. WHO. WHO COVID-19 dashboard: Number of COVID-19 cases reported to WHO (cumulative total). 2022. [https://data.who.int/dashboards/covid19/cases?n=c].
6. FAO, IFAD, UNICEF, WFP, WHO. The State of Food Security and Nutrition in the World 2019: Safeguarding against economic slowdowns and downturns. 2022. [https://openknowledge.fao.org/items/f73edb75-4017-497b-8ca3-e66ea2109560].
7. Picchioni F, Goulao LF, Roberfroid D. The impact of COVID-19 on diet quality, food security and nutrition in low and middle income countries: A systematic review of the evidence. Clin Nutr. 2022;41(12):2955–64.
8. Dasgupta S, Robinson EJZ. Impact of COVID-19 on food insecurity using multiple waves of high frequency household surveys. Sci Rep. 2022;12(1):1865–1865.
9. Kansiime MK, Tambo JA, Mugambi I, Bundi M, Kara A, Owuor C. COVID-19 implications on household income and food security in Kenya and Uganda: Findings from a rapid assessment. World Dev. 2021;137:105199–105199.
10. Niles MT, Beavers AW, Clay LA, Dougan MM, Pignotti GA, Rogus S, Savoie-Roskos MR, Schattman RE, Zack RM, Acciai F, et al. A Multi-Site Analysis of the Prevalence of Food Insecurity in the United States, before and during the COVID-19 Pandemic. Curr Dev Nutr. 2021;5(12):135nzab135-nzab135.
11. Kent K, Alston L, Murray S, Honeychurch B, Visentin D. The Impact of the COVID-19 Pandemic on Rural Food Security in High Income Countries: A Systematic Literature Review. Int J Environ Res Public Health. 2022;19(6):3235–3235.
12. Devereux S, Béné C, Hoddinott J. Conceptualising COVID-19's impacts on household food security. Food Security. 2020;12(4):769–72.
13. Louie S, Shi Y, Allman-Farinelli M. The effects of the COVID-19 pandemic on food security in Australia: A scoping review. Nutr Diet. 2022;79(1):28–47.
14. Abay KA, Berhane G, Hoddinott J, Tafere K. COVID-19 and Food Security in Ethiopia: Do Social Protection Programs Protect? Econ Dev Cult Change. 2023;71(2):373–402.
15. Hirvonen K, de Brauw A, Abate GT. Food Consumption and Food Security during the COVID-19 Pandemic in Addis Ababa. Am J Agr Econ. 2021;103(3):772–89.
16. Tefera SA, Tadesse TB, Asmare GW. Prevalence of household food insecurity in Ethiopia during the COVID-19 pandemic: Evidence from panel data. Scientific African. 2022;16:e01141–e01141.
17. Zhang P. Léo, Hakiza, Sandrine, Biru, Loza, Girmatsion, Lemlem: Impact of COVID-19 on Food Security in Ethiopia. Epidemiologia. 2022;3(2):161–78.
18. Ethiopian Statistical Service. Population Size of Towns by Sex, Region, Zone and Weredas as of July 2021. 2022. [https://www.statsethiopia.gov.et/wp-content/uploads/2020/08/Population-of-Towns-as-of-July-2021.pdf].
19. Australian Bureau of Statistics. Australian Bureau of Statistics: Sample Size Calculator. 2024. [https://www.abs.gov.au/websitedbs/D3310114.nsf/home/Sample+Size+Calculator].
20. FAO. Voices of Hungry. The Food Insecurity Experience Scale: Measuring food insecurity through people's experiences. 2022. [http://www.fao.org/in-action/voices-of-the-hungry/fies/en/].
21. Cafiero C, Viviani S, Nord M. Food security measurement in a global context: The food insecurity experience scale. Measurement. 2018;116:146–52.
22. Coffin JL, Monje F, Asiimwe-Karimu G, Amuguni HJ, Odoch T. A One Health, participatory epidemiology assessment of anthrax (Bacillus anthracis) management in Western Uganda. Soc Sci Med. 2015;129:44–50.
23. Gaitán-Rossi P, Vilar-Compte M, Teruel G, Pérez-Escamilla R. Food insecurity measurement and prevalence estimates during the COVID-19 pandemic in a repeated cross-sectional survey in Mexico. Public Health Nutr. 2021;24(3):412–21.
24. Nussbaum EM. Categorical and Nonparametric Data Analysis. 2nd ed. New York: Routledge; 2024.
25. Narayanan S, Saha S. Urban Food Markets and the Lockdown in India. Glob Food Secur. 2021;29:100515. https://doi.org/10.1016/j.gfs.2021.100515.
26. Lowe M, Nadhanael GV, Roth B. India's Food Supply Chain during the Pandemic. Food Policy. 2021; 105:102162. https://doi.org/10.1016/j.foodpol.2021.102162.
27. Adjognon GS, Bloem JR, Sanoh A. The coronavirus pandemic and food security: Evidence from Mali. Food Policy. 2021;101:102050–102050.
28. Josephson A, Kilic T, Michler JD. Socioeconomic impacts of COVID-19 in low-income countries. Nat Hum Behav. 2021;5(5):557–65.
29. Amare M, Abay KA, Tiberti L, Chamberlin J. Impacts of COVID-19 on food security panel data evidence from Nigeria. Food Policy. 2020;101:102099. https://doi.org/10.1016/j.foodpol.2021.102099.
30. Srivastava S, Muhammad T. Rural-urban differences in food insecurity and associated cognitive impairment among older adults: findings from a nationally representative survey. BMC Geriatr. 2022;22(1):287–287.
31. Getaneh Y, Alemu A, Ganewo Z, Haile A. Food security status and determinants in North-Eastern rift valley of Ethiopia. J Agric Food Res. 2022;8:100290–100290.
32. Ghanbari Movahed R, Maleki Fard F, Gholamrezai S, Pakravan-Charvadeh MR. The Impact of COVID-19 Pandemic on Food Security and Food Diversity of Iranian Rural Households. Front Public Health. 2022;10:862043.
33. Derso A, Bizuneh H, Keleb A, Ademas A, Adane M. Food insecurity status and determinants among Urban Productive Safety Net Program beneficiary households in Addis Ababa, Ethiopia PLOS ONE. 2021;16(9):e0256634–e0256634.
34. Nguyen PH, Kachwaha S, Pant A, Tran LM, Ghosh S, Sharma PK, Shastri VD, Escobar-Alegria J, Avula R, Menon P. Impact of COVID-19 on household food insecurity and interlinkages with child feeding practices and coping strategies in Uttar Pradesh, India: a longitudinal community-based study. BMJ Open. 2021;11(4):e048738–e048738.
35. Giacoman C, Herrera MS, Ayala Arancibia P. Household food insecurity before and during the COVID-19 pandemic in Chile. Public Health. 2021;198:332–9.

36. Hamadani JD, Hasan MI, Baldi AJ, Hossain SJ, Shiraji S, Bhuiyan MSA, Mehrin SF, Fisher J, Tofail F, Tipu SMMU, et al. Immediate impact of stay-at-home orders to control COVID-19 transmission on socioeconomic conditions, food insecurity, mental health, and intimate partner violence in Bangladeshi women and their families: an interrupted time series. Lancet Glob Health. 2020;8(11):e1380–9.
37. Kharroubi S, Naja F, Diab-El-Harake M, Jomaa L. Food Insecurity Pre- and Post the COVID-19 Pandemic and Economic Crisis in Lebanon: Prevalence and Projections. Nutrients. 2021;13(9):2976–2976.
38. Mialki K, House LA, Mathews AE, Shelnutt KP. Covid-19 and College Students: Food Security Status before and after the Onset of a Pandemic. Nutrients. 2021;13(2):628–628.
39. Ahmed T, Ilieva RT, Shane J, Reader S, Aleong C, Wong HY, Chu C, Brusche D, Jiang K, Lopez D, et al. A Developing Crisis in Hunger: Food Insecurity within 3 Public Colleges before and during the COVID-19 Pandemic. J Hunger Environ Nutr. 2023;18(1):1–20.
40. Joulaei H, Keshani P, Foroozanfar Z, Afrashteh S, Hosseinkhani Z, Mohsenpour MA, Moghimi G, Homayouni Meymandi A. Food insecurity status and its contributing factors in slums' dwellers of southwest Iran, 2021: a cross-sectional study. Arch Public Health. 2023;81(1):38–38.
41. Faridi A, Furqan M. Household Characteristics, Consumption Pattern and Household Food Security Before and During Covid-19 In Banten Province. Malaysian J Public Health Med. 2021;21:164–73.
42. Kakaei H, Nourmoradi H, Bakhtiyari S, Jalilian M, Mirzaei A. Effect of COVID-19 on food security, hunger, and food crisis. COVID-19 and the Sustainable Development Goals. 2022;3–29. https://doi.org/10.1016/B978-0-323-91307-2.00005-5.
43. Ferreira Rodrigues J. Cunha dos Santos Filho MT, Aparecida de Oliveira LE, Brandemburg Siman I, Barcelos AdF, de Paiva Anciens Ramos GL, Almeida Esmerino E, Gomes da Cruz A, Arriel RA: Effect of the COVID-19 pandemic on food habits and perceptions: A study with Brazilians. Trends Food Sci Technol. 2021;116:992–1001.
44. Gebeyehu DT, East L, Wark S, Islam MS. A systematic review of the direct and indirect COVID-19's impact on food security and its dimensions: pre- and post-comparative analysis. BMC Public Health. 2023;23(1):2298–2298.
45. Aday S, Aday MS. Impact of COVID-19 on the food supply chain. Food Qual Safety. 2020;4(4):167–80.
46. Godrich SL, Lo J, Kent K, Macau F, Devine A. A mixed-methods study to determine the impact of COVID-19 on food security, food access and supply in regional Australia for consumers and food supply stakeholders. Nutr J. 2022;21(1):17–17.
47. Rivera AKB, Bullecer ER, Rama RLCM, Malimban RC. Food and nutrition security in the Philippines during the COVID-19 pandemic. J Rural Med. 2023;18(3):2022–49.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.