

REVIEW

The effects of the COVID-19 pandemic on food security in Australia: A scoping review

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Abstract

Aim: The COVID-19 pandemic has disrupted the Australian food supply with potential ramifications on food security. This scoping review aimed to synthesise current evidence on the prevalence of food insecurity and changes to factors related to food insecurity during the COVID-19 pandemic in Australia.

Methods: A comprehensive search strategy was used to search seven databases (MEDLINE, CINAHL, Embase, Global Health, Cochrane Database of Systematic Reviews, PsycINFO, Informit Online) and Google Scholar. Included studies were written in English, published in 2020–2021 and examined food security status in Australia during the COVID-19 pandemic and/or factors associated with food insecurity in free-living Australian residents. Articles with participants residing in institutional settings, where meals were supplied, were excluded.

Results: A total of 700 records were identified from database, grey literature and hand searching, and nine articles were included. All studies indicated that the prevalence of food insecurity had increased due to negative changes to food availability, accessibility, usability and stability. The downturn in employment and economic circumstances following the onset of the COVID-19 pandemic appeared to create a new group of food-insecure Australians consisting of newly unemployed, and international students.

Conclusion: COVID-19 has exacerbated vulnerabilities in the Australian food supply and food security. Suggested actions include ongoing data collection on the long-term impact of COVID-19 on food supply and security in addition to coordinated national and community responses that improve the stability of the local food supply and address underlying determinants of food insecurity.

KEYWORDS

Australia, COVID-19, food accessibility, food availability, food insecurity, food supply

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1 | INTRODUCTION

The COVID-19 pandemic, alongside natural disasters such as bushfires, cyclones, storms and floods occurring in 2020, precipitated unprecedented social and economic disruptions potentially exacerbating the prevalence of food insecurity in Australia.^{1–5} Food security is defined as consistent physical, social and economic access to sufficient and safe food that meets nutritional needs and food preferences.⁶ In addition to accessibility, other pillars of food security include food availability, utilisation and the stability of these factors to withstand climatic, economic, social and/or political changes.^{6,7} Subsequently, food insecurity occurs when one or more of these domains are not met temporarily or in the longer term.⁷ The temporary disruption to food supply chains in 2020 may have led to compromises in nutrition, food preferences and forced acculturation due to decreased availability and accessibility to locally produced and imported food products.³

The response to COVID-19 by the Federal government involved closing international borders and introducing mandatory quarantine for returning Australian citizens.⁸ Lockdown protocols, behavioural restrictions and border regulations varied between the States and Territories. Western Australia has been the least locked down state (12 days) but maintains closed borders when eastern states have experienced COVID-19 outbreaks, whereas Melbourne, Victoria, has been the ‘world’s most locked down city’ (262 days).^{9,10} In New South Wales, there was an initial lockdown, and targeted lockdown in Sydney Northern beaches in December 2020, then a 107-day lockdown in 2021 following the arrival of the Delta variant in Sydney.^{11,12}

Employment and income have been significantly impacted by COVID-19 with underemployment reaching a historic high of 13.8% in Australia, the equivalent of 1.8 million people working reduced hours or becoming unemployed.⁴ Between March and June 2020, a 5.7% reduction in the number of payroll jobs occurred.¹³ In response, the Federal Government provided JobKeeper payments to help businesses pay their employees, and the Coronavirus Supplement for eligible recipients in addition to regular income support payments.^{14,15} The Coronavirus Supplement rate of \$550 per fortnight almost doubled the maximum JobSeeker payment rate until September 2020 when it was reduced to \$250 per fortnight, and then again in January to \$150 per fortnight.^{16,17} The JobKeeper rate similarly decreased from \$1500 fortnightly to \$1000. By the end of March 2021, JobKeeper and the Coronavirus Supplement ceased,¹⁶ but JobSeeker payments remain available for the unemployed albeit the loss of the Coronavirus Supplement

made payments barely above the poverty line (defined as 50% of median household income).^{18,19}

Collective changes in employment, income and food supply during COVID-19 are expected to have amplified the prevalence and extent of food insecurity and affected population groups that were not affected previously.⁶ Food insecurity in Australia has historically been associated with food prices, and socioeconomic or cultural disadvantage.^{20–22} Prior to COVID-19, the prevalence of food insecurity in Australia has been estimated to be 4% to 14% in the general population and up to 82% in vulnerable groups being similar across the country.^{20–31} This represents at least one million Australians experiencing food insecurity pre-COVID-19.²³ It is also highly likely that the single-item question assessing food insecurity underestimates the level of food insecurity by more than 5%.^{32,33}

Recent trends have predicted an increase in the prevalence of undernourishment in Australia and New Zealand from 5.8% in 2019 to 7.0% in 2030 (equivalent to 2.4–3.4 million) without accounting for the impact of the COVID-19 pandemic.⁶ The predicted rise in the prevalence of food insecurity is particularly concerning for those vulnerable prior to the pandemic such as people living in rural and remote areas, Aboriginal and Torres Strait Islander people, people experiencing homelessness, single-parent households, people with a disability, the elderly, the immunocompromised and those relying on welfare payments.²¹

Food insecurity is associated with poor diet quality, obesity, reduced short and long-term health status, and higher mortality rates adding to individual suffering and the financial burden on healthcare services.^{6,20,22,34–36}

Therefore, this scoping review aimed to examine and synthesise the emerging evidence base on the impact of COVID-19 on the prevalence of food insecurity in Australia and the factors related to changes in food insecurity that have occurred.

2 | METHODS

The scoping review was conducted according to the Joanna Briggs Institute methodology for scoping reviews³⁸ and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Extension for Scoping Reviews Checklist.³⁹ The review protocol has been published on the Open Science platform <https://osf.io/zdp58/>.

A preliminary search of medical databases and review registries yielded no current or underway scoping or systematic reviews on the concept of COVID-19 and food insecurity in Australia. As this was a new and emerging

topic, it was determined that a scoping review would be most appropriate to map the types and volume of available literature on the concept, determine current knowledge gaps, and provide an overview of evidence to inform future studies and/or systematic reviews.³⁷

The following questions were used to guide this review: (i) What is the prevalence of food insecurity in Australia during the COVID-19 pandemic? (ii) What changes in food security have occurred in Australia during the COVID-19 pandemic? (iii) What factors have influenced these changes? The search strategy aimed to identify published and unpublished primary studies, reviews and reports according to the three-step strategy recommended by the Joanna Briggs Institute. An initial search was conducted to identify relevant articles in MEDLINE (PubMed) and CINAHL (EBSCO). Based on keywords and phrases identified in the initial search, a full search strategy was developed for MEDLINE (PubMed) with assistance from a research librarian. A full search in the selected databases was conducted on the 4th of April 2021 using all identified keywords and index terms. Key terms related to all aspects of food security were included for comprehensive results. The search strategy, keywords and index terms were adapted for each information source. Online supplementary file I contains the search strategies utilised in MEDLINE. Finally, reference lists of selected articles were screened for additional papers. The language of included publications was limited to English and the publication year was set to 2020 and onwards since the aim was to map evidence on the impact of COVID-19. The publication year limit was not applied when searching the Google Scholar database to prevent false exclusion since articles do not always have a publication year.

Electronic databases searched included MEDLINE (via Ovid), CINAHL (via EBSCO), Embase (via Ovid), Global Health (via Ovid), Cochrane Database of Systematic Reviews (via Ovid), PsycINFO (via Ovid) and Informit Online. Unpublished studies and grey literature were searched using Google Scholar.

This review included studies on free-living individuals residing in Australia from 2020 onwards. This included people who may not be Australian citizens such as those born in foreign countries who entered Australia for tertiary education or extended travel prior to the travel ban on the 20th of March 2020. There were no restrictions on age, sex, employment, socioeconomic status or education. Studies that examined food security status in Australia during COVID-19 were included. The concept of food security encompassed the four domains of food security (food accessibility, affordability, availability and stability) as well as acceptability, nutritional requirements, food

preferences and access to culturally appropriate foods. Food preferences and culturally appropriate foods were included for their importance in attaining an inclusive and culturally relevant understanding of food security within the multicultural Australian context. Factors associated with food security such as education, food prices, household structure, income and food environment were also included. This review considered studies based on the Australian community at large and excluded institutionalised settings where food was provided such as aged care homes or hospitals, to focus on free-living individuals. All study designs (quantitative, qualitative and mixed method), systematic reviews and grey literature (excluding news articles and opinion pieces) were considered.

All citations from the full search were imported into EndNote X9.2 (Clarivate Analytics, PA, USA). After removing duplicates, two independent reviewers screened the titles and abstracts against the inclusion criteria. Full texts for potentially relevant papers were retrieved and screened by both reviewers. Reasons for excluding studies that did not meet the inclusion criteria were recorded. Any disagreements between two reviewers at each stage were resolved through discussion or consultation with a third reviewer.

A data charting form was developed for this review and used to extract data from included papers. Extracted data included citation, participant sample and characteristics, study aims, research design, data collection and analysis, primary outcomes (i.e. prevalence of food insecurity) and secondary outcomes (i.e. factors associated with food insecurity) and study limitations. The data extraction tool was used iteratively and modified throughout data extraction as needed. Both reviewers extracted data for all included studies independently then compared and discussed the data to resolve discrepancies.

Key demographics and findings for all included studies were summarised in tables. For qualitative findings, a thematic analysis was conducted. Themes from the review questions guided the approach with additional themes identified during analysis of the papers. Findings were presented in a tabular form. Representative quotations were selected by two reviewers and presented thematically. A descriptive summary of all studies was created to report the impact of COVID-19 on food security in Australia during the pandemic.

3 | RESULTS

The full search identified 689 articles from databases ($n = 360$) and grey literature ($n = 329$), and 11 articles

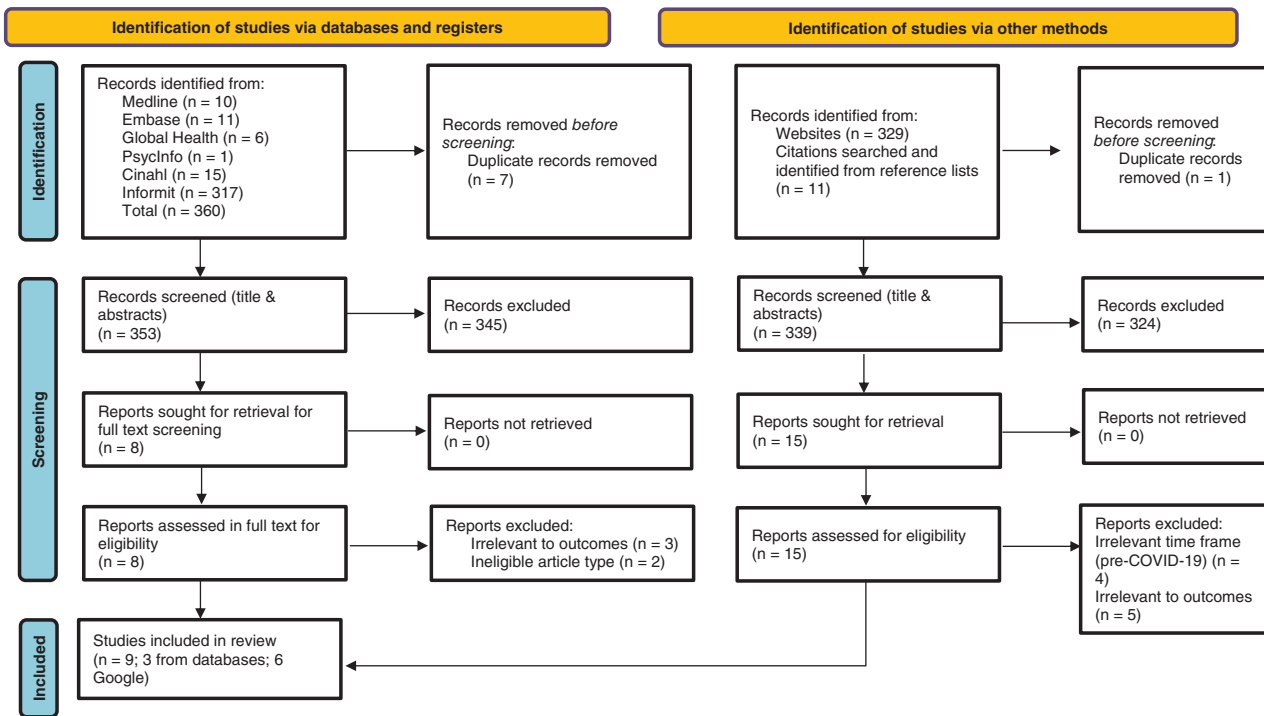


FIGURE 1 PRISMA flow diagram of record identification and study selection

from the reference lists of included studies (Figure 1). After removing duplicates, the titles and abstracts of the remaining 692 citations were screened, then the remaining 23 articles were screened in full text. Nine studies were included in the final synthesis. Reasons for exclusion after full-text screening are listed in the PRISMA flow diagram (Figure 1) and online supplementary file II.

Table 1 depicts the study (aim, study design, data collection methods) and demographic characteristics of participants such as sample size, age and gender. The majority of the included studies were from Victoria ($n = 3$)^{40–42} followed by New South Wales ($n = 2$),^{43,44} all states ($n = 2$),^{45,46} Tasmania ($n = 1$)⁴⁷ and Western Australia ($n = 1$).⁴⁸ Study participants included food relief providers ($n = 4$),^{40,41,43,45} Aboriginal community members ($n = 1$)⁴⁴ and the general Australian population ($n = 5$).^{42,45–48} Sample sizes ranged from 4 to 1170 participants.

Of the included studies, there were three each of qualitative,^{42–44} quantitative^{40,41,47} and mixed-method study designs^{45,46,48} (Table 1). Two studies employed a longitudinal design where data were collected at multiple time points.^{45,48} Mixed-method studies combined cross-sectional or longitudinal surveys with a qualitative method.^{45,46,48} All studies were conducted in 2020 and published between 2020 and 2021.

The most common quantitative data collection method was self-administered cross-sectional surveys with open and closed questions ($n = 5$).^{40,41,45–47} The most common quantitative variables measured were the prevalence of COVID-related job changes and income loss,^{40,45,47,48} prevalence of those receiving government welfare payments,^{40,41,45,47,48} proportion of respondents reporting changes to food relief access^{40,41,45,48} and sociodemographic characteristics of the food insecure.^{40,41,45–47} Only two studies quantitatively measured the prevalence of food insecurity using the validated USDA six-Item Short Form Household Food Security Survey Module (HFSSM) or a single item measure ('In the last 12 months, was there any time you or anyone in your household ran out of food and did not have enough money to purchase more?').^{45,47} Participants responded based on their experience in the previous 30 days in one study⁴⁷ and the past 12 months in the other.⁴⁵ Two studies asked participants about the impact of COVID-19 on psychological health however no standardised survey tool was used to measure this.^{45,48}

Semi-structured interviews were the most common qualitative method used ($n = 4$)^{43,45,46,48} followed by online workshops ($n = 1$)⁴² and focus groups ($n = 1$).⁴⁴ Qualitative measurements of food insecurity involved all domains of food security: food availability,^{42,43,45} accessibility,^{42,43,45,46,48} affordability,^{42–45,48} stability,^{43,48} acceptability,^{42,45} utilisation/

TABLE 1 Study and demographic characteristics of participants in included studies that investigate the prevalence of COVID-19 on food security in Australia ($n = 9$)

Author, state	Aim	Study design	Data collection methods	Participants	Sample size	Age	Gender	Other demographic characteristics
Brown et al. ⁴⁶ Australia	To identify the impacts of learning at home during COVID-19 for vulnerable young Australians	Cross-sectional, mixed methods	Online survey and interviews (April 2020)	School students: preschool in the year prior to full time school, up to Year 12	Survey: $n = 70$; interviews: $n = 51$	N/R	N/R	N/R
Callis et al. ⁴⁸ WA	To explore experiences of the COVID-19 pandemic, its restrictions, and its early economic and social impacts	Longitudinal, mixed methods	Surveys over 2 years (baseline, wave 2, and COVID-19 supplement between May and July 2020) and fortnightly interviews for a year	Entrenched disadvantaged families ^a in Perth	Completed COVID-19 supplement survey: $n = 158$	N/R	72% female	Aboriginal and Torres Strait Islanders: 20%; Had dependent children: 54%; Employment status: 19% employed in the week prior to survey; 13% unemployed but actively seeking and able to work; 68% not in labour force; Government assistance: 89% received at least one payment in the last 12 months
Craven and Mey ⁴³ NSW	To identify the impact COVID-19 had on the community food sector within the Greater Sydney and Illawarra region and propose mitigation strategies	Cross-sectional, qualitative	Semi-structured interviews (August 2020)	Representatives from four community food organisations (OzHarvest, Rozelle Neighbourhood Centre, Community Greening and Food Fairness Illawarra)	$n = 4$ (one interviewee for each organisation)	N/R	N/R	N/R
Follent et al. ⁴⁴ NSW	To show evidence to inform conversations on Aboriginal health issues in response to COVID-19 and beyond	Cross-sectional, qualitative	3 group discussions (August–September 2020)	Aboriginal community members from across NSW (Eora, Wilyakali, Bundjalung, Yuin and Gumbaynggirr lands)	$n = 12$	N/R	N/R	N/R
Foodbank Australia ⁴⁵ Australia	To identify the impact of COVID-19 on Foodbank and its participants experiencing food insecurity	Mixed method (cross-sectional survey and interviews, longitudinal surveys)	A cross-sectional online survey (June–July 2020), 5 pulse surveys (monthly between April and	Individuals experiencing food insecurity (cross-sectional survey and interviews), charities and	Cross-sectional survey: $n = 1001$; Pulse surveys:	18 years and older	50% female	N/R

TABLE 1 (Continued)

Author, state	Aim	Study design	Data collection methods	Participants	Sample size	Age	Gender	Other demographic characteristics
Kent et al. ⁴⁷ Tasmania	To determine the prevalence and socio-demographic predictors of food insecurity during the COVID-19 pandemic	Cross-sectional, quantitative	September 2020), in-depth phone interviews (August 2020)	community groups providing food relief (pulse surveys and interviews)	<i>n</i> = 500 on average per survey; Interviews: <i>n</i> = 9	18 years and older (68% over 46 years)	77% female	Aboriginal and Torres Strait Islanders: 2%; disability: 22% with disability; rurality: 28% rural; education: 67% bachelor's degree or higher; residency: 2% temporary residents; relationship status: 53% married; household status: 43% couple with no dependents, 28% couples with dependents, 6% single parent, 18% living alone, 5% other; primary shopper: 82%; household income per year: 21% less than AUD 40 000, 23% AUD 40 000–80 000, 43% more than AUD 80 000
McKay, Bastian and Lindberg ⁴¹ Victoria	To explore the impact of the COVID-19 pandemic on the emergency and community food sector and food insecure populations that use food aid	Cross-sectional, quantitative	Online survey (closed- and open-ended questions, May to June 2020)	Emergency and community food providers: pantries, soup kitchens, social enterprises, foodbanks and similar programs that provide free or subsidised food	101 agencies	N/R	N/R	Location: 64% in the greater metropolitan area; eligibility requirements: 61% required no proof of need of food relief; number of clients accessing service: 52% 50 or less, 46% more than 50; allowed frequency of access: 24% less than weekly, 71% weekly or more; type of emergency food provided: 82% food parcels, 49% pre-prepared

(Continues)

TABLE 1 (Continued)

Author, state	Aim	Study design	Data collection methods	Participants	Sample size	Age	Gender	Other demographic characteristics
McKay and Brain ⁴⁰ Victoria	To explore how emergency and community food aid providers in the Geelong region were impacted by the Covid-19 pandemic (including client needs, problems with demand and implications)	Cross-sectional, quantitative	Online survey (closed- and open-ended questions, November to December 2020)	Emergency food aid providers in the Geelong region	15 agencies	N/R	N/R	meals, 44% food pantry, 40% vouchers, 14% cooking classes; primary population: 89% families, 69% people experiencing homelessness, 65% people with disability, 60% migrants, 49% young people and children, 36% Aboriginal and Torres Strait Islanders, 15% older people, 81% serve several population groups
Whelan et al. ⁴² Victoria	To explore the impact of COVID-19 on food supply and purchasing behaviour in a rural supermarket in a rural Australian community	Cross-sectional, qualitative	Online workshops (June–July 2020)	Managers (managing director, operations manager and buyer/operations manager) and regular customers from a rural supermarket in Victoria	<i>n</i> = 36 (manager: <i>n</i> = 3, customer: <i>n</i> = 33)	Over 18 years	56% female in customers, all male in managers	Type of providers: community organisations (40%), religious organisations (26%), and/or welfare and non-profit organisations (53%)

Abbreviations: AUD, Australian dollars; N/R, not reported; NSW, New South Wales; WA, Western Australia

^a 'Families' = single person or an extended related (or unrelated) group of people.

TABLE 2 Summary of included studies that reported on the prevalence of food insecurity and factors related to changes in food security in Australia during COVID-19

Author, state	Secondary outcomes		Sociodemographic factors associated with changes in food security	Other factors related to the change in food security
	Primary outcomes	COVID-19-related job change		
Brown et al. ⁴⁶ Australia	Prevalence of food insecurity Most respondents concerned about 'lack of food'	N/A	N/A	<i>School closures</i> : → ^a loss of school breakfast program which majorly contributes to children and adolescents' nutritional needs nationally
Callis et al. ⁴⁸ WA	<i>Limited access to food services</i> : 44.3% sought food services during COVID-19; 50% whose access to food services was stopped altogether by COVID-19; 63.9% reported changes to methods of accessing food services (paused or modified delivery mode such as providing pre-packed food parcels); 37.9% chose not to access or not able to access food services every time when they needed to; 43.3% who accessed food services reported it met their needs a bit or much less than before the pandemic	<i>COVID-related job changes</i> : The COVID-19 restrictions caused significant job losses and business closures (e.g., restaurants and cafes); 11.5% reported that they had been stood down or retrenched due to the pandemic; some industries needed to expand their work force due to ↑demand; of those who were employed, 13.3% got their current job and 6.7% got more hours in a job they already had	<i>Government financial support</i> : 33.3% received the JobSeeker payment, only one received JobKeeper payment; 50.6% received coronavirus supplement; 27.8% reported that the coronavirus supplement allowed them to afford enough food and ↑ the meal quality	<i>School closures</i> : contributes to food insecurity for children. <i>Cost of living</i> : food and bills (rent, utilities, debt repayments, car registration, and car repairs) were the most common expenditure. <i>Mental health</i> : Family members in this study had higher rates of depression and/or anxiety symptoms for most to all of the time (38.1% during the week prior to the survey) than the general Australian population (17.1% during the pandemic)
Craven and Meyer ⁴³ NSW	All food relief organisations were negatively impacted by COVID-19; ↑ (S) in clients accessing food relief. ↓ <i>Availability</i> : ↓ (S) food at food relief; ↓ (S) food donated by supermarkets due to low supply caused by panic buying. Agencies primarily reliant on supermarket donations were most affected	<i>Food relief staff changes</i> : ↓ (S) in food charity volunteers—the most common reason was volunteers among the elderly (it was their best interest to avoid face-to-face contact with people during the pandemic). ↑ In volunteers at some points (attracting assistance from those who have lost their jobs)	<i>Government financial support</i> : Previous food relief recipients who received Centrelink benefit payments pre-COVID withdrew from food relief. Additional COVID supplement payments → more people were able to buy food directly from supermarkets instead of accessing food relief	N/A

(Continues)

TABLE 2 (Continued)

Author, state	Primary outcomes		Secondary outcomes		Sociodemographic factors associated with changes in food security	Other factors related to the change in food security
	Prevalence of food insecurity	COVID-19-related job change	COVID-19-related income change	COVID-19-related job change		
Follent et al. ⁴⁴ NSW	<p>↑ <i>Food insecurity for some Aboriginal & Torres Strait Islanders</i> (based on community members' lived experience and anecdotal community feedback).</p> <p>↓ <i>Affordability</i>: Price ↑ in local shops in some rural and remote areas → forced to buy cheaper (and often less healthy) options</p>	N/A	N/A	N/A	<p>Minority groups within <i>Aboriginal communities</i> (S) affected by COVID-19: people with existing chronic conditions, people with disabilities, the homeless, people living in rural and remote areas, and people identifying as lesbian, gay, bisexual, transgender, queer, asexual and questioning</p>	<p><i>Fear of going large shopping centres due to the fear of catching COVID-19</i></p>
Foodbank Australia ⁴⁵ Australia	<p>↑ <i>Prevalence of food insecurity</i>: 28% Australians experiencing food insecurity in 2020 did not experience it pre-COVID-19; 43% food insecure Australians went a day without eating at least once a week in 2020 compared to 30% in 2019; 61% of food insecure Australians accessing food relief since COVID-19; 31% food insecure Australians sought food relief at least once a week in 2020 compared to 15% in 2019.</p> <p>↓ <i>Availability</i>: 81% of charities said demand for food relief has become more erratic and unpredictable since COVID-19.</p> <p>↓ <i>Affordability</i>: 80% Australians receiving JobSeeker expect an AUD 300 payment cut after government payments are rolled back would mean they have to skip meals and buy less fruit and vegetables.</p> <p>↓ <i>Accessibility and acceptability</i>: 39% of food insecure Australians in urgent need of help did not access food relief during the pandemic.</p>	<p>COVID-19-related job loss: Retail and accommodation industries were most impacted, accounted for most of casual workforce</p>	<p>Government financial support: 45% of food insecure Australians were getting assistance but needed more; 12% needed government assistance for the first time; of food insecure Australians receiving or needing assistance, only 38% felt the assistance helped their situation a lot; 62% did not receive help they need (37% needed additional assistance, 21% ineligible, 4% found it too difficult to apply)</p>	<p>Aggr: 65% of food insecure Australians aged 18–25 years went hungry at least once a week, 25% in 56–74 years; 25% in aged 75 years and older.</p> <p><i>Traditional food relief clients need assistance more often during the pandemic</i>: Low-income families, unemployed, single-parent families, the homeless and people with mental illnesses.</p> <p><i>Newly food insecure</i>: 39% charities saw ↑ in international students seeking food relief.</p> <p>69% saw ↑ in newly unemployed casuals seeking food relief since COVID-19</p>	<p><i>Mental health</i>: 53% food insecure Australians had decline in mental health since COVID-19: stress (49%), depression (46%), anxiety (41%) and sadness (39%).</p> <p><i>Cost of living</i>: Main reason for the inability to afford food: 41% unexpected or large bills, 35% rent and mortgage payments</p>	

TABLE 2 (Continued)

Author, state	Primary outcomes	Secondary outcomes	COVID-19-related job change	COVID-19-related income change	Sociodemographic factors associated with changes in food security	Other factors related to the change in food security
Kent et al. ⁴⁷ Tasmania	<p>Prevalence of food insecurity</p> <p>Barriers to seeking assistance: thinking others more in need (33%), embarrassment (33%), shame (30%)</p> <p>↑ Prevalence of food insecurity: 26% between late April to early June 2020 (12.3% marginal food security, 10.1% low food security, 3.7% very low food security). Higher than 2019 Tasmanian prevalence (6.2%) and national prevalence of (4%)</p>	<p>COVID-related job change: 34.6% had COVID-related job change; these people had a 75% ↑ in the odds of experiencing food insecurity compared to those not impacted.</p> <p>(S) higher proportion of those with COVID-related job change was in low (17%) and very low food secure groups (5%)</p>	<p>COVID-related income loss: Independently associated with higher odds of food insecurity; 34.2% had COVID-related income loss; 65% of those who had lost over 75% of their income had some degree of food insecurity; compared with who did not lose income, respondents who lost 25%–49% of income were twice more likely to be food insecure, who lost above 75% were seven times more likely to be food insecure.</p> <p>Government financial support: 14% received government support payments; receiving JobKeeper—20% more likely to be food insecure than employed without receiving government support; receiving JobSeeker—3.5 times more likely to be food insecure than employed without receiving government support</p>	<p>Respondents with younger age, living in rural areas, with disability, lower education levels, lower income, and living with dependents are more likely to experience food insecurity during COVID-19</p>	N/A	
McKay et al. ⁴¹ Victoria	<p>↑ Food insecurity and ↓ availability: ↑ in number (41.6%) and variety of people seeking food relief → food shortage at emergency food providers; 36.6% reported ↓ in people seeking food. 50.5% provided services to more people, 40.6% reported regular clients using service</p>	N/A	<p>Government financial support: 34.7% reported JobKeeper/JobSeeker has been helpful; 33.7% found no change; Concerned about the reduction or termination of government support and this may worsen supply/demand imbalance</p>	<p>Demographic change in food insecure: ↑ in international students (27.7%), people on temporary visas, and people ineligible for government support</p>	<p>Loss of food relief staff and social distancing restrictions: 76.2% lost volunteers due to age (>65 years) or the way of the service provided food aid</p>	

(Continues)

TABLE 2 (Continued)

Author, state	Primary outcomes	Secondary outcomes	COVID-19-related income change	Sociodemographic factors associated with changes in food security	Other factors related to the change in food security
McKay and Brain ⁴⁰ Victoria	<p>Prevalence of food insecurity</p> <p>less frequently, 28.7% reported more frequently.</p> <p><i>Accessibility to food relief:</i> 37.6% reported reduced operation hours;</p> <p>15.8% extended operation hours; 40.6% extended service types; 30.7% temporarily closing or suspending services despite ↑ demand for food relief.</p> <p><i>Nutritional requirements:</i> Most food relief agencies able to get at least half of required foods, but others reported changes to the food quality and quantity; 35%–45% unable to provide sufficient food in each of the nutritious food groups. More storage or freezer space needed.</p> <p><i>Food preferences/culturally appropriate:</i> 55.4% unable to source quality foods; 22.8% unable to source food for specific cultural groups, 21.8% unable to source food for dietary requirements</p>	<p><i>COVID-19-related food relief staff losses:</i> 75% lost volunteer or paid staff due to the pandemic. Most operating with 1–2 paid staff, and mainly volunteers</p>	<p><i>Government financial support:</i> 60% reported government support had not been helpful; Some reported ↓ in clients due to temporary government financial support.</p> <p><i>Lack of food relief funding:</i> 66% food relief agencies funded via philanthropic funding with only modest funding changes; 20% received extra COVID-19 government funding</p>	<p><i>Demographic of main food relief recipients</i> ↑ in people from casual/unstable industries and international students seeking food relief.</p> <p>40% reported ↓ in food relief for children</p>	<p><i>COVID-19 government restrictions:</i> 60% said restrictions affected client's access to food relief services and operation of many services (87%); 40% affected by physical distancing restrictions, 27% by capacity/density limits, 20% by close of business and stay at-home orders; Limits ↓ number of clients allowed inside, client/staff</p>

TABLE 2 (Continued)

Author, state	Primary outcomes		Secondary outcomes		Sociodemographic factors associated with changes in food security	Other factors related to the change in food security
	Prevalence of food insecurity	COVID-19-related job change	COVID-19-related income change	COVID-19-related job change		
Whelan et al. ⁴² Victoria	<p>this year due to lack of income and ↑ demand; 75% changed operations (close services, change service delivery to takeaway, delivery or phone assessments), 32% served more people, 14% extended service types, 18% temporarily closed or suspended services, 14% reduced operation hours, 7% extended hours.</p> <p><i>Nutritional requirements/food preferences/culturally appropriate:</i> ↓ quality and quantity of food available at food aid providers; 57% had difficulty getting enough quality food, 29% had difficulty acquiring food for people with dietary requirements, 14% had difficulty obtaining cultural foods</p>					<p>interaction, community meals and meal deliveries</p>
	<p>↓ <i>Availability:</i> ↑ demand for food, insufficient supply, product limits. Customers stockpiling, shopping more frequently.</p> <p>↓ <i>Accessibility:</i> One supermarket in the town and travel restrictions → ↑ online shopping.</p> <p>↓ <i>Affordability:</i> Alternate supply logistics/suppliers → price ↑.</p> <p><i>Acceptability:</i> No marketing/promotions and price ↑, yet customers still shop locally due to travel restrictions and fear.</p> <p><i>Nutrition requirements/preferences/cultural appropriateness:</i> Customers</p>	N/A	N/A	N/A	<p><i>Fear of COVID-19 and/or food:</i> Caused by government and media messages and product limits → ↑ demand for food</p> <p><i>Alternate suppliers and supply logistics and staff working longer hours to ↑ food supply.</i></p> <p><i>Lobbying by major chains:</i> negatively impacts food availability</p> <p><i>Price ↑ and no promotions.</i></p> <p><i>COVID-19 government restrictions:</i> → more time for cooking, more meals eaten at home → larger basket size, more frequent</p>	

(Continues)

TABLE 2 (Continued)

Author, state	Secondary outcomes		Other factors related to the change in food security
	Primary outcomes	Sociodemographic factors associated with changes in food security	
	Prevalence of food insecurity with dietary/health requirements more likely to use strategies (online shopping, liaising with friends/family to shop for them and changing frequency of shopping)	COVID-19-related job change COVID-19-related income change	shopping, ↓ food availability and diet changes (e.g., not buying discretionary food); Capacity limit → restaurant closure, ↑ demand and pressure on local supermarket.

Abbreviations: AUD, Australian dollars; N/A, not Applicable; S, significant; ↑, increased; ↓, decreased; NSW, New South Wales; W/A, Western Australia.

^aCaused/lead to.

nutritional requirements,^{42,45,46} food preferences^{42,45} and cultural appropriateness.⁴³

Study findings are listed in Table 2 and include the prevalence of food insecurity based on the domains of food security and secondary outcomes: COVID-19-related job and income changes and sociodemographic factors related to changes in food security.

Two studies quantitatively measured the prevalence of food insecurity; the Kent et al. study which used a modified version of the six-item US Household Food Security Survey Module to survey 1170 Tasmanian adults and the Foodbank report which involved a cross-sectional survey and five pulse surveys with 1001 members of the Australian public and food relief organisations.^{45,47} Both reported higher percentages of food insecurity in Australia during COVID-19 compared to prior to the pandemic.^{45,47} Kent et al. reported the prevalence of food insecure Tasmanian adults to be 26% between late April and early June 2020 with 10.1% and 3.7% in the low and very low food secure categories, respectively.⁴⁷ Fourteen percent of respondents were experiencing severe food insecurity and were regularly running out of food, going hungry and unable to afford balanced meals in the previous month.⁴⁷ This was substantially higher than pre-pandemic levels which were 6.2% in Tasmania and 4%–14% nationally, although the prevalence in Kent et al. study was measured by using a six-item tool and the prevalences prior to the pandemic were derived from a single-item question.^{31,47,49} However, Kent et al. assert that when asked the same single item question in her study the response indicated more than 20% were food insecure.⁴⁷ Despite using a single item measurement tool prone to underestimation,⁵⁰ Foodbank found the prevalence of food insecure Australians going a day without food at least once a week to be even higher at 43% in 2020 compared to 30% in 2019.⁴⁵

A demand and supply imbalance caused by a large increase in demand for food resulted in widespread unavailability of food.^{40–48} Physical access to food outlets and food relief was found to be impaired in rural areas.^{40,42} At the beginning of the pandemic (June – September 2020), studies conducted by Whelan et al. and Follent et al. noted an increase in food prices in rural Australia and Aboriginal NSW settings representing a reduction in food affordability for Australians living in these geographical areas who may have already been experiencing financial challenges.^{42,44} In response, consumers stockpiled and shopped more frequently which added to the demand on food providers.⁴² Stockpiling and limits on the quantity of a product able to be purchased in a single transaction hindered the access to food, especially for larger families, low-income

households and/or rural residents.⁴⁷ Strategies used to cope with changes in food security in rural areas included eating less, buying cheaper foods, liaising with others to shop for them, shopping online, accessing food banks or government assistance, or buying smaller quantities of food at a higher unit price.⁴²

In addition to food-insecure populations previously noted the COVID-19 pandemic saw new demographics experiencing food insecurity for the first time. Four studies noted rising numbers of international students, people from casual/unstable industries, and those who lost jobs due to COVID-19 experiencing food insecurity and seeking food relief more frequently during the pandemic (Table 2).^{40,41,43,45} Two studies also reported an increase in children experiencing food insecurity and accessing food relief during the pandemic.^{40,46}

Food relief organisations reported their operations being negatively impacted by COVID-19 and difficulties coping with demand.^{40,41,43,45} Foodbank,⁴⁵ a major food relief organisation, reported a 61% increase in Australians accessing food relief since COVID-19 with 31% seeking food relief at least once a week in 2020 compared to 15% in 2019 with similar findings from two other studies.^{40,41} One-third of previous food relief recipients opted not to access food relief during the pandemic and food insecure people and families did not always access relief when needed.^{40,41,48} COVID-19 also necessitated changes to operations by emergency providers that included closures during lockdowns, reducing operating hours, phone assessments and providing take-away to minimise social interaction while serving more people.^{40,41,43,45} Some

organisations extended operating hours but this was less common.^{40,41} Despite these changes, about half of the users of food relief organisations in the 100 Families study in Western Australia indicated that their access was stopped during COVID-19 and services no longer met their needs the same as pre-COVID-19.⁴⁸

A reduction in quantity and quality of food available at food outlets and food relief providers reduced the ability to eat balanced meals that met nutritional requirements or cultural food preferences during the pandemic.^{40,41,43,47} Nearly, half of the food relief agencies were unable to provide sufficient food in each of the five food groups (e.g., 44% reported insufficient quantities of vegetables).⁴¹ Many food relief agencies reported difficulties in sourcing quality foods (55%), foods for special dietary requirements (29%) and cultural groups (23%).^{40,41}

Table 2 also shows the factors influencing the changes in food security status during the pandemic which included government restrictions, changes to food suppliers and supply logistics, fear of COVID-19 transmission, product limits, COVID-related job and income changes, cost of living, receiving government financial support, difficulties accessing welfare or food relief, and stigma associated with food banks.^{40–48}

Changes in employments such as becoming retrenched, unemployed or having reduced work hours, and income changes appeared to be major drivers of food insecurity during COVID-19.^{47,48} Experiencing a COVID-related job change increased the odds of food insecurity by 75% compared to those who had not,

TABLE 3 Themes that show the changes in food security, contributing factors and effects of the changes among Australians during COVID-19 from studies using a qualitative approach

Themes	Brown et al. ⁴⁶	Callis et al. ⁴⁸	Craven and Meyer ⁴³	Follent et al. ⁴⁴	Foodbank ⁴⁵	Whelan et al. ⁴²
Food supply and demand imbalance	√	√	√	√	√	√
Increase in food prices		√		√	√	√
Cost of living		√			√	
Fear of COVID-19 or running out of food		√		√		√
Feeling shame and/or embarrassment accessing food relief		√			√	
Impact of at-home learning on food security	√					
Demographic changes in the food insecure	√		√	√	√	
Impact of government welfare payments		√	√			
Coping mechanisms						√

TABLE 4 Selective quotations to show the changes in food security, contributing factors and effects of the changes among Australians during COVID-19 from included studies

Themes	Quotations from articles
Food supply and demand imbalance	<p>'Increase in demand for our food relief meant donated surplus food was insufficient to meet demand. We have been purchasing fresh food from a local wholesaler for the past month to supplement donated surplus food'. (Food relief provider, Victoria)⁴¹</p> <p>'...the channels from which you [customers] could get food had diminished, so supermarkets became the main outlets for that and in addition to that and because of the panic buying, people were filling their pantries and buying more product'. (Supermarket manager, Victoria)⁴²</p>
Increase in food prices	<p>'Increase in government payments has resulted in the one and only shop in community providing food jamming their prices up. The price of food and water is beyond compare when you are paying \$10 for a loaf of bread. Because of COVID-19, people do not want to come into town to do their shopping'. (Aboriginal community member, NSW)⁴⁴</p> <p>'Because the state of Victoria was declared a disaster so all food from food bank Victoria was diverted to Red Cross for emergency hampers. This left much of the pasta and ambient goods that we were normally able to access unavailable for food aid agencies. We had to purchase these products through other means, thus putting budgets under pressure'. (Food relief provider, Victoria)⁴⁰</p>
Cost of living	<p>'Rents have increased locally keeping the situation very similar'. (Food relief provider, Victoria)⁴⁰</p>
Fear of COVID-19 transmission	<p>'When Geelong was in the first and second wave, [agency] began a meal delivery service to ensure those that needed meals received them. Many of our clients that attend the community meal stayed home, instead of coming to the foodbank due to fear of COVID. In the beginning, we had to close for about 3 months'. (Food relief provider, Victoria)⁴⁰</p>
Feeling shame and/or embarrassment accessing food relief services	<p>'(Sometimes I do not seek food relief even if we have run out) because it's kind of embarrassing. I feel embarrassed and like I'm not a good enough parent because I cannot afford food'. (Single mother, SA)⁴⁵</p> <p>'What we are seeing is they cannot be the breadwinner in the home and they cannot feed their families and they feel really bad not being able to provide for them. We have seen a lot more coming in and asking for it. They're really embarrassed about asking for it, and that's really sad. It's really hard for men to come and ask, women find it easier'. (Founder of Survivors R Us, NSW)⁴⁵</p>
At home learning and reduced access to school breakfast programs	<p>'Children we work with also receive their breakfast from school, as they do not receive this at home, although not an educational requirement, these support structures that traditional schooling provides equip a child's opportunity to learn'. (Non-Government Organisation, Australia)⁴⁶</p> <p>'Some (families) that are really struggling because they have got no work...They will be really, really under the pump to provide food for their children because they have got to still pay for the basics. And when you have got children under your feet and at home all day, they eat a lot more than when they are at school'. (School-based staff, Australia)⁴⁶</p>
Demographic shift: Emerging food insecure groups	<p>'We started to see another layer on top of our regular clients, of people who had not accessed food relief before and were doing okay before the pandemic. Some had two working people in their families and then they no longer had jobs... because they were thrown into that situation, the levels of anxiety and fear rose, people were very worried...' (Reservoir Neighbourhood House, Victoria)⁴⁵</p> <p>'It's been very, very hard times, since May this year. I was doing my master's in information technology and I'm spending almost \$70 000 on university for 2 years. I graduated in mid-July and have not been able to find employment since then... and I do not know who to ask or who to approach, because I'm not eligible for any kind of funding from the government... My parents have supported me until now. It's really hard for them to support me now... this was the first time I've had to</p>

TABLE 4 (Continued)

Themes	Quotations from articles
	worry about food. I came to Australia in July 2018, and before that, I was living in India with my parents. It's a first for me.' (Recently graduated international student, Victoria) ⁴⁵
Impact of government welfare payments	'Well it's made it a lot easier, I can feed the girls a lot better, I have been able to supply more balanced meals'. (Food insecure family member, WA) ⁴⁸ 'We received additional funding due to impact of COVID. We have had more funding for the purchase of emergency food from local government and philanthropy but have lost income from our traditional voucher system as referring agencies have closed operations and lost income from their op shops, etc. We have received less general donor and local business support'. (Food relief provider, Victoria) ⁴⁰
Coping mechanisms	'I think it's because I had a bit more time and there's been a lot of talk about food recipes, so it's probably just motivated me'. (Rural supermarket customer, Victoria) ⁴² 'I remember going in when Covid started and there was absolutely none [chocolate] of them were on offer and I suppose that's good because. . . you probably should not eat it, but you know, you have got [to] treat yourself sometimes and I noticed that none of them were on offer and I did not actually buy any'. (Rural supermarket customer, Victoria) ⁴²

resulting in significantly more of these people in low and very low food security groups.⁴⁷ Independently of other factors (including household income), COVID-related income loss was associated with a significantly increased risk of food insecurity.⁴⁷ Some people were recently employed or received more working hours due to COVID-19-related demand; however, this proportion was much smaller (lower than 15%).⁴⁸

Regarding the effectiveness of the government support payments for alleviating financial stress and food insecurity, some Australians found it helpful but there were concerns about how to cope with the situation after payments end.^{40,41,43,45,48} The type of government payments appeared to be a factor. Those receiving the JobKeeper payment were 20% more likely to be food insecure and those receiving JobSeeker were 3.5 times more likely to be food insecure than employed people who were not receiving financial benefits.⁴⁷ Among JobSeeker recipients, 25% experienced marginal food security and a further 27% experienced low and very low food security.⁴⁷

From the two studies measuring sociodemographic factors ($n = 2671$), increasing age was protective against food insecurity with the odds of experiencing food insecurity reducing by 16% with every decade of life.^{45,47} There were significantly more Aboriginal and Torres Strait Islander people, people with a disability, permanent and temporary residents, single-person households (never married, separated or single parents), low-income households (less than AUD 40 000 per year)

and people residing in rural areas experiencing marginal, low or very low food security than their counterparts.⁴⁷ Notably, food insecurity was still evident in respondents with the highest incomes (above AUD 100 000 per year).⁴⁷ No significant difference was found between sexes in food-secure categories but more females reported very low food security (4%) than males (1%) in one study only.⁴⁷

The themes synthesised from studies using a qualitative approach are listed in Table 3 and included nine themes: food supply and demand imbalance, rising food prices, cost of living, fear of COVID-19 and running out of food, feeling shame and/or embarrassment accessing food relief, impact of at-home learning on food security, demographic changes in the food insecure, impact of government welfare payments on food security, and coping mechanisms. Table 4 presents representative quotations from studies that used qualitative approaches and open-ended questions to investigate the impact of COVID-19 on food security.

4 | DISCUSSION

The findings of this review indicate increases in the prevalence of food insecurity in Australia since COVID-19 highlighting the vulnerability of the Australian food system and the urgency to address risk factors contributing to food insecurity.^{40–48} COVID-19 has had profound effects on food supply and demand resulting in negative

changes to all food security domains including physical and social accessibility, affordability, availability and stability.^{40–48}

The government-enforced travel restrictions, border closures and lockdowns disrupted food transport and supply, and food agencies reported these limited physical access and availability of nutritious and acceptable food.^{40–48} Consumers began stockpiling food due to stay-at-home restrictions and shopping more frequently which compounded access problems that impacted the food security of Australians across all income brackets.^{40,42,45,47}

Multiple economic barriers to food security during COVID-19 were identified and included higher food prices, no price promotions aimed to incentivise customers to purchase certain food products (e.g., discounts) and job or income changes. The association between unemployment and/or low income with higher food insecurity is consistent with studies conducted in the United States and Canada.^{47,51–53} In the United States, 31% of those who had become unemployed due to COVID-19 in February 2020 were food insecure, and subsequently, 33% of these individuals ate less due to financial constraints.⁵³ In households where there was more than one member who lost their job or income, 72% were food insecure (59% if only one household member lost a job or income).⁵² In Canada, nearly 25% of job-insecure individuals experienced food insecurity.⁵¹ Changes in the food environment and financial security are therefore likely to contribute to impaired financial access, availability and affordability of food and subsequently food security.

Due to the physical and financial barriers to food access, the ability to consistently obtain preferred food of sufficient nutritional quality was reduced.^{40,41,44,45} Lower-income individuals were forced to buy cheaper and often less nutritious options because they were unable to stockpile or purchase expensive alternatives.^{44,45} In Victoria, the percentage of people relying on lower cost, less nutritious food options in May/June 2020 (23%) significantly decreased by the second wave of the pandemic in September 2020 (18%) suggesting that the financial ability to purchase food may have improved over time.⁵⁴

This improvement could be related to the increase in income support payments in 2020 with some government welfare recipients, who were previously food insecure, finding the payments enabled them to afford enough and better quality food explaining why some previous food relief recipients withdrew from the food relief service.^{40,43,48} A survey conducted by the Australian Council Of Social Service in May 2020 similarly reported that more than 80% of respondents could eat more regularly

and 93% could afford fruit and vegetables when receiving the full coronavirus supplement.⁵⁵ The reduction in food insecurity in recipients of unemployment insurance was also observed in a longitudinal study conducted in the United States during the pandemic.⁵⁶

For those who did not find government payments helpful, reasons included needing more financial assistance, ineligibility and difficulty to apply so they remained or became food insecure.^{40,41,43,45,48} Cost of other living expenses such as rent, mortgages and medical costs was commonly cited as a reason for being unable to afford food.^{40,41,43,45,48,55} It was reported that almost half of adult Australians were drawing on finite financial resources to manage household expenses reducing the money available for food.⁵⁷ This adds to the argument that higher income, which was associated with higher food security prior to the pandemic, continues to be protective against food insecurity by alleviating total living costs.⁴⁷

A primary response to food insecurity in Australia has involved a reliance on food relief charities. COVID-19 has exposed the fragility of the food relief system as most food relief providers struggled to meet the increased demand with a diminished food supply.^{40,41,43,45} This stems from their reliance on donations from supermarkets or larger food banks who were experiencing their own supply issues.^{40,41,43} The access to food relief was hindered by eligibility requirements, difficulties in accessing online service updates, physical distancing restrictions, capacity limits, and closure of businesses and home deliveries.^{40,48} Dramatic reductions in staff numbers, especially older volunteers who preferred to stay home due to increased susceptibility to COVID-19, had a major impact on food relief organisations being able to operate effectively and efficiently.⁴¹ Food relief providers also experienced difficulties acquiring good quality food and appropriate food for dietary and/or cultural requirements which may exacerbate inequalities particularly for low income and ethnic minority groups.^{40,41}

Despite increased need, some food insecure Australians chose not to seek food relief.^{45,48} This could be a result of stigma associated with food assistance since common concerns about accessing food relief voiced by respondents included thinking others needed it more, embarrassment or shame.^{45,48} Overall, the reduction in food quantity and quality, operational changes and compromised access to food relief may explain why a low percentage of recipients reported that the services met their needs.^{40,41,43,48}

COVID-19 has exacerbated existing social inequities and created economic vulnerability for people who were previously food secure and are now experiencing income losses. During COVID-19, there was an increase in food

insecurity for international students, workers from casual or unstable industries, and the newly unemployed.^{40,41,43,45} International students became more vulnerable during COVID-19 due to their ineligibility for government welfare, reduced financial support from family, and loss of part-time work.⁴⁵ Most casual workers were greatly impacted by COVID-19 and had less entitlements and working hours.^{45,47} This may also explain the correlation between increased age and lower odds of food insecurity as older age groups are less likely to belong to these newly food insecure groups.^{45,47} The potential increase in food insecurity among children could be attributed to school closures stopping access to free meals from school breakfast programs and only half of family members with children in the 100 families project being eligible for COVID-19 supplement payments.^{46,48}

A strength of this scoping review is the synthesis of qualitative and quantitative evidence and inclusion of multiple perspectives including those from vulnerable groups. Findings of this review can be used to inform further research. Furthermore, the search strategy considered the multi-dimensional nature of food security enabling a comprehensive assessment of food security. This review also has some limitations. The number of studies located is small and diverse which makes generalisation difficult. For an even wider scope of grey literature, Google could also be searched. Due to the need for rapid responses and social distancing, convenience sampling and online data collection methods were used in some studies which may have introduced bias and prevented those without internet access from participating. In addition, as the search for articles to be included in the review was conducted at a single point in time, the findings reflect the state of food security at that time point so further investigation is recommended.

In conclusion, the increasing prevalence of food insecurity in Australia during the COVID-19 pandemic has highlighted vulnerabilities in the Australian food system and the urgent need to address factors contributing to food insecurity. Many casual workers and international students became food insecure for the first time due to the loss of income during COVID-19. Coping with food insecurity by purchasing cheaper but unhealthy food emphasises the importance of having sufficient nutritious food to achieve genuine food security. Since the pandemic is still occurring, further data collection of food security in Australia is vital to understand the prevalence and extent of food insecurity experienced at different stages of the pandemic. Future research should focus on changes to, and factors affecting, food security in newly food insecure groups, the impact of COVID-19 on diet quality, coping strategies for food insecurity, and the association between mental health and food security. In

the short term, food aid providers would benefit from increased financial support for maintaining a sufficient food supply, better storage facilities, or mobile foodbanks to improve food access and availability. Food relief organisations could also implement strategies to increase the awareness of their services, reduce stigma and restore dignity to recipients.⁴⁵ Long-term strategies that address underlying factors of food security could involve policies that improve financial resources such as secure employment opportunities that pay living wages and sufficient welfare payments.^{23,47} Finally, collaborations between communities and governments to create resilient urban and rural food environments are necessary for a food secure nation.⁴⁷

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Serena Louie conducted the searches, study selection, data extraction and synthesis, and wrote the first manuscript draft. Yumeng Shi contributed to the study selection, data extraction, and the second manuscript draft. Margaret Allman-Farinelli contributed to the study design, study selection and synthesis of the results. All authors reviewed and revised the manuscript draft. The authors would like to acknowledge Monica Cooper, an academic liaison librarian at the University of Sydney for support in the development of the search strategy.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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