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Household food insecurity during the COVID-19 pandemic and associated socioeconomic demographic factors in Papua New Guinea: evidence from the Comprehensive Health and Epidemiological Surveillance System

Vinson D Silas,[1] William Pomat,[1] Ronny Jorry,[1] Rebecca Emori,[1] Seri Maraga,[1] Lydia Kue,[1] Noel Berry,[1] Tess Aga,[1] Hung N Luu,[2,3] Toan H Ha,[4] Anthony D Okely,[5] Bang N Pham [1]

For numbered affiliations see end of article.

Correspondence to
Dr Bang N Pham;
pnbang2001@yahoo.com

ABSTRACT

Introduction The COVID-19 pandemic had an unprecedented impact on global food security, but little is known about the impact on food security at the household level. We examined the prevalence and socioeconomic demographic factors for household food insecurity during the COVID-19 pandemic in Papua New Guinea.

Methods Household socioeconomic demographic data from the Comprehensive Health and Epidemiological Surveillance System were collected from six main provinces in 2020 (37880 participants) and compared with the 2018 data (5749 participants). The prevalence of household food insecurity was estimated and stratified by household socioeconomic demographic characteristics. Multinomial logistic regression was conducted to estimate adjusted OR (aOR) and 95% CI of risk factors.

Results The overall prevalence of household food insecurity increased from 11% in 2018 to 20% in 2020, but varied across provinces, with the highest level reported in Central Province (35%) and the lowest level in East New Britain Province (5%). Food shortages were 72% less likely among urban residents than those living in rural areas (aOR 0.28 (95% CI 0.21 to 0.36)). The risk of food insecurity was 53% higher among adults aged 25+ years with primary education (grades 3–8) than those with university education (aOR 1.53 (95% CI 1.09 to 2.13)). People from households in the poorest wealth quintiles were 80% more likely to report food shortage than those from the richest wealth quintile (aOR 1.78 (95% CI 1.29 to 2.45).

Conclusion The study provides evidence to develop policy and intervention to deal with food insecurity in emergency situations in the future.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The COVID-19 pandemic had an unprecedented impact on global food security, but little is known about the impact of the pandemic at the country level and in poor resource settings such as Papua New Guinea (PNG).

WHAT THIS STUDY ADDS

⇒ Using household socioeconomic surveillance data, the study has provided evidence of the COVID-19 impact on food security at the household level in PNG and reported the prevalence and variation of household food insecurity across urban–rural sector, provinces, age and sex, and socioeconomic groups.

⇒ The study has identified most vulnerable populations to household food insecurity during the COVID-19, including rural residents, children (aged 5–14 years), adults (aged 25+ years) with primary education attainment, working population (aged 15–64 years) with an income less than 200 PNG Kina per fortnight, and those people from the poorest household wealth quintile.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study has developed a practical method for measuring household food security in the local context of PNG to inform public policy and target interventions in dealing with food insecurity during the COVID-19 pandemic in PNG that can be replicated in low-income and middle-income countries and similar settings for monitoring and reporting household food insecurity in emergency situations.

INTRODUCTION

Food insecurity continues to be a global concern as a result from climate change, natural disasters, social conflicts and health emergencies. The United Nations' Sustainable Development Goals (SDGs), the global development agenda for the period 2015–2030, emphasised Goal 2 'End hunger, achieve food security and improved nutrition and promote sustainable agriculture'.[1] To monitor countries' progress towards achieving this goal, governments are encouraged to collect data for reporting the SDG indicator 2.1.2 'Prevalence of moderate or severe food insecurity in the population'. According to the Global Food Security Report, there were approximately 135 million people in food crisis across 55 countries and territories in 2019.[2]

Global food security in the context of COVID-19 pandemic

The outbreak of COVID-19 pandemic in early 2020 impacted global food security, worsening the household food insecurity.[3] The United Nations estimated that food and nutritional insecurity reached 265 million people worldwide during the COVID-19 pandemic.[2 4] New challenges to addressing food insecurity emerged due to the COVID-19 pandemic.[5] To control the rapid spread of COVID-19, governments around the world imposed local lockdowns and social distancing that led to increased unemployment as well as disrupted local and international transport routes and food supply chains.[6] While such efforts slowed or stopped the spread of the COVID-19, they also resulted in reduced incomes and increased food prices.

The analysis from the global assessment of COVID-19 impacts on the food security status in 62 low-income and middle-income countries (LMICs) showed that both financial and physical accessibility to food have been disrupted.[7] However, little is known on the impact of COVID-19 on household food insecurity in poor resource settings like Papua New Guinea (PNG).

Food security in PNG during the COVID-19 pandemic

Located just south of the equator and 160 km north of mainland Australia, PNG is the largest nation in the South Pacific region with a total population of approximately 8 million in 2020. The first COVID-19 case in PNG was officially reported in Port Moresby (POM) on 20 March 2020,[8] and the second case was detected in East New Britain (ENB) Province on 6 April 2020. Wider spreads of COVID-19 transmission in the community were later observed in Central Province, Eastern Highlands Province (EHP) and East Sepik Province (ESP).[9] The Southern Region was hardest hit by the COVID-19 pandemic, followed by the Highlands, the Momase and the Islands regions.[8] From the 3 January 2020 to 9 December 2022, there were 46 427 confirmed cases of COVID-19 infection with 668 deaths reported to the WHO. As of 27 November 2022, a total of 502 119 vaccine doses have been administered.[8 10] Reporting the number of COVID-19 infections and vaccinations during the first year of COVID-19 pandemic was beyond the scope of this study. These figures are covered in a separate manuscript focused on measuring the impact of COVID-19 pandemic in PNG.

Like other countries, the unprecedented nature of COVID-19 pandemic prompted PNG to put in place preventive measures to control the spread of the viruses and reduce the cost of human lives. From 2020 to 2021, the PNG government took proactive steps to address the outbreaks by implementing a series of preventive measures.

States of emergencies were declared with extended nationwide lockdowns, including provincial curfews and isolations.[8] Main airports and seaports were closed and road transports were blocked. Food storages and market facilities including supermarkets were closed, making availability and accessibility to foods difficult and more expensive. As a result, food supply and distribution networks were interrupted and broken.[11] The PNG Government, through the Department of National Planning and Monitoring announced free-freight and subsidised logistics systems for food supply and distribution on 27 April 2020.[12] In the worst affected provinces, people received emergency food aid and other social supports from the government agencies, international and local non-government organisations, friends and families.[9]

Conceptualisation and justification of study on food security in the context of COVID-19 outbreaks in PNG

Food security at a country level often emphasises food availability. This traditional approach relies on nationally aggregated data on food supply (total amount of food produced and imported) and utilisation (the quantity of food exported, fed to livestock, used for seed, processed for food and non-food uses). In contrast, household-level measures of food security are concerned with food accessibility within households and these measures rely on data collected directly from households.[13]

The Food and Agriculture Organization (FAO) approach to dealing with household food insecurity relies on four pillars, including (1) availability, (2) accessibility, (3) affordability and (4) utilisation, providing a holistic framework for analysing food security at the household level.[14] Using this framework to conceptualise study on food security could enhance the understanding of the impact of COVID-19 pandemic on food security and pinpoint areas for the public and private sectors to intervene in the food system.

The COVID-19 pandemic affected household food security directly and indirectly. An early assessment of the impact of COVID-19 pandemic on the food system in India showed that COVID-19 pandemic caused disruption to household livelihoods. The direct impacts of COVID-19 included disruption in food production and distribution while the indirect impacts were on the economic affordability and physical access to food.[15] Multilayered shocks on food security were identified on both sides: producers and consumers.[16] Social

factors including social instability during the COVID-19 pandemic contributed to the increased prevalence of household food insecurity.[17] National response to the COVID-19 pandemic undermined the food supply-side such as food production, processing and distribution, but more concerning impact are on the food demand-side. Measuring food insecurity at the household level could be based on the household experience of food shortage, using both qualitative and quantitative methods.[18]

Our hypothesis was that the COVID-19 pandemic had adversely affected household food security in PNG. The direct impact of COVID-19 outbreaks on household food security could be reflected in the household experience of food shortages. We examined and compared the household food security indicators such as the prevalence and the scope of food insecurity in the households prior to and during the COVID-19 pandemic. Socioeconomic demographic factors of household food insecurity could be identified by measuring its association with the food insecurity status in the households. This information is important because it provides insight into the national responses to the COVID-19 pandemic.

Research objective and research questions
This study assessed the impact of the COVID-19 pandemic on food security at the household level, using the household socioeconomic demographic data collected in PNG in 2018 and 2020. The study addressed the following research questions:
► What is the prevalence of household food insecurity (ie, mild, moderate and severe) and its variation across socioeconomic demographic groups during the COVID-19 pandemic?
► What is the evidence of COVID-19 pandemic impact on household food security by comparing the household food insecurity levels before and during the first year of the pandemic?
► What are socioeconomic demographic factors associated with household food insecurity at the household level during the COVID-19 pandemic?

METHODS
Data source
Data were extracted from the household socioeconomic status (SES) data component of the Comprehensive Health and Epidemiological Surveillance System (CHESS). The CHESS method and design have been thoroughly described in previous studies.[19 20] Briefly, CHESS was established and operated by the Papua New Guinea Institute of Medical Research (PNGIMR) in the period 2018–2022. CHESS was developed based on the existing infrastructure of the integrated Health and Demographic Surveillance System, which was set up in the previous phase 2011–2017. CHESS is a third-generation population-based surveillance system, where household socioeconomic and demographic data were

integrated in individual morbidity and mortality data, with an electronic population database.

CHESS sites were established in six main provinces: one in POM—the National Capital District of PNG, and one in Central Province, representing the Southern region; two in EHP representing the Highlands region; two in ENB representing the Islands region, and one in ESP and one in Madang Province representing the Momase region.[15 21]

The selection of these surveillance sites and provinces was based on the previous phase of the CHESS programme, with adjustments to meet the new requirements of the PNG Government for comprehensive data disaggregated by urban–rural sectors and at national and subnational levels. Each province had one field office, and the main office of PNGIMR was based in Goroka town, EHP. As of December 2022, CHESS covered a surveillance population of approximately 80 000 people and 15 000 households, equivalent to 1% of the total PNG population, estimated at 8.8 million for the period 2017–2022. All residents who lived in the catchments areas of these surveillance sites were eligible to participate in this study. This study design did not target a specific random sample size. The household SES data represent only the surveillance population.[20]

Data collection instrument
In 2020, the household SES questionnaire was modified and updated with a new data module on food security in the context of COVID-19 outbreaks in PNG. The new household food security data module consisted of four groups of questions, exploring: (1) household experience on food security in the last 12 months; (2) household perception on the cause of food shortage; (3) Household experience on the impact of COVID-19 outbreaks and (4) household report on food assistance and public benefits they received during the COVID-19 outbreaks. These questions were adapted from standard and validated survey tools on household food security,[22] including the FAO's Food Insecurity Experience Scale (FIES) Survey Module,[1] and the US Food Security Measure for Assessing Household Food Security.[13] Respondents were also asked reasons for food shortage in their households.

FAO's FIES consists of eight questions on the self-reported food experience of individuals and households regarding access to food. The questions ask if during the last 12 months, was there a time when: (1) You were worried you would not have enough food to eat?; (2) You were unable to eat healthy and nutritious food?; (3) You ate only a few kinds of foods?; (4) You had to skip a meal?; (5) You ate less than you thought you should?; (6) Your household ran out of food?; (7) You were hungry but did not eat?; (8) You went without eating for a whole day?.[23] In our study, the question (6) was adapted to estimate prevalence of household food shortage while the questions (2), (4) and (7) were modified to measure the scope of food insecurity that households experienced

during the COVID-19 pandemic (online supplemental table 1).

Other indicators for measuring household food insecurity include: (1) Food Consumption and Coping Strategies Index which counts the frequency and severity of individuals' behaviours when they do not have enough food; (2) Food Consumption Score and (3) Household Dietary Diversity Scale. These indicators are designed to capture quality and diversity of food consumption.[24] Since the primary objective of this study is to measure the household food insecurity in the local context of COVID-19 pandemic in PNG, these measures were not employed.

Data collection and processing

Household SES data were collected by village-based data collectors via household interviews, using the paper-based household SES questionnaire. The interviews were conducted mostly with household heads in Tok-Pisin, the most common local language in PNG. Household SES data used in the study was collected in the most recent data collection round, conducted from January to December 2021. Because the household SES questionnaire asked questions about household food security in the past 12 months, the collected data mostly reflected the situation in 2020, the first year of COVID-19 pandemic in PNG.

Refresh trainings on data collection tool, data collection methods and household interview skills were conducted by the principal investigator for the surveillance team before the field work. Household interviews were conducted under the supervision of fieldwork coordinators. The information was quality checked by site managers before they were sent to the data processing centre based in PNGIMR main office in Goroka town of EHP. Data were entered into the CHESS database by data management team, using a standard data entry template, developed by database manager using My SQL/Process Maker platform.[25] A raw dataset were extracted from the CHESS database in the format of Microsoft Excel spreadsheet (csv.file) by the database manager for quality check. Data cleaning was conducted by data editor to ensure data errors were fixed. Data quality control and quality assurance were oversight by principal investigator.[15]

Analysing prevalence of household food security

In this study, the prevalence of household food insecurity was determined using the individual responses to the question of 'In the last 12 months, were there ever any times when you and/or your household members did not have enough food to eat?'.[23] The prevalence was then stratified by household socioeconomic demographic characteristics to show the variation. Variables included in the cross-tabulation included the age group and sex of participants, household size, number of women of reproductive age 15–49 years, number of children under 5 years of age and number of men of working age 15–64 years, urban–rural sector, province, household wealth quintile, income in the past 2 weeks and employment status of the

working population 15–64 years, and educational attainment among adult population who have finished school age, 25 years or above (educational attainment of the schooling age population, 5–24 years were not considered as it was confounded by age groups). These disaggregated data determined the variation of household food insecurity across subpopulations.

Household food insecurity was further examined and divided into four levels: (1) no food shortage; (2) mild food shortage; (3) moderate food shortage and (4) severe food shortage. These four levels of food shortage were defined based on the frequency and the scope of food shortage reported by the household members. The frequency of household food shortage had four categories: (1) none throughout the year; (2) once or twice a year; (3) every quarter and (4) every month. The scope of household food shortage also had four categories: (1) no food shortage; (2) unable to eat healthy and nutritious food; (3) skip a meal for a day and (4) no food for a whole day. Household members' responses to these categories were synthesised to determine the level of household food insecurity.

Identifying associated risk factors of household food insecurity

Multinomial logistic regression (MLR) was employed to determine the factors affecting the household food security status during the COVID-19 pandemic in PNG and predict the risk of food insecurity across the subpopulations. The binary variable on household food security (1=yes, 2=no) was included in MLR model as dependent variable while household socioeconomic demographic variables were included in the model as independent factors.[26] The main effect was selected to produce estimates of unadjusted and adjusted ORs (aORs) for the risks of household food insecurity.

Household SES is conventionally characterised by variables at both household and individual levels. In this study, the household-level variables included urban–rural residence, province, household size, number of children under 5 years of age, number of women of reproductive age (15–49 years), number of men of working age (15–64 years) living in the household and household wealth quintile. Individual-level variables included age, sex, education attainment, employment status and income. Both individual and household variables were included in MLR modelling to estimate the likelihood of household food shortage and identify subpopulations who were more vulnerable to food insecurity during the COVID-19 pandemic.

Non-significant variables in MLR model included sex, household size, number of women aged 15–49 years, number of children aged 0–4 years and employment status among the working population aged 15–64 years (online supplemental table 2). These variables were removed from the final MLR model. The variable of province was also excluded from the final MLR model because it was confounded with the urban–rural sector

Table 1 Prevalence of food insecurity by household socioeconomic demographic characteristics, PNGIMR's CHESS 2021

Household characteristics	Category	Food insecurity level				Food security	Total population
		Severe	**Moderate**	**Mild**	**Total**		
Sector	Urban	74 (0.8%)	252 (2.7%)	589 (6.3%)	915 (9.8%)	8389 (90.2%)	9304 (100.0%)
	Rural	975 (3.4%)	2731 (9.6%)	2825 (9.9%)	6531 (22.9%)	22 045 (77.1%)	28 576 (100.0%)
Province	Port Moresby	20 (1.1%)	42 (2.3%)	96 (5.2%)	158 (8.5%)	1692 (91.5%)	1850 (100.0%)
	Central	236 (2.2%)	1805 (16.7%)	1739 (16.1%)	3780 (35.1%)	7001 (64.9%)	10 781 (100.0%)
	Eastern Highlands	436 (3.8%)	765 (6.7%)	1259 (11.1%)	2460 (21.7%)	8894 (78.3%)	11 354 (100.0%)
	Madang	297 (6.7%)	357 (8.0%)	53 (1.2%)	707 (15.9%)	3751 (84.1%)	4458 (100.0%)
	East Sepik	0 (0.0%)	13 (0.3%)	82 (1.7%)	95 (2.0%)	4745 (98.0%)	4840 (100.0%)
	East New Britain	60 (1.3%)	1 (0.0%)	185 (4.0%)	246 (5.4%)	4351 (94.6%)	4597 (100.0%)
Age group (in year)	0–4	84 (3.2%)	194 (7.3%)	246 (9.3%)	524 (19.7%)	2131 (80.3%)	2655 (100.0%)
	5–14	234 (2.6%)	746 (8.3%)	776 (8.6%)	1756 (19.5%)	7234 (80.5%)	8990 (100.0%)
	15–24	211 (2.9%)	600 (8.2%)	654 (8.9%)	1465 (20.0%)	5875 (80.0%)	7340 (100.0%)
	25–34	163 (2.9%)	440 (8.0%)	553 (10.0%)	1156 (20.9%)	4370 (79.1%)	5526 (100.0%)
	35–44	124 (2.6%)	422 (8.8%)	452 (9.4%)	998 (20.8%)	3794 (79.2%)	4792 (100.0%)
	45–54	117 (3.0%)	269 (6.8%)	349 (8.9%)	735 (18.6%)	3207 (81.4%)	3942 (100.0%)
	55–64	70 (3.0%)	167 (7.2%)	219 (9.5%)	456 (19.7%)	1853 (80.3%)	2309 (100.0%)
	65–101	46 (2.0%)	145 (6.2%)	165 (7.1%)	356 (15.3%)	1970 (84.7%)	2326 (100.0%)
Sex	Male	552 (2.9%)	1567 (8.1%)	1748 (9.1%)	3867 (20.1%)	15 362 (79.9%)	19 229 (100.0%)
	Female	497 (2.7%)	1416 (7.6%)	1666 (8.9%)	3579 (19.2%)	15 072 (80.8%)	18 651 (100.0%)
No of household member	1–2	52 (2.6%)	134 (6.6%)	183 (9.1%)	369 (18.3%)	1647 (81.7%)	2016 (100.0%)
	3–4	266 (3.1%)	542 (6.3%)	689 (8.0%)	1497 (17.4%)	7115 (82.6%)	8612 (100.0%)
	5–6	348 (3.1%)	906 (8.1%)	1004 (9.0%)	2258 (20.3%)	8860 (79.7%)	11 118 (100.0%)
	7–8	186 (2.5%)	466 (6.3%)	554 (7.5%)	1206 (16.4%)	6166 (83.6%)	7372 (100.0%)
	9–10	91 (2.7%)	313 (9.3%)	358 (10.6%)	762 (22.6%)	2607 (77.4%)	3369 (100.0%)
	10+	106 (2.0%)	622 (11.5%)	626 (11.6%)	1354 (25.1%)	4039 (74.9%)	5393 (100.0%)
No of women aged 15–49 years in household	0	95 (3.1%)	195 (6.4%)	264 (8.6%)	554 (18.1%)	2506 (81.9%)	3060 (100.0%)
	1	528 (3.3%)	1223 (7.6%)	1316 (8.1%)	3067 (19.0%)	13 109 (81.0%)	16 176 (100.0%)
	2	200 (2.2%)	756 (8.2%)	907 (9.8%)	1863 (20.1%)	7391 (79.9%)	9254 (100.0%)
	3	137 (2.8%)	488 (10.0%)	544 (11.1%)	1169 (23.8%)	3734 (76.2%)	4903 (100.0%)
	4+	89 (2.0%)	321 (7.2%)	383 (8.5%)	793 (17.7%)	3694 (82.3%)	4487 (100.0%)
No of children under 5 years of age living in household	0	640 (3.0%)	1804 (8.4%)	1854 (8.7%)	4298 (20.1%)	17 083 (79.9%)	21 381 (100.0%)
	1	286 (2.9%)	688 (6.9%)	1062 (10.7%)	2036 (20.5%)	7887 (79.5%)	9923 (100.0%)
	2	87 (2.4%)	326 (8.9%)	332 (9.0%)	745 (20.3%)	2927 (79.7%)	3672 (100.0%)
	3+	36 (1.2%)	165 (5.7%)	166 (5.7%)	367 (12.6%)	2537 (87.4%)	2904 (100.0%)

Table 1 Continued

Household characteristics	Category	Food insecurity level				Food security	Total population
		Severe	Moderate	Mild	Total		
No of men aged 15–64 years living in household	0	35 (1.2%)	133 (4.5%)	138 (4.6%)	306 (10.3%)	2671 (89.7%)	2977 (100.0%)
	1	404 (2.9%)	985 (7.1%)	1081 (7.7%)	2470 (17.7%)	11 484 (82.3%)	13 954 (100.0%)
	2	259 (2.7%)	690 (7.3%)	944 (10.0%)	1893 (20.0%)	7551 (80.0%)	9444 (100.0%)
	3	196 (3.5%)	436 (7.7%)	624 (11.0%)	1256 (22.1%)	4424 (77.9%)	5680 (100.0%)
	4	65 (1.9%)	357 (10.5%)	400 (11.8%)	822 (24.3%)	2566 (75.7%)	3388 (100.0%)
	5+	90 (3.7%)	382 (15.7%)	227 (9.3%)	699 (28.7%)	1738 (71.3%)	2437 (100.0%)
Household wealth quintile	Poorest	243 (3.2%)	582 (7.7%)	503 (6.6%)	1328 (17.5%)	6248 (82.5%)	7576 (100.0%)
	Poor	263 (3.5%)	572 (7.6%)	481 (6.3%)	1316 (17.4%)	6259 (82.6%)	7575 (100.0%)
	Middle	214 (2.8%)	674 (8.9%)	640 (8.4%)	1528 (20.2%)	6049 (79.8%)	7577 (100.0%)
	Rich	278 (3.7%)	418 (5.5%)	846 (11.2%)	1542 (20.4%)	6029 (79.6%)	7571 (100.0%)
	Richest	51 (0.7%)	737 (9.7%)	944 (12.5%)	1732 (22.8%)	5849 (77.2%)	7581 (100.0%)
Total		1049 (2.8%)	2983 (7.9%)	3414 (9.0%)	7446 (19.7%)	30 434 (80.3%)	37 880 (100.0%)

CHESS, Comprehensive Health and Epidemiological Surveillance System; PNGIMR, Papua New Guinea Institute of Medical Research.

variable (POM has only one urban site while Central Province has only one rural site). Significant variables were identified, including age group, number of men aged 15–64 years, urban–rural sector, HWQ, income and education attainment. These variables remained in the final MLR model for estimation of aORs.

All statistical analyses were performed by using SPSS (V.20). Statistical likelihood tests were used to provide 95% CIs of the estimated ORs and a p<0.05 was considered as statistical significance.

RESULTS

Data of 37 880 residents living in the CHESS surveillance sites were included in the data analysis, including 1850 in POM, 10 781 in Central, 11 354 in EHP, 4458 in Madang, 4840 in East Sepik and 4579 in ENB.

Prevalence and variation of household food insecurity

Table 1 shows the prevalence of household food insecurity in 2020, stratified by household socioeconomic demographic characteristics. The overall prevalence of household food insecurity was about 20% with variations across subpopulations. The prevalence of household food insecurity was less than 10% in urban areas, but as high as 23% in rural areas. There was a significant difference between specific regions with POM reporting a relatively low prevalence of 8.5%, while Central Province had the highest prevalence at 35%. The prevalence of food insecurity was high in households with 10 or more members (25.1%). However, the prevalence was reported to be similar between males and females and across households with different numbers of women of reproductive age 15–49 years living in the households. The impact of COVID-19 pandemic on household food security was more evident when comparing the food shortage situation in 2018 and 2020.

Figure 1 shows the prevalence of household food insecurity had increased from 11.4% in 2018 to 19.7% in 2020.[27] Further examination of the prevalence of household food insecurity revealed that 9% of the population reported mild food shortage in 2020, an increase of 8-percentage points from less than 1% reported in 2018. Whilst the prevalence of severe food shortage remained almost unchanged, ranging from 2% to 3%, and moderate food shortage fluctuated around 7%–8% of the surveillance population.

As shown in figure 2, 12% of the surveillance population reported health related problems as the cause of food shortages in their households in 2020, which is a substantial increase from 0.2% reported in 2018. In addition, 3.8% of the population reported they could not sell or exchange food during the COVID-19 pandemic, compared with none of the population faced this issue prior to the pandemic.
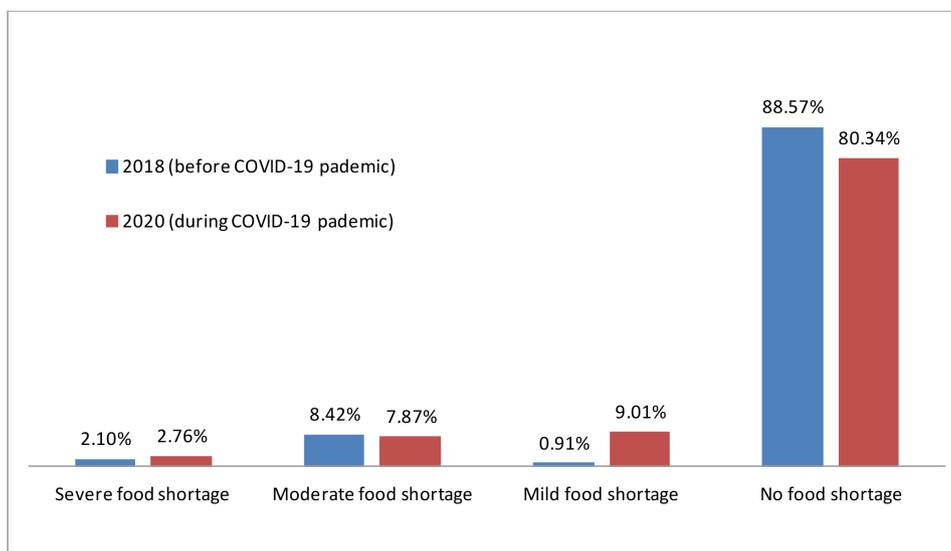
Figure 1 Proportion of households reported food shortages in Papua New Guinea before and during the first year of COVID-19 pandemic, PNGIMR's CHESS, 2022. CHESS, Comprehensive Health and Epidemiological Surveillance System; PNGIMR, Papua New Guinea Institute of Medical Research.

Socioeconomic demographic factors of household food insecurity in COVID-19 pandemic

Table 2 presents aORs of factors associated with household food insecurity. Children aged 5–14 years were twice more likely to experience food shortages than the elderly aged 65+ years (aOR 2.2 (95% CI 1.3 to 3.6)). Similarly, people of working age (15–64 years) were about twofold higher odds of food insecurity than those in the age group 65+ years (aOR 2.2 (95% CI 1.32 to 3.66)). Urban residents were 72% less likely to suffer food insecurity than their rural counterparts (aOR 0.28 (95% CI 0.21 to 0.38)). People from the poorest and poor HWQs were 78% (aOR

1.78 (95% CI 1.29 to 2.45)) and 40% (aOR 1.4 (95% CI 1.03 to 1.91)) more likely to lack food than those from the richest HWQ. Adult population of working age (15–64 years) who had income less than 200 PNG Kina in the past fortnight were about 50% more likely to have shortages of food than those who had income of 800 PNG Kina or higher (aOR 1.50 (95% CI 1.03 to 2.19)). On the other hand, adults aged 25+ years with an elementary education (grades 1–2) were four times more likely to report food insecurity than those having university education (aOR 4.13 (95% CI 1.21 to 14.16)). Similarly, adults aged 25+ years who attained primary education (grades 3–8) were 50%
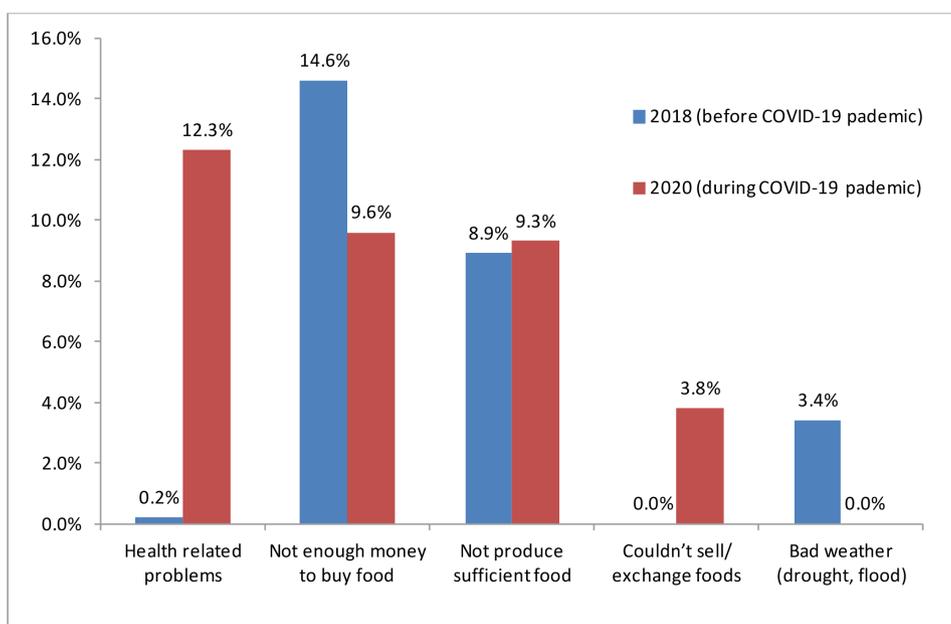
Figure 2 Reasons for household food shortages in the past 12 months in Papua New Guinea before and during the first year of COVID-19 pandemic, PNGIMR's CHESS, 2022. CHESS, Comprehensive Health and Epidemiological Surveillance System; PNGIMR, Papua New Guinea Institute of Medical Research.

Table 2 Adjusted ORs of socioeconomic demographic factors associated with household food insecurity during COVID-19 pandemic in Papua New Guinea PNGIMR's CHESS, 2021

Socioeconomic demographic factor	Category	No	Percentage	Adjusted OR	Lower bound	Upper bound	Sig.
Urban–rural sector	Urban	485	19.3	0.286	0.212	0.384	0.000
	Rural	2022	80.7	Ref.			
Age group (in year)	0–4	164	6.5	1.752	0.970	3.164	0.063
	5–14	591	23.6	2.201	1.323	3.659	0.002
	15–24	441	17.6	2.012	1.197	3.385	0.008
	25–34	376	15.0	2.054	1.211	3.485	0.008
	35–44	339	13.5	2.243	1.317	3.823	0.003
	45–54	272	10.8	1.780	1.026	3.089	0.040
	55–64	143	5.7	2.689	1.483	4.876	0.001
	65–101	181	7.2	Ref.			
No of men of working age, 15–64 years living in household	0	176	7.0	0.200	0.106	0.374	0.000
	1	837	33.4	0.492	0.351	0.691	0.000
	2	659	26.3	0.746	0.534	1.042	0.086
	3	356	14.2	0.709	0.491	1.023	0.066
	4	253	10.1	0.704	0.473	1.049	0.084
	5+	226	9.0	Ref.			
Household wealth quintile	Poorest	257	10.3	1.782	1.293	2.454	0.000
	Poor	376	15.0	1.400	1.028	1.906	0.033
	Middle	482	19.2	1.271	0.970	1.667	0.082
	Rich	626	25.0	1.124	0.873	1.445	0.365
	Richest	766	30.6	Ref.			
Income per fortnight among population of working age 15–64 years (1 PNG Kina=US$0.28)	None	174	6.9	0.706	0.423	1.177	0.182
	1–100	665	26.5	1.485	1.040	2.121	0.030
	101–200	440	17.6	1.504	1.032	2.190	0.033
	201–400	440	17.6	1.138	0.777	1.668	0.507
	401–600	343	13.7	1.546	1.045	2.286	0.029
	601–800	223	8.9	1.277	0.829	1.967	0.268
	800+	222	8.9	Ref.			
Highest education attainment among population finished school age, 25 years and above	Elementary (grades 1–2)	12	0.5	4.131	1.205	14.165	0.024
	Primary (grades 3–8)	795	31.7	1.526	1.092	2.132	0.013
	Secondary (grades 9–10)	1037	41.4	1.268	0.917	1.752	0.151
	secondary (grades 11–12)	222	8.9	1.211	0.793	1.848	0.375
	training	181	7.2	1.311	0.841	2.043	0.232
	University +	260	10.4	Ref.			
Valid		2507	100.0				
Missing		35 373					
Total		37 880					

CHESS, Comprehensive Health and Epidemiological Surveillance System; PNGIMR, Papua New Guinea Institute of Medical Research.

more likely to experience food shortage than those with university education (aOR 1.52 (95% CI 1.09 to 2.13)).

DISCUSSION

PNG was defined by the FAO as a low-income country with food deficit in 2000.[27–29] This classification was based on the increasing volumes of food imports, declining purchasing power and indicators of malnutrition such as prevalence of wasting, stunting, underweight and overweight and obesity in the population.[30] Using surveillance data of approximately 38 000 population, this study estimated the overall prevalence of household food insecurity of about 20% in 2020, which increased 9 percentage points from 11% reported in 2018.

Impact of COVID-19 pandemic on household food security

The impact of COVID-19 on household food security in PNG was relatively minor in 2020, the first year of the pandemic. The prevalence of mild food shortage was above 9% in 2020, increased from less than 1% prior to the pandemic.

The household food insecurity in PNG during the COVID-19 pandemic was less severe than in other LMICs. In the Philippines, 60% of households reported experiencing moderate and severe food shortage and the poorest households were 1.7 times more likely to become food insecure, and 22% of the households reported no money to buy food.[31] In India, household food insecurity increased from 20% before the COVID-19 outbreak to 80% during the pandemic and 62% of the households changed their food status from security to insecurity.[32] Findings from the COVID-19 National Longitudinal Phone Survey conducted in Nigeria showed that over two-thirds of households lacked food, including 5% of mildly food shortage, 25% of moderately food shortage and 58% of severe food shortage.[33]

Understanding socioeconomic demographic factors of household food insecurity

Socioeconomic demographic groups including children aged 5–14 years, people of working age (15–64 years), rural residents, households of the poorest and poor HWQs, low income working population, and adults with elementary and primary educations were the most vulnerable to food insecurity during the COVID-19 pandemic (see table 2). Understanding of these factors could provide insight into the impact of COVID-19 pandemic on household food insecurity and the variation of household food insecurity across socioeconomic demographic groups in PNG during the pandemic.

Rurality was an important factor in household food shortage. PNG is divided into four geographical regions: the Southern, the Highlands, the Momase and the Islands. PNG consists of 22 provinces, with more than 85% of the population widely dispersed across the vast rural areas, where people are mostly involved in subsistence-based agriculture.[34 35] The prevalence of household food insecurity in urban areas was about 10% during the COVID-19 pandemic. The urban residents were 70% less likely to experience household food shortage than rural counterparts (see table 2) because have better access to safety nets and public services. POM has the highest socioeconomic development level in the country. People living in this surveillance site have better off SES than those in other provinces.[25] Hence, only 8% of them reported experience food shortages during the pandemic. By contrast, rural residents heavily rely on food subsistence gatherings. They are more vulnerable to food shortage in a crisis situation such as the COVID-19 pandemic. These observations are consistent with previous findings in Burkina Faso that urban households were more resilient to food shortage than rural ones during the COVID-19 pandemic.[36]

Age was identified as a significant factor of household food insecurity in this study. PNG has a young population with 38.2% of child population under the age of 15 years.[37 38] The prevalence of food shortage was 15% in the elderly, lower than other age groups. Furthermore, children in age group 5–14 years and the population of working age (15–64 years) were twice more likely to experience food insecurity than the elderly (see table 1). This observation is supported by the finding from a previous study conducted in Indonesia, which suggested the impact of COVID-19 on household food security was less profound in older population.[39] In a traditional society such as PNG, the senior people in the family are often household heads. They usually live with their families together with their children and grandchildren. The elderly are respectful and honoured by younger household members. Younger people often save food for the elderly when the households experience a food shortage.

Like other traditional societies, men are the main labour force in PNG family. Previous studies on household SES in PNG suggested that the presence of male household head and the number of men of working age (15–64 years) are positive factors of household wealth and household income. However, this study found that number of working men in the households was a significant factor, but negatively associated with the prevalence of household food security. In other words, households with more men of working age had higher prevalence of food insecurity. The prevalence of food insecurity was 10% in households with only one men of working age, but as high as 30% in households with five or more men of working age (see table 1). MLR analysis also indicated that households with no man of working age were 80% and households with one man of working age were 50% less likely to have food shortage than those with 5+ men of working age, respectively (see table 2).

Due to the restriction of mobility and the social distance measures imposed throughout the COVID-19 pandemic, many working men lost their jobs and incomes. Hence, households with more working men were more likely to experience of losing jobs and incomes and their households were at a higher risk of food shortage. Moreover, men of working age tended to skip meals to save food for the elderly and young children (less than 5 years old) living in their households. Therefore, they were more likely to report household food shortages. These observations could be unique in the local context of PNG and have never been reported in previous studies of household food security during the COVID-19 pandemic.

HWQ in this study was a negative predictor of household food insecurity, meaning households in low HWQ were at higher risk of food shortage than those in high HWQ. For instance, the prevalence of food insecurity among households in the poorest and poor quintiles was about 80% and 40% higher than those in the richest quintile, respectively. These findings are consistent with findings from the previous study conducted in PNG before the COVID-19 outbreaks,[40] but the significant association

of HWQ and household food insecurity could have accelerated during the COVID-19 pandemic.

Income level of the population of working age (15–64 years) was also a significant factor associated with household food insecurity. Men of working age reported having fortnight income less than 200 PNG Kina were about 50% more likely to experience food shortage than those with income of 800 PNG Kina or more. As most working men (82%) have an income less than 600 PNG Kina per fortnight, this finding supports our argument that low income working men were particularly vulnerable to food insecurity during the COVID-19 pandemic in PNG.

Adult education attainment was a significant contributor of household food security. Adult people with lower education were at higher risk of food shortages compared with those with higher education levels, suggesting lower educational people were more vulnerable during the COVID-19 pandemic. This finding is consistent with the finding from our previous study that PNG adult population with lower education were often in lower SES.[41]

Unexpected results from the study

There have been a number of unexpected observations emerging from this study. First, the prevalence of household food insecurity was highest in Central Province (35%), followed by EHP (22%) although these provinces have relatively higher SES development level than other provinces. By contrast, the prevalence of household food insecurity was reported as low as 2%–5% in ESP and ENB, where the SES development was relatively lower than other provinces.

During the pandemic, the local government of Central Province deployed restrictive measures to limit the population mobility from surrounding areas, particularly from POM to the province. This could have affected the food supply to Central Province and food distribution within the province, and possibly explain the high prevalence of food shortage (35%) reported in this province. In EHP, farmers spent more time and labour to harvest coffee and kaukau (sweet potato) but they faced difficulty in selling them due to the lack of a functioning food purchasing system. The disruption of food supply in Central Province and EHP were more likely due to the sharp decline in food availability in the local markets as they were periodically locked down during the pandemic.

By contrast, the existing market infrastructures were available in ESP and ENB; hence the food procurement was sustained at stable prices in these provinces, limiting the impact of COVID-19 restriction measures on household food security. On the other hand, households in POM and Madang could have benefited from more diverse crops and increased food supply from surrounding areas, where the food transportation were less restricted.

Given the shortage of COVID-19 prevention materials such as face masks and sanitisers in PNG, the social distancing could be the only public health tool available to effectively mitigate the COVID-19 transmission by breaking close physical contacts between people who were infected with the viruses from others. From food security perspectives, the social distancing measures including periodic curfews and knockdowns deployed by the Government of PNG in the first years of COVID-19 pandemic imposed relative minor socioeconomic cost to the households, with mild impact on food distribution and supply in the society (see figures 1 and 2). A study in India suggested that the effect of lockdowns on the agriculture production was likely related to interruption of the existing food market infrastructure and the local specific COVID-19-related policies.[42] Geographical barriers remain a major issue in food supply, transportation and distribution in many parts of PNG,[43] that requires sustainable solutions in the long term to improve the access to adequate and quality food for the population, especially among children under 5 years of age.[44 45]

Previous studies in PNG showed that household size was a positive predictor of household wealth. Larger households were often better off than smaller ones.[15] This study found the prevalence of household food insecurity among households with 10 or more people at more than 25%, which was higher than households of smaller sizes (see table 1). However, further analysis of association of household size and food insecurity showed that this association was not statistically significant (see online supplemental table 1). Household size variable could have been confounded with other demographic factors such as the numbers of women aged 15–49 years and children under 5 years living in the household. Studies conducted in LMICs found that number of women of reproductive age 15–49 years and number of children under 5 years were significant factors of household food insecurity in COVID-19 pandemic,[3 31 39] but these variables were not significant in the MLR model of our study (see table 2). These observations suggest that the larger households were more vulnerable to food shortage during the COVID-19 pandemic in PNG.

Limitations

The food security data module of the household SES questionnaire has limitations. The household SES data are not country representative for the entire PNG population. The household perceptions towards food security and food shortages varied across social classes and geographical regions that were difficult to quantify by using a standard data collection tool. CHESS was operated with 10 surveillance sites established in 6 provinces, with different socioeconomic development statuses and representing four geographical regions of PNG. The quality of household SES data was not consistent between the sites. The quality of data from long-established surveillance sites such as Hiri in Central Province, Goroka and Asaro in EHP seems more stable than other sites established more recently. The field work and household interviews were interrupted during the COVID-19 pandemic that affect the overall quality of the data.[25] This

study reported prevalence and scope of household food security only for the year 2020, which was the first year of COVID-19 pandemic in PNG. Further studies on this topic in the following years of the pandemic are needed to show changes over the time.

CONCLUSION

This study assessed the impact of COVID-19 pandemic on food security at the household level, using the household socioeconomic demographic data collected in PNG in 2020 and compared with those collected in 2018. The prevalence of household food insecurity during the first year of the COVID-19 pandemic was 20%, compared with 11% prior to the pandemic. The impact of COVID-19 pandemic on household food insecurity was relatively minor, with 9% of the surveillance population experiencing mild food shortages, which increased from the prepandemic level of only 1%.

Household food insecurity during the COVID-19 pandemic varied across socioeconomic demographic groups. The most vulnerable populations included rural residents and children aged 5–14 years, people from households in the poorest and poor wealth quintiles, working people with income less than 200 PNG Kina per fortnight, and adults with elementary and primary educational levels. Household food security should be included as an essential part of the national response to COVID-19 pandemic and health crisis plans in PNG.

This research has developed a practical method for measuring household food security in the local context of PNG during the COVID-19 pandemic that can be replicated in LMICs and similar settings to facilitate monitoring and reporting household food insecurity in health crisis situations.

Author affiliations
[1]Population Health and Demography Unit, Papua New Guinea Institute of Medical Research, Goroka, Papua New Guinea
[2]UPMC Hillman Cancer Center, University of Pittsburgh Medical Center (UPMC), Pittsburgh, Pennsylvania, USA
[3]Department of Epidemiology, School of Public Health, University of Pittsburgh, Pittsburgh, Pennsylvania, USA
[4]Department of Infectious Diseases and Microbiology, School of Public Health, University of Pittsburgh, Pittsburgh, Pennsylvania, USA
[5]School of Health and Society, University of Wollongong, Wollongong, New South Wales, Australia

Twitter Anthony D Okely @tonyokely

ORCID iD
Bang N Pham http://orcid.org/0000-0002-8136-4660

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