

Comparing regional Australian fruit and vegetable prices according to growing location and retail characteristics

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Abstract

Objectives: To understand how fruit and vegetable prices in regional Victoria, Australia, vary depending on growing location, retailer type, socioeconomic area and remoteness level.

Methods: A feasibility study was conducted to collect and examine fruit and vegetable prices in Loddon Campaspe based on growing location and store characteristics. Statistical analyses were used to test the significance of price differences according to these area-level characteristics.

Results: Fruit and vegetable prices were collected from 65 vendors between February and May 2023. Fruit or vegetable options were typically similar in price when locally grown compared to when grown elsewhere but were often cheapest at large supermarkets. No consistent relationships were found between fruit and vegetable prices and area-level socioeconomic position or remoteness.

Conclusions: With the exception of fruit and vegetable prices often being cheaper at supermarkets than small retailers, no other consistent relationships were observed in the context of our study.

Implications for Public Health: Addressing fruit and vegetable prices and their affordability, including through policies and research that target small retailers, income supports, and localised food systems initiatives are likely to be important leverage points to reduce regional inequities in access to healthy diets in Victoria.

Key words: food price, food affordability, price-monitoring methods, food policy

Introduction

Dietary risks are described by food and beverage consumption patterns low in fruits, vegetables, legumes, nuts, seeds and milk, and high in processed meats, red meat, added sugars, trans fatty acids, and sodium.¹ Dietary risks lead to overweight and obesity, cardiovascular diseases, type 2 diabetes, and some forms of cancer.² An estimated 188 million disability-adjusted life years and 8 million deaths among adults were thought to be attributable to dietary risks in 2019.¹ In Australia, approximately 95% of people do not meet fruit and vegetable recommendations that promote optimal health over the life course,³ with dietary risks and diet-related diseases disproportionately experienced by people living in lower socioeconomic areas and in regional and rural areas.⁴

Local food systems (e.g. farmers' markets, community-supported agriculture, etc) play a major role in supporting healthy and sustainable diets.⁵ However, many social, commercial, political and economic factors influence whether or not optimal diets can be achieved, with the globalisation of food systems, often geared towards promoting the sale and consumption of less healthy over healthy diets.⁶ Food prices and affordability are key economic factors often identified as significant barriers to healthy diets globally.⁷ Indeed, fruits and vegetables are often perceived as unaffordable, especially for people on low incomes, who report consuming less fruits and vegetables because of their cost relative to other less-healthy foods.⁸ In 2021, the Food and Agriculture Organization (FAO) estimated that approximately 3.1 billion people worldwide could not afford healthy diets.⁹ Recent Australian evidence has also shown that

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healthy foods such as fruits and vegetables, increased in price more than less healthy foods since the COVID-19 pandemic.¹⁰

Since 2020, food prices have continued to escalate due to global, national and regional shocks and stressors, including climate change increasing the frequency and severity of extreme weather events (i.e. bushfires and floods), the Ukraine conflict with Russia, and food production and supply chain disruptions stemming from the COVID-19 pandemic.¹¹ Yet, it remains difficult to capture localised price changes as they relate to healthy and less healthy foods across different settings, especially in regional and remote areas. This is typically because efforts to collect food and beverage prices can be resource-intensive, necessitating in-store audits across large geographic areas.

Nevertheless, the available evidence indicates that fruit and vegetable prices can vary depending on where people live as well as seasonality. An Australian longitudinal study (2012-2014) found that the price of food increases with increased distance from capital cities.¹² In 2017, additional evidence from Australia showed that fruit and vegetable prices can be cheaper in lower socioeconomic areas and discount supermarkets compared to higher socioeconomic areas and other supermarkets, respectively.¹³ More recently in the US, evidence has shown that a basket of fruits and vegetables tended to be \$USD3.68 more expensive from farmers markets compared to other supermarkets.¹⁴ Understanding whether there is a difference in the costs of locally, regionally, nationally and internationally grown fruits and vegetables can help all levels of government create targeted policy interventions, marketing, or promotional campaigns to increase the accessibility and consumption of affordable fruits and vegetables for everyone. To date, national-level monitoring does not provide up-to-date estimates on how the prices of various fresh fruits and vegetables may differ depending on where produce has been grown (i.e. locally, regionally, nationally or internationally), and evidence has predominantly focused on major supermarkets and major cities.¹⁵ To address this gap, this study aimed to understand how fruit and vegetable prices in the regional area of Loddon Campaspe vary depending on where the produce has been grown, retailer type, socioeconomic area and remoteness level.

Methods

Setting

The Loddon Campaspe Regional Partnership is one of nine regional partnerships established by the Victorian State Government to support the unique challenges and opportunities in the region.¹⁶ It comprises six municipalities: Campaspe Shire, Central Goldfields Shire, Loddon Shire, Macedon Rangers Shire, City of Greater Bendigo and Mount Alexander Shire.¹⁶ The region has a combined population of about 249,192 people (with projected growth of 19% between 2021 and 2036¹⁷) and a gross regional product of \$11.75 billion.¹⁶ Agriculture and food manufacturing are major industries in the region and key pathways to driving economic development in Loddon Campaspe, with the agriculture, forestry and fishing sectors experiencing 18% growth in employment in the last five years.¹⁷ Many new migrant and refugee communities have settled across the municipalities.¹⁶

The Loddon Campaspe region also has higher rates of overweight and obesity than the Victorian average, with two in three adults

experiencing overweight or obesity.¹⁸ Fruit and vegetable consumption in the region is very low, with one in eight residents meeting the recommended daily vegetable intake and one in two meeting the daily fruit intake guidelines.¹⁸ The 2019 Active Living Census found that the most common barriers identified by Loddon Campaspe residents who did not meet the fruit and vegetable recommendations were personal preference, time and cost.¹⁸

Study design

A cross-sectional feasibility study was conducted to develop and implement a novel tool for monitoring locally grown fruit and vegetable prices in the region. The data collected was used to inform comparisons with non-locally grown produce prices (i.e. produce grown elsewhere in Victoria, Australia or internationally) and retailer characteristics. Three stages were followed:

Stage 1: Developing the food pricing tool

The fruit and vegetable list represented the fruits and vegetables most frequently consumed in Australia based on the International Food Policy Study (2020) and Euromonitor data (see [Supplementary Material Table S1](#)). Two dietitians and a local food supply expert reviewed the initial list and supplemented it with products that grow locally in the region based on the availability of specific vendors at local farmers' markets. Based on previous food price data collection tools used in Australia,¹⁹ fruit and vegetable items in the tool were assigned an item description and columns to extract price information per unit sold (e.g. price per unit, price per kilogram) and growing location. Four categories of growing location could be selected: locally grown in Loddon Campaspe, Victorian grown, grown elsewhere in Australia or internationally grown.

Stage 2: Mapping fruit and vegetable vendors in the region

A list of all possible fruit and vegetable vendors in the Loddon Campaspe region was compiled using Google Maps. Search terms used were the names of the suburbs (n=305) within the six municipalities, followed by the term 'grocery store', 'fruit shop' or 'farmer's market'. The vendor's name, type of vendor (i.e. small supermarket, large supermarket, greengrocer, general store and farmers market), phone number and email (if publicly available), as well as the suburb where the vendor was located, were mapped using 'Google My Maps' and extracted into a Microsoft Excel spreadsheet. Fruit and vegetable vendors were assessed for eligibility based on the following criteria.

Inclusion criteria

- Large supermarkets such as Coles, Woolworths or ALDI
- Small supermarkets such as IGA, Food Works or other independent grocery stores
- Greengrocers that sell fresh fruit and vegetables
- Cultural supermarkets (i.e. supermarkets that provide culturally diverse foods)
- Vendors at farmers' markets within Loddon Campaspe
- Vendors that sell at least 10 of the fruit and vegetable items listed in our pricing tool

Exclusion criteria

- Honesty stands (i.e. unmanned fruit and vegetable stands) with a price list and a locked money box for residents to purchase/take fruits and vegetables)
- Residents selling fruit and vegetables out of their garages or homes
- Butchers, bakeries and delis
- Farms or programs supplying produce directly to members through a subscription model (e.g. community-supported agriculture schemes)

The fruit and vegetable vendors list was stratified by Local Government Area (LGA), vendor type, area-level socioeconomic position and remoteness level. Socioeconomic position was determined by using the Index of Relative Socioeconomic Disadvantage (IRSD)²⁰ to rank suburbs into five quintiles (Q1=most disadvantaged, Q5=least disadvantaged based on their level of disadvantage). The Monash Modified Model (MMM) was used to rank suburbs based on their level of remoteness (Level 1= major city, Level 7 = very remote).²¹ A stratified random sample (n=49) of retailers according to LGA, vendor type and socioeconomic position was initially obtained to pilot the data collection protocol described below. Following protocol piloting, we sought to collect data across all potential fruit and vegetable vendors in the region.

To streamline data collection, fruit and vegetable vendors were contacted directly and asked to complete a pricing tool through email or phone calls. For vendors where online data were available, fruit and vegetable prices and grower information were collected online, and a sub-sample (n=2 stores for each of the 3 major supermarket chains) were validated in-store. Whilst online supermarket food prices have been shown to be similar to in-store in urban areas,²² we examined whether this approach would also be valid in a regional setting. Vendor stores were visited in-person to collect data when vendors could not be reached via email or phone, or when prices were not available online.

Stage 3: Baseline cross-sectional fruit and vegetable price dataset

All collected data were entered into the aforementioned Microsoft Excel template. During data collection, units were adjusted to align with how the fruits and vegetables were sold (e.g. fruit and vegetable items are commonly sold as per each or per KG). How to best collect data and navigate unit adjustments is further explained in Table S2. If growing location data were not evident (i.e. not listed on the item tag, display or unavailable online), the retailers were asked to provide additional information. All fruit and vegetable price data and area-level characteristics were publicly available; thereby, ethical approval was not needed.

Data analysis

Descriptive statistics (mean, SD) and 95% confidence intervals were calculated to summarise fruit and vegetable prices across the Loddon Campaspe region and, according to i) where produce were grown, ii) retailer/vendor type, iii) area-level socioeconomic position, and iv) level of remoteness. Linear regressions and pairwise comparisons of mean fruit and vegetable prices according to these area-level characteristics were assessed using a standard cut-off of $p < 0.05$ in Stata 17 (StataCorp LLC, College Station, TX).

Results

Data were collected between April and May 2023. The fruit and vegetable pricing tool is available in Table S1 along with a step-by-step guide (Table S2). A total of nine fruits and 27 vegetables were included in this list. Two other items (peaches and artichokes) were limited in their availability, likely due to seasonality during data collection, and were removed from statistical analyses. Fresh fruit and vegetable prices were collected from 65 (75%) vendors in the Loddon Campaspe region out of a potential 87 identified vendors (see Table 1 for vendor characteristics). Data were not collected from some vendors (25%, n=22) due to vendors not permitting data collection to occur (7%, n=6), vendors not answering calls or replying to emails (7%, n=6), and vendors not being open when visited due to irregular operating hours (9%, n=8). Two vendors (2%) were also excluded due to missing contact data. Table S3 summarises the characteristics of the vendors sampled.

Prices were collected for 1,989 fruit and vegetable items, with 30 items (SD=6) found on average at each vendor. Of these items, 5% (n=91) were locally grown, compared to 15% (n=306) being grown in Victoria, 77% (n=1,531) being grown in other parts of Australia and 3% (n=61) being grown internationally. Locally grown fruit and vegetable items (n=91) were primarily available through the local farmers' markets (38%, n=35), followed by greengrocers (31%, n=29) and small supermarkets (30%, n=27). According to IRSD, 31% (n=28) of local fruits and vegetables were most frequently observed in Q5 areas (the least disadvantaged), followed by Q3 (26%, n=28), Q2 (22%, n=20) and Q1 (21%, n=19). According to remoteness level, local fruits and vegetables were most frequently available in more remote areas (35%, n=32 in level 5 and 42%, n=38 in level 4) compared to less remote areas (23%, n=21 in level 2).

Table 1: Socio-demographic characteristics of fruit and vegetable vendors sampled in Loddon Campaspe.

| Socio-demographic characteristic | n | % (n=65) |
|---|----|----------|
| Local government area: | | |
| City of Greater Bendigo | 23 | 35 |
| Shire of Campaspe | 15 | 23 |
| Shire of Macedon Ranges | 11 | 17 |
| Shire of Loddon | 8 | 12 |
| Shire of Mount Alexander | 5 | 8 |
| Shire of Central Goldfields | 3 | 5 |
| Retail type: | | |
| Small supermarket | 33 | 51 |
| Large supermarket | 23 | 35 |
| Greengrocer | 6 | 9 |
| Farmers market | 3 | 5 |
| Index of Relative Socioeconomic Disadvantage (IRSD): | | |
| Q1 (most disadvantaged) | 16 | 25 |
| Q2 | 25 | 38 |
| Q3 | 10 | 15 |
| Q4 | 2 | 3 |
| Q5 (less disadvantaged) | 12 | 19 |
| Monash modified Model: | | |
| Level 2 (less remote) | 23 | 35 |
| Level 3 | 2 | 3 |
| Level 4 | 19 | 29 |
| Level 5 (more remote) | 21 | 32 |

Table 2 outlines the linear regression results of the mean fruit and vegetable prices according to growing location. No fruit or vegetable options were statistically significantly cheaper when locally grown. The only significant differences observed were Victorian-grown tomatoes and Australian-grown broccoli and green beans being significantly cheaper than locally grown options. Descriptive comparisons indicated that on average, ten fruits and vegetables (28%) were cheapest when locally grown (lettuce, potatoes, silver beet, leek, butternut pumpkin, radishes, eggplant, bok choy, sweet corn, garlic), compared to seven (19%) Victorian-grown options (tomato, green apples, watermelon, oranges, rhubarb, zucchini, kale), 16 (44%) Australian-grown options (banana, strawberry, red apples, blueberry, mixed leaf salad, carrot, cucumber, spinach, capsicum, red onion, broccoli, mushroom, basil,

spring onion, sweet potato, green beans) and two (6%) internationally grown options (avocado, beetroot) being the cheapest options.

Pricing differences were observed according to retail type; more than half (53%, n=19) of the mean fruit and vegetable prices were significantly cheaper at large supermarkets compared to small supermarkets in the Loddon Campaspe region. The full linear regression results are shown in Table S3. Ten fruit and vegetable items (28%) were descriptively cheaper at greengrocers, with only cucumber and capsicum being significantly cheaper than at small supermarkets. The average prices of six fruit and vegetable varieties (17%) were lowest at farmers' markets, with only spinach and leek being significantly cheaper than at small supermarkets.

Table 2: Summary of mean fruit and vegetable prices in \$AUD (per kilogram) in Loddon Campaspe, stratified according to where the fruit and vegetable were grown.

| | Overall | Locally grown | Victorian grown | Australian grown | Internationally grown |
|--------------------|--------------------------------|--------------------------------|-----------------------------------|---------------------------------|--------------------------------|
| | Mean price AU\$/Kg (95% CI) | Mean price AU\$/Kg (95% CI) | Mean price AU\$/Kg (95% CI) | Mean price AU\$/Kg (95% CI) | Mean price AU\$/Kg (95% CI) |
| Fruits | | | | | |
| Tomato | 8.97 (8.44, 9.50) | 9.50 (7.29, 11.71) | 5.55 ^a (4.50, 6.59) | 9.58 (9.14, 10.02) | 7.99 (4.87, 11.11) |
| Avocado | 8.00 (7.25, 8.76) | n/a | 12.51 (8.52, 16.50) | 7.95 (7.18, 8.72) | 6.48 (3.66, 9.30) |
| Banana | 3.50 (3.25, 3.75) | n/a | n/a | 3.50 (3.25, 3.75) | 3.69 (1.77, 5.61) |
| Strawberry | 20.42 (18.84, 22.01) | 19.92 (13.93, 25.91) | 22.37 (19.82, 24.93) | 19.19 (17.10, 21.27) | n/a |
| Apple, red | 6.12 (5.67, 6.56) | 6.90 (5.88, 7.92) | 6.77 (5.75, 7.79) | 5.72 (5.19, 6.26) | n/a |
| Blueberry | 62.86 (58.64, 67.07) | n/a | 71.92 (41.28, 102.56) | 62.33 (57.22, 67.44) | 63.56 (55.37, 71.75) |
| Apple, green | 5.77 (4.32, 7.21) | 5.13 (1.33, 8.92) | 5.05 (2.68, 7.42) | 6.53 (4.42, 8.65) | n/a |
| Watermelon | 2.86 (2.69, 3.03) | n/a | 2.29 (1.00, 3.58) | 2.87 (2.70, 3.04) | n/a |
| Orange, navel | 6.34 (5.77, 6.90) | n/a | 5.80 (4.13, 7.48) | 6.30 (5.59, 7.01) | 6.71 (5.53, 7.89) |
| Vegetables | | | | | |
| Lettuce, iceberg | 4.60 (4.24, 4.96) | 4.11 (2.50, 5.72) | 4.37 (3.68, 5.07) | 4.73 (4.29, 5.16) | n/a |
| Mixed leaf salad | 21.78 (19.26, 24.30) | 27.45 (15.48, 39.42) | 27.31 (23.85, 30.77) | 17.41 (14.47, 20.36) | n/a |
| Carrot | 2.89 (2.59, 3.19) | 6.50 (5.50, 7.50) | 3.32 (2.66, 3.97) | 2.63 (2.39, 2.86) | n/a |
| Cucumber | 6.60 (5.94, 7.26) | n/a | 7.49 (5.35, 9.64) | 6.51 (5.81, 7.20) | n/a |
| Spinach | 22.50 (20.98, 24.01) | 23.69 (18.14, 29.24) | 25.18 (22.92, 27.45) | 20.40 (18.46, 22.33) | n/a |
| Capsicum, red | 8.82 (8.12, 9.52) | n/a | 10.26 (8.08, 12.45) | 8.66 (7.93, 9.39) | n/a |
| Onion, red | 5.49 (5.00, 5.98) | 6.00 (2.12, 9.88) | 5.93 (4.63, 7.22) | 5.40 (4.86, 5.94) | n/a |
| Broccoli | 4.90 (4.44, 5.35) | 6.98 (5.28, 8.67) | 5.63 (4.61, 6.65) | 4.56 ^a (4.07, 5.04) | n/a |
| Mushroom | 15.89 (14.71, 17.08) | 16.48 (9.85, 23.10) | 16.48 (13.78, 19.19) | 15.72 (14.35, 17.09) | n/a |
| Potato | 4.48 (4.10, 4.87) | 3.50 (1.33, 5.67) | 5.10 (3.97, 6.14) | 4.43 (4.01, 4.85) | n/a |
| Basil | 20.95 (19.14, 22.76) | 21.47 (17.69, 25.26) | 28.22 ^a (25.40, 31.04) | 18.43 (16.06, 20.06) | n/a |
| Beetroot | 6.54 (5.58, 7.50) | 5.41 (1.89, 8.93) | 7.68 (6.06, 9.29) | 6.02 (4.73, 7.31) | 5.20 (0.73, 9.67) ^b |
| Silver beet | 7.43 (5.14, 9.72) | 6.40 (3.92, 8.88) ^b | 6.99 (1.77, 12.21) | 7.67 (4.92, 10.42) | n/a |
| Leek | 6.84 (6.48, 7.20) | 6.29 (5.02, 7.56) | 7.08 (5.44, 8.71) | 6.88 (6.49, 7.27) | n/a |
| Spring onion | 15.93 (14.88, 16.99) | 17.42 (13.03, 21.80) | 18.32 (16.36, 20.28) | 14.93 (13.73, 16.13) | n/a |
| Pumpkin, butternut | 2.79 (2.52, 3.05) | 2.25 (0.80, 3.69) | 3.49 (2.46, 4.51) | 2.75 (2.48, 3.03) | n/a |
| Rhubarb | 11.24 (10.26, 12.22) | 11.33 (8.03, 14.62) | 9.48 (6.63, 12.33) | 11.44 (10.30, 12.58) | n/a |
| Radishes | 16.05 (14.65, 17.46) | 14.65 (9.62, 19.68) | 18.96 (15.07, 22.85) | 15.72 (14.16, 17.28) | n/a |
| Zucchini | 6.44 (5.93, 6.96) | 7.98 (5.13, 10.82) | 5.77 (3.97, 7.57) | 6.45 (5.90, 7.00) | n/a |
| Kale | 11.20 (10.45, 11.95) | 11.49 (8.45, 14.54) | 10.91 (8.55, 13.27) | 11.21 (10.37, 12.06) | n/a |
| Sweet potato | 3.88 (3.55, 4.21) | n/a | 3.99 (2.50, 5.48) | 3.87 (3.53, 4.22) | n/a |
| Eggplant | 7.93 (7.38, 8.48) | 5.49 (1.70, 9.28) | 10.28 (8.10, 12.47) | 7.83 (7.28, 8.38) | n/a |
| Bok choy | 9.00 (8.36, 9.65) | 8.25 (4.77, 11.73) | 9.09 (7.45, 10.73) | 9.02 (8.30, 9.75) | n/a |
| Sweet corn | 5.26 (4.76, 5.76) | 4.34 (1.61, 7.06) | 5.77 (4.31, 7.22) | 5.23 (4.68, 5.77) | n/a |
| Green beans | 9.73 (8.36, 11.09) | 20.38 (13.49, 27.26) | 11.69 (7.33, 16.04) | 9.13 ^a (7.78, 10.48) | n/a |
| Garlic | 27.18 (24.59, 29.77) | 22.99 (11.78, 34.21) | 44.48 (30.74, 58.21) | 27.23 (23.62, 30.83) | 26.27 (22.47, 30.08) |

^aStatistically significant difference in fruit and vegetable price compared to the local grown price, determined using linear regression and a standard cut-off of $p < 0.05$;

^bPoisson regression was applied to address the negative confidence intervals observed in two linear regression models.

No consistent relationships were observed between the mean prices of fruits and vegetables and IRSD (indicator of area-level socioeconomic position). For MMM (indicator of remoteness), the only significant difference in mean fruit and vegetable prices was observed for beetroot, being significantly cheaper in level 2 (less remote) versus level 3 vendors. These findings are outlined in [Supplementary Tables S4 and S5](#).

Discussion

In this study, we developed a novel toolkit to monitor the prices of fruits and vegetables based on where they are grown and sold and tested its use by implementing it in regional Victoria, Australia. Our tool expands on existing food price monitoring tools^{15,23} by comprehensively collecting localised food and beverage price data from retail vendors beyond major supermarkets.^{15,22} We found that small supermarkets were the main type of retailer in the region and tended to have higher fruit and vegetable prices compared to all other types of retailers. Indeed, over half of the produce options were significantly cheaper at large compared to small supermarkets. No notable differences in the prices of fruits and vegetables based on where produce was grown or by store-level socioeconomic position and remoteness were observed.

The movement towards consuming locally grown fruits and vegetables

Consuming locally grown fruits and vegetables has multiple benefits for human and planetary health; our results found that at least in the Loddon Campaspe region, these benefits do not necessarily translate to additional costs to the consumer. Findings from Marrero et al.²⁴ indicated that people in Puerto Rico who purchase locally grown fruits and vegetables have a higher diet quality than those who seldom purchase local options. These health benefits reflect communities having greater access to unprocessed alternatives that can also be culturally appropriate, influencing food purchasing and consumption patterns.²⁴ Local food supplies can also support shorter supply chains and improvements in the social determinants of health, reducing food miles, supporting local primary producers and local employment, and enhancing rural development and social connection in communities.²⁵ Indeed, agriculture and food manufacturing are often key employment sectors in regional areas where employment may otherwise be limited. For this reason, local food system solutions to food insecurity, defined as the lack of access to affordable healthy food, are increasingly featuring on political agendas across all levels.^{26,27}

However, there are challenges with buying and consuming locally grown produce. For example, the price of locally grown produce obtained from farmers' markets has previously been estimated to be more expensive than supermarkets in the US,¹⁴ although few studies have comprehensively examined this to derive strong conclusions, including in Australia. Other literature suggests that buying local foods cannot be assumed to be sustainable if underlying food supply chain issues, such as contractual agreements with larger and more distant producers or suppliers, centralised market distribution practices, production efficiency and sufficient supply are not addressed.^{25,28} Emerging work in the Australian context suggests that equitable, healthy and sustainable food system transformations, including at the local level, hinge on comprehensively i)

strengthening connections between food system enterprises and value and supply chains, ii) focusing on fairness through food security, inclusive employment, and activated communities and iii) investing in regenerative and First Nations growing practices and circular economy.²⁹

Fruit and vegetable price variations

Multiple studies have shown that healthy and sustainable diets comprising mainly fruits and vegetables are less expensive than those Australians typically consume.³⁰ Parallel findings have been substantiated across many other countries.³¹ Limitations of this previous research have been the lack of systematic food price data collection from regional and rural areas, with some evidence suggesting food costs are greater in regional and rural areas compared to urban areas.³² For example, in 2014, a Western Australia study found that fruits and vegetables were 32% and 26% more expensive in very remote areas than in major cities due to associated transport and freight costs.³² Yet, cross-sectional evidence has also shown that major supermarket food and beverage prices are similar when collecting data across regional areas and major cities in Victoria and Australia.^{15,22} Whilst we did not include data from major cities, our findings align with this evidence, as we observed few significant differences in fruit and vegetable prices based on remoteness. However, some consistency was observed in small supermarket fruit and vegetable prices being higher than other retail types. The lack of clear trends in fruit and vegetable prices according to remoteness should be interpreted with an understanding of the Victorian context. In Victoria (and Loddon Campaspe), there are not very remote areas as there are in other states and territories. Regional areas often have access to large supermarkets, which likely dilutes any differences in fruit and vegetable prices according to remoteness. However, this does not factor in proximity to supermarkets, which may still require lengthy travel times to access, compared to smaller, more accessible grocery retailers.

Our research findings also indicated that locally grown fruits and vegetables are not significantly more expensive than those grown elsewhere. This is not unexpected, given how modern food system supply chains operate. To this extent, smaller food retailers source their fruits and vegetables from a limited number of buyers and/or centralised state-wide fruit and vegetable markets that growers directly sell to. For Australia's three major food retail chains, fruits and vegetables are typically sourced from a small number of major producers, with corporate power driving prices down.³³ For over a decade, fruit and vegetable prices in Victoria and Australia have been influenced by low farmgate prices with low profitability for many farmers, increasing fuel, pesticide and farm costs, and the loss of productive agricultural land.³⁴ Policy actions focused on delivering consumers affordable and sustainable fruits and vegetables should continue to be coordinated across sectors so that primary producers and local food economies can simultaneously flourish.

Implications for research, policy and practice

The statistical significance (or lack of) across our findings should be interpreted with discretion, given that a few dollars difference may be of practical, real-world significance to people, especially when managing low incomes and small food budgets. In recent years where food prices and living expenses have increased, policies to ensure all Australians have the opportunity to access affordable healthy diets

are increasingly being discussed publicly. Policies should ensure fruits and vegetables can be accessed at affordable prices and provide adequate social protection and income supports so that people with low incomes can still afford basic necessities such as a healthy diet. For many Australians, inadequate incomes limit their ability to purchase fruits and vegetables more so than fruit and vegetable prices.³⁵ There is also increasing political attention to localised food systems initiatives that can reduce inequities in access to healthy diets, including via recent Federal (2022) and Victorian (2024) inquiries into food security.^{26,27} Additional empirical evidence is required to understand how improving access to locally grown produce can contribute to reducing inequities in nutrition, community wellbeing outcomes, and the social determinants of health (e.g. income and employment opportunities) across Australia, including in regional areas. Such analyses should incorporate measures of economic access to local produce, while also investigating how this intersects with other key dimensions of food access and security (i.e. local food availability, utilisation, sustainability, agency and stability).³⁶

Strengths and limitations

The data sources that have informed our work are a key strength of this research. Firstly, our food price list was developed to reflect Australia's most commonly consumed fruits and vegetables based on recent food consumption data.³⁷ Our pilot study confirmed the relevance of this list, with only two items (peaches and artichokes) being seldom identified, likely due to seasonality. Moreover, we sampled 65 vendors in Loddon Campaspe to collect fruit and vegetable prices, which exceeds typical food pricing audits of 10–15 vendors.²² Nevertheless, this study was cross-sectional, conducted over several weeks in Autumn 2023 (April–May) and limited to one regional area in Australia—indicating a need to further test the generalisability of the tool and findings. This limitation is common in other food price data collection tools (i.e. Healthy Diets ASAP),^{38–40} as efforts to routinely collect food and beverage prices are resource intensive. Despite this, future research should focus on developing ongoing monitoring platforms, which are essential for understanding the impacts of seasonality and other events on food prices over time. Finally, this research was constrained by the limited availability of fruit and vegetable growing information available to consumers. Vendor staff were also often unsure about where the fruits and vegetables were grown. Where this information could not be determined, it was assumed that the fruits and vegetables were being sourced from elsewhere in Australia.

Conclusions

Our study indicates that, at least in the Loddon Campaspe region of Victoria, locally grown fruits and vegetables are similar in price to those grown elsewhere, suggesting that consumers and retailers may not incur additional costs by purchasing locally grown foods. Nonetheless, the higher (but non-significant) prices of fruit and vegetables within smaller food retail outlets, compared to all other retailer types, is an important area for potential intervention to ensure fruits and vegetables remain affordable for everyone. Addressing fruit and vegetable prices and their affordability in regional Victoria will also require additional policies to reduce income inequality, alongside further research to explore how localised food systems initiatives can

address various aspects of regional inequities in accessing healthy diets.

Ethical standards disclosure

All data were publicly available, and non-human data was collected; thereby, no ethical approval was required.

Author contributions

CZ, KP, CR, KB conceived the work; CZ, JM, TW contributed to data collection; CV and JF provided critical interpretation of the research. CV prepared the manuscript for publication with feedback from all authors. All authors approved the final version of the manuscript.

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.anzjph.2024.100211>.