

## Original Article

# Geographic factors as determinants of food security: a Western Australian food pricing and quality study

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Food affordability and quality can influence food choice. This research explores the impact of geographic factors on food pricing and quality in Western Australia (WA). A Healthy Food Access Basket (HFAB) was cost and a visual and descriptive quality assessment of 13 commonly consumed fresh produce items was conducted in-store on a representative sample of 144 food grocery stores. The WA retail environment in 2010 had 447 grocery stores servicing 2.9 million people: 38% of stores the two major chains (Coles® Supermarkets Australia and Woolworths® Limited) in population dense areas, 50% were smaller independently owned stores (Independent Grocers Association®) in regional areas as well, and 12% Indigenous community stores in very remote areas. The HFAB cost 24% ( $p < 0.0001$ ) more in very remote areas than the major city with fruit (32%,  $p < 0.0001$ ), vegetables (26.1%,  $p < 0.0005$ ) and dairy (40%,  $p < 0.0001$ ) higher. Higher price did not correlate with higher quality with only 80% of very remote stores meeting all criteria for fresh produce compared with 93% in Perth. About 30% of very remote stores did not meet quality criteria for bananas, green beans, lettuce, and tomatoes. With increasing geographic isolation, most foods cost more and the quality of fresh produce was lower. Food affordability and quality may deter healthier food choice in geographically isolated communities. Improving affordability and quality of nutritious foods in remote communities may positively impact food choices, improve food security and prevent diet-sensitive chronic disease. Policy makers should consider influencing agriculture, trade, commerce, transport, freight, and modifying local food economies.

**Key Words:** food, affordability, quality, geographic factors, food security

## INTRODUCTION

Chronic diseases account for 60% of the 56 million deaths globally, with unhealthy diets being a major contributor to key risk factors (high blood pressure, high cholesterol, low fruit and vegetable intake and overweight and obesity).<sup>1</sup> The most socially and economically disadvantaged have the worst health and a greater incidence of disease risk factors.<sup>2-4</sup> Food choice is in part determined by food supply, pricing, quality, availability and income disparities.<sup>4</sup> There are times when individuals have to compromise the quality or quantity of their diet because of a lack of money or access to food.<sup>5</sup> Australians relying on the lowest income have to pay the greatest percentage of their income towards food.<sup>6</sup>

### *Food insecurity and diet-sensitive chronic disease*

Food security can be defined as existing “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy lifestyle” (FAO, 1996, Rome declaration on food security). The ability of individuals, households and communities to acquire appropriate and nutritious food on a regular and reliable basis using socially acceptable means is deter-

mined by people's local food supply and their capacity and resources to access and use that food. Food availability, quality and price influence the affordability of food.<sup>7</sup> There is no regular monitoring system capturing the severity of food or nutrition insecurity in Australia, however, a single question measures food insufficiency in state-based population surveys. In 2010, 3.3% of Western Australia (WA) adults said they had run out of money and could not afford to buy food during the previous 12 months.<sup>8</sup> Australians residing in rural and remote areas are susceptible to food insecurity,<sup>9</sup> particularly Indigenous Australians who suffer preventable diet related chronic disease.<sup>2</sup> Ideally, systems to monitor a nation's food security should include information about factors that affect food supply,<sup>10</sup> including food affordability and

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quality.

Food insecurity has been found to be associated with diet-sensitive chronic disease (including cardiovascular disease risk factors (hypertension, and hyperlipidaemia)) in children and adults.<sup>11,12</sup>

### ***The Australian policy context***

The National Health and Medical Council's recent review of the dietary guidelines continue to encourage the consumption of nutritious but perishable foods (for example, fruit, vegetables, dairy foods, lean meats, and fish).<sup>13</sup> These foods require appropriate storage and transportation. Increased transportation costs lead to increased food prices.

In 2013, the Australian Government's National Food Plan-Our Food, Our Future (NFP) had a focus on domestic food security and factors affecting food affordability. "In a country as wealthy as Australia is, no-one should go hungry" NFP page 56.<sup>14</sup>

The NFP considered the causes complex and included: poverty; poor infrastructure; lack of social protection (access to a regular income); water; poor education; individual poor management skills; and lack of access to reasonably priced foods. In response to 24% of Indigenous people and those living in disadvantaged areas being food insecure, compared with 2% of the "general population", the 2025 goal was to "build on the high level of food security by continuing to improve access to food in remote communities or to those struggling with disadvantage".<sup>14</sup> The Council of Australian Government's (COAG) National Strategy for Food Security in Remote Indigenous Communities outlined actions to improve both the supply and demand for nutritious food in remote Indigenous communities.<sup>15,16</sup>

At the national level, the NFP has been superseded by the current government's Agricultural Competitiveness White Paper (ACWP) which focuses Australian food and agricultural policy on agricultural business development. Although food security is within scope "through the creation of a stronger and more competitive agriculture sector," the emphasis is on economic competitiveness, reducing regulatory burden, reduction of inputs along the supply chain, enhancing exports and exploring new markets. In contrast to the former NFP, the new approach to food affordability is on increasing food production without putting this in the context of human health or the social aspects of food affordability in Australia.<sup>17</sup>

### ***Geographical impact on food supply in Western Australia***

In 2009, in acknowledgment of the challenge of achieving an adequate supply of safe, nutritious and affordable food in remote areas in Australia, a parliamentary inquiry into "food stores servicing remote Indigenous communities" was undertaken. The inquiry concluded that food costs were higher in remote communities due to the transport logistics of servicing relatively small communities in isolated geographical locations.<sup>16</sup> This is particularly true for Western Australia (WA) with its vast land mass (2,527,875 square kilometres) and concentrated population, 75% residing in the capital, Perth metropolitan area. Most of the state is categorised rural, remote or very re-

ote. Perth is the source of all transport logistics to grocery stores in WA, with the exception of far northern (Kimberly area) stores where some items come from Darwin, Northern Territory. The food distribution channels to the communities are via long haul road or train, and remote community stores often service a community of less than 100 people. The relatively small amount of food production and processing in WA means a large proportion of food is brought into WA from the Eastern states of Australia or overseas. The geographical impact on food pricing and quality in WA is relatively unexplored.

### ***Grocery food retail and price***

Food accounts for about half (46%) of all retailing turnover in Australia.<sup>18,19</sup> Supermarkets and grocery stores are responsible for 63% of the total food retail in WA at AU\$6.6 billion in 2009.<sup>19</sup> The price of a small number of selected foods is collected in capital cities for the calculation of the Consumer Price Index<sup>20</sup> and, every five years, the average weekly household expenditure on food is measured in the Household Expenditure Survey.<sup>21</sup> These surveys do not enable exploration with geographic locations.

The price of food in Australia is increasing, particularly fruit and vegetables, however, there is limited routinely collected food pricing information in Australia.<sup>22</sup> Ad hoc "healthy food" market basket surveys have captured food affordability trends in Queensland,<sup>23,24</sup> the Northern Territory,<sup>25</sup> New South Wales<sup>26,27</sup> and South Australia,<sup>28,29</sup> but there is no regular survey in WA. The dearth of food pricing information in WA was of particular concern due to the geographic uniqueness of the state and anecdotal reports of higher food prices in remote areas.

### ***Food quality and purchasing decisions***

Food purchasing decisions at point-of-sale are in part based on "appeal" or quality, as well as price, for example, the perception of freshness which is influenced by appearance, colour, aroma or odour, texture, size, shape, flavour, and freedom from defects.<sup>30,31</sup> The definition of quality depends on the food and characteristics being considered. The commercial quality of food considers attributes based on appeal as well as characteristics such as "cleanliness, firmness, lack of damage, freedom from disease, and consistency" and the descriptions vary for specific fruit and vegetables.<sup>32</sup> Lacking is information on the quality of fresh produce by geographic location in WA.

In 2010, the Department of Health conducted the first statewide Food Access and Costs Survey (FACS) as part of the WA Environmental Health Food Unit's food monitoring and surveillance program. This paper analyses the FACS to explore the impact of geographical location on food pricing and quality of a healthy food basket.

## **METHODS**

The FACS was developed and implemented in six stages:

1. Review of the literature and existing costing survey instruments;
2. Identification of geographic locations of all grocery stores and selection of a state-wide representative

- store sample;
3. Surveyor recruitment and online training of local government Environmental Health Officers and Public Health Nutritionists;
  4. Notification of grocery stores of the survey timing and content;
  5. Surveys conducted August/September 2010;
  6. Data entry and analysis.

### Sampling

The survey was restricted to major grocery supermarket retailers from two main supermarket chains (Coles® Supermarkets Australia and Woolworths® Limited) and the network of independently owned supermarkets who trade under the Independent Grocers Association (IGA®), and all Indigenous community stores. Contact details and geo-locations of all stores were obtained from store websites and for remote community stores obtained from state and local governments. A random sample of stores was selected to ensure a representative selection of supermarkets from different Statistical Local Areas (SLA) based on socio-economic status and remoteness. Socio-economic status was based on the Australian Bureau of Statistics (ABS) Socio-Economic Indexes for Areas (SEIFA),<sup>33</sup> the Index of Relative Socio-economic Advantage and Disadvantage and remoteness from the Australian Standard Geographical Classification remoteness classification.<sup>34</sup> All store geographic locations were mapped as were transportation routes and remoteness categories. For each SLA, the nearest Coles®, Woolworths® and IGA® store was chosen and all remote Indigenous Community Stores were included. This final sample size of 160 stores was selected from the 447 identified overall.

### Survey instrument-pricing

The food products and brands priced in the overall survey were chosen based on consistency with the Australian Dietary Guidelines<sup>13</sup> and comparability with Australian state government food baskets. The brands and products were chosen to reflect market share (Retail World's Australasian Grocery Guide 2009 market share and sales by volume in Australia) and included supermarket own branded products.<sup>35</sup>

The regular price of 430 specified food products, across 230 foods types, was recorded in-store on a paper

audit sheet. To increase ease of use, the instrument was piloted in the three types of grocery chains prior to conducting the state wide survey.

### Survey instrument-quality

To standardise quality criteria existing in-store produce quality assessment tools were reviewed.<sup>23,25,36</sup> To reduce subjectivity, the quality assessment criteria were developed for 13 commonly consumed fruit and vegetables using descriptive wording adapted from Australian industry horticultural quality grading system (www.Marketfresh.com.au).<sup>25</sup>

The quality descriptors based on industry standards included: intact-free of major injury and spoilage; sound-not overripe, soft, wilted, free of foreign odours and foreign tastes and free of injury and blemishes; and clean-free of dirt, dust, unacceptable chemical residues and other foreign matter. The cheapest variety for each fruit and vegetable product on sale in-store was selected by the surveyor who then assessed the product criteria based on at least 75% of the displayed stock. Each criteria was rated as present or not, with a "yes" or "no" response. (Figure 1 shows the quality criteria.)

### Data collection

The survey was conducted over the same time period throughout the state and the completed surveys mailed to the Department of Health's Food Unit where the results were collated and entered into a Microsoft Excel database.

### Analysis

Data for all surveyed stores were entered and the average price per 100 g (or 100 mL) for each food item was calculated. When calculating the cost for each SLA, for every food, the prices were averaged across all selected stores in that SLA. Prices for missing foods were imputed using the average price from other stores the same distance, by road, from Perth. Selected stores were categorised by the ABS remoteness criteria and the median price of the respective food baskets were calculated by SLA.

The healthy food basket for the current analysis is based on the Queensland healthy food access basket (HFAB).<sup>23,25</sup> The HFAB basket contains popular and commonly available foods in the amounts needed to meet 70% of the nutrient requirements and 95% of the energy

#### Quality Check for Fresh Common Fruit

Apples, red		Yes	No	Variety	
		<input type="radio"/>	<input type="radio"/>		
	Smooth Skin	<input type="radio"/>	<input type="radio"/>		
	Bruising/discolouration	<input type="radio"/>	<input type="radio"/>		
	Skin broken	<input type="radio"/>	<input type="radio"/>		
	Mould	<input type="radio"/>	<input type="radio"/>	Comments:	
	Firm	<input type="radio"/>	<input type="radio"/>		
	Skin Blemished	<input type="radio"/>	<input type="radio"/>		
	Clean/dirt free	<input type="radio"/>	<input type="radio"/>		
	Stored in fridge	<input type="radio"/>	<input type="radio"/>		

#### Quality Check for Fresh Vegetables

Broccoli		Yes	No	Variety	
		<input type="radio"/>	<input type="radio"/>		
	Blue/green colour	<input type="radio"/>	<input type="radio"/>		
	Tight compact heads	<input type="radio"/>	<input type="radio"/>		
	Open/yellow flowers	<input type="radio"/>	<input type="radio"/>		
	Mould	<input type="radio"/>	<input type="radio"/>	Comments:	
	Firm	<input type="radio"/>	<input type="radio"/>		
	Clean/dirt free	<input type="radio"/>	<input type="radio"/>		
	Stored in fridge	<input type="radio"/>	<input type="radio"/>		

Figure 1. Quality assessment criteria

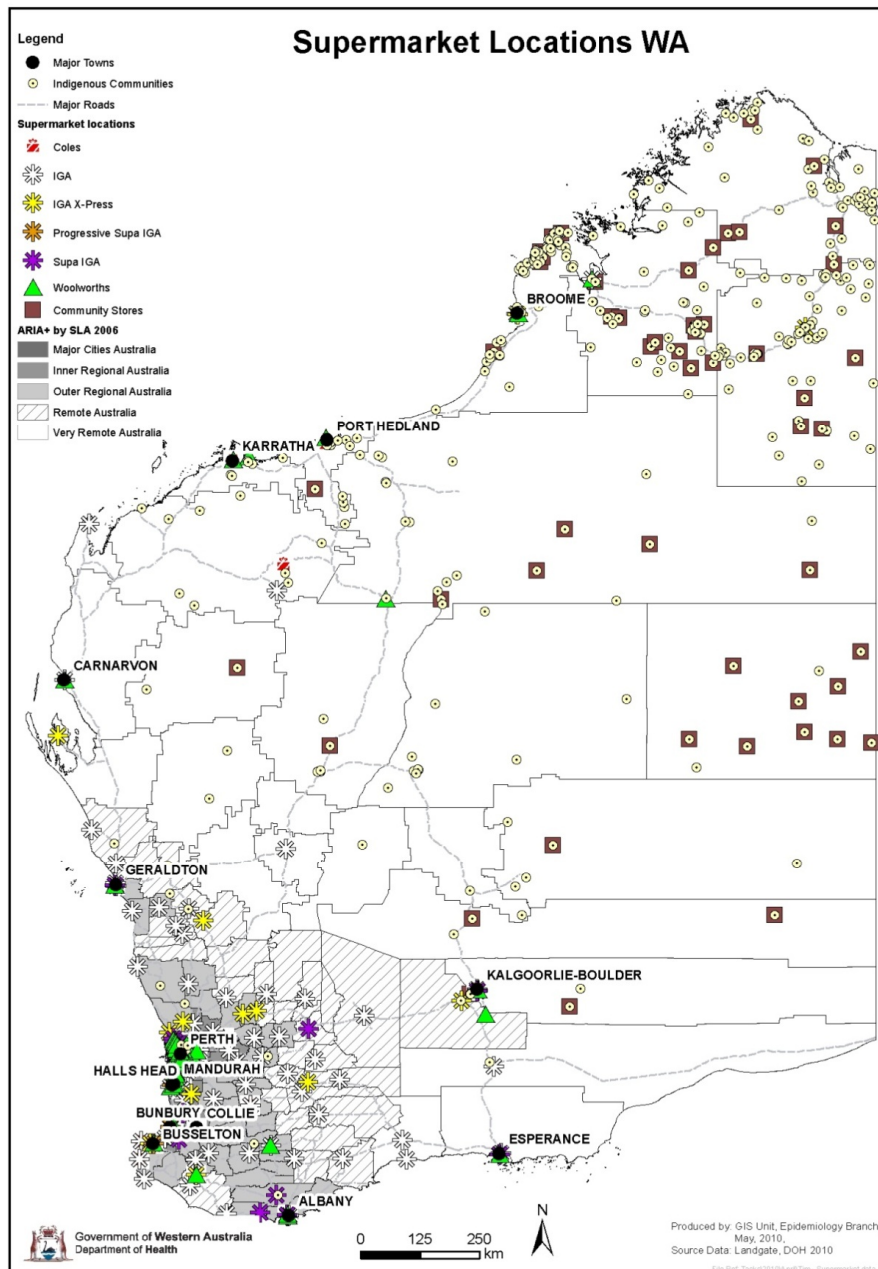


Figure 2. Supermarket density in Western Australia

requirements of a hypothetical family of six (including a man and a woman >19 years, an older woman >61 years, a teenage boy 14 years, a girl 8 years and a boy 4 years) over a fortnight.<sup>23,25</sup> See Harrison et al (2010) for a full description of the basket.<sup>24</sup> As with the HFAB, a “junk food” basket of less nutritious items (cream biscuits, plain milk chocolate, ice-cream, a packet of potato crisps, a soft drink and a meat pie) and one brand of cigarettes were included for comparison with the healthy foods.

Quality was measured by applying a score to each of the quality attributes if that quality was present in 75% of the produce on display when assessed at point of sale. These scores were added up to give a quality score out of 100 for each fruit or vegetable. The criteria were selected to represent good quality for each individual produce and a score of 100 was considered good quality. The mean quality scores for the 13 fresh fruit and vegetables were determined.

Statistical analysis was conducted by the ABS statistician (TL) using Statistical Analysis System (SAS) Enterprise Guide (2006–2008).<sup>37</sup> Kendall’s Tau was used to test for correlations between remoteness and cost. One-way analysis of variance was used to assess for differences in mean costs of a healthy food basket across remoteness categories.

## RESULTS

### *Geographical location of grocery stores*

The location of grocery stores in WA was related to population density. Figure 2 displays the geographical location of the 447 grocery stores by type (85 Coles®, 84 Woolworths®, 226 IGA® stores, and 52 Indigenous community stores). IGA® stores vary in size: IGA X-press (smaller convenience supermarket), Supa-IGA and Progressive Supa-IGA (larger supermarkets).

The population density by supermarket density was

much higher in the Perth metropolitan area compared with the rest of the state, 0.05 versus 0.0001 supermarkets per km<sup>2</sup> as shown in Figure 2. The population for WA in March 2010 was 2.29 million people and approximately 75% reside in Perth.<sup>38</sup> WA's population density at June 2009 was 0.9 people per square kilometre (km<sup>2</sup>).<sup>39</sup> Most of the state has a very low population density with 97% of the total area of the state having less than one person per square km compared with Perth statistical division with 308 people per km<sup>2</sup>.<sup>39</sup>

Mapping grocery store and Indigenous community locations, remoteness, and transport routes clearly illustrates the complexity and distance of the transport networks required for the delivery of food in WA.

### **Response rate**

The in-store survey response rate was 90% with data received from 144 of the 160 stores selected. Of the 52 community stores that were initially identified, eight were closed and two were found not to be operating as stores when surveyed, resulting in an eligible sample of 38. Ninety seven individual surveyors implemented the 144 surveys across the state. It took surveyors an average of 4.1 hours to complete the survey. Community stores took an average of 2.5 hours to complete due to fewer foods to choose from.

### **Cost of a healthy food basket**

The mean cost of a healthy food basket in August/September 2010 was AU\$542.10 (see Table 1). The cost of foods significantly increased with distance from the major cities. The increase in cost between the major cities and very remote areas was across all food groups, particularly perishable foods (fruit, vegetables, and dairy). The increase for non-core foods was high in terms of percentage change, however, not in terms of actual amount.

The analysis was also conducted without community stores to determine whether the increase in cost was due to store type rather than geographic location. The increase in the mean price of the food basket was less (AU\$565.67 compared with AU\$627.11 for very remote and AU\$546.74 compared with AU\$567.92 for remote stores), however the prices for remote and very remote areas were still higher than for the other regions and major cities. The mean price of the Perth metropolitan healthy basket was influenced by two outliers, supermarkets in affluent suburbs where the price and quality of foods was significantly higher than in other suburbs.

### **Quality of fresh produce**

The mean quality rating for fresh produce ranged from 80% to 95%. The mean quality for fresh produce generally decreased with geographical distance from the major city, see Table 2 for the mean quality rating for each produce type by geographic location. For most produce, the mean quality in stores in urban areas was higher than in remote or very remote stores. There were exceptions; the mean quality rating for lettuce and green beans was lowest in remote areas, but lower in Perth than in regional areas. Oranges were rated better quality in remote stores, possibly due to local production.

## **DISCUSSION**

Food pricing and quality varied by geographical location in WA, with higher food prices and poorest quality of 13 selected fruit and vegetables in the areas of the greatest geographic and socioeconomic disadvantage. The FACS methodology using a representative selection of supermarkets state-wide based on socioeconomic status and remoteness allows for generalizes ability of results in WA.

### **Geographic location of grocery stores in Western Australia**

Grocery store mapping illustrates that supermarket density is greatest in areas with accessibly by main roads. The geographical uniqueness of WA, with 25% of the population dispersed across very remote areas accounting for 75% of the land mass presents particular challenges for equitable food pricing and quality. Mapping also revealed that the large supermarkets (Coles® and Woolworths®) who control Australia's retail supermarket sector with 76% market share,<sup>40,41</sup> only service areas of high population density. The largest number of grocery stores in WA were independently owned and located in smaller rural and remote communities. The areas of lowest population density also have a higher proportion of Aboriginal residency, 8.4% compared with 1.7%.<sup>42</sup> Many of the stores servicing remote Indigenous communities of less than 100 people, therefore operate more as an "essential service" than as a "viable business",<sup>43</sup> and this is reflected by community ownership of these stores rather than privately held businesses.

Market forces and business drivers dictate grocery store locations and food prices. The buying power of the two major supermarket chains means that they can offer an enormous range of goods at prices that smaller retailers cannot compete with.<sup>44</sup> Foods in smaller stores may be more expensive due to smaller economies of scale and lower turnover, and as we have found in this study, due to geographic location. Metcash, a wholesaler organisation, buys on behalf of the independent grocers (IGA®) to try to assist them to remain competitive in both product diversity and pricing.<sup>44</sup> Community stores do not generally belong to these competitive buying cooperatives. Although the alliances between wholesalers, retailers and manufacturers attempt to address economies of scale, stores may require further assistance to reduce food costs associated with transport logistics.

### **Food costs**

The study findings support previous Australian research suggesting that food cost and quality may contribute to food purchasing decisions and possibly the strong associations between food security and socioeconomic disadvantage.<sup>28,29</sup> The mean cost of a healthy food basket was 23.5% more in very remote areas than in Perth. The price of fresh produce and dairy foods increased more than frozen or standard sized packaged food. As food price increase was also seen across almost all foods, it is plausible that transport and freight costs contribute. The findings are consistent with 2009 research which found excessive food prices in remote WA communities.<sup>45</sup>

Fruit, vegetables and dairy foods in very remote areas cost more than in metropolitan areas (32%, 26%, and

**Table 1.** Mean cost of WA<sup>†</sup> healthy food access basket per fortnight for food groups, using QLD<sup>†</sup> Healthy Food Access Basket, by remoteness area, (95% CI)

Food group	Western Australia AU\$ (CI)	Major cities AU\$ (CI)	Inner regional AU\$ (CI)	Outer regional AU\$ (CI)	Remote AU\$ (CI)	Very remote AU\$ (CI)	Increase from Major cities to very remote %	Kendall's Tau <i>p</i> -value
Fruit	113 (107-118)	103 (97.8-107)	103 (95.1-111)	99.1 (91.5-107)	123 (108-137)	136 (125-146)	32.2	<0.0001
Vegetables & legumes	105 (101-110)	98.0 (94.4-102)	97.6 (92.4-103)	97.7 (89.0-106)	109 (95.7-122)	124 (113-134)	26.1	0.0005
Bread & cereals	139 (135-143)	132 (130-134)	133 (128-138)	127 (122-132)	144 (136-153)	160 (149-171)	21.2	<0.0001
Dairy	50.2 (47.8-52.5)	44.6 (43.7-45.5)	44.1 (42.4-45.8)	47.2 (44.0-50.5)	52.7 (48.7-56.8)	62.4 (55.9-69.0)	40.0	<0.0001
Meat & alternatives	114 (112-116)	111 (109-114)	109 (104-114)	110 (107-114)	116 (112-121)	120 (114-126)	8.0	0.0017
Non-core foods	21.3 (20.4-22.3)	19.2 (18.7-20.0)	19.7 (18.4-21.0)	19.8 (18.6-20.9)	23.1 (20.6-25.6)	25.2 (22.2-28.3)	31.6	<0.001
Total healthy food basket	542 (526-559)	508 (499-516)	507 (496-518)	501 (490-512)	568 (529-607)	627 (588-667)	23.5	<0.0001
Junk food	55.7 (52.7-58.7)	49.9 (49.0-50.8)	51.3 (49.0-53.7)	52.0 (49.3-54.8)	58.9 (52.8-65.1)	67.2 (54.5-80.0)	34.8	<0.0001
Cigarettes	252 (246-257)	242 (239-244)	241 (234-248)	246 (238-254)	255 (242-269)	276 (257-295)	14.3	<0.0001

<sup>†</sup>Western Australia (WA) and Queensland (QLD).

**Table 2.** Mean quality rating for produce by remoteness category

Produce	Perth	Inner regional	Outer regional	Remote	Very remote
Apples green	93.3	94.5	95.5	94.3	85.7
Apples red	90.7	86.9	93.3	91.8	87.4
Bananas	90.5	97.0	90.5	80.4	69.3
Broccoli	90.5	94.9	99.1	87.5	89.6
Carrots	95.0	96.7	99.2	90.7	84.1
Celery	86.6	90.1	94.0	79.3	70.8
Green beans	83.6	86.5	95.1	68.1	70.0
Lettuce	78.6	86.1	93.0	72.5	68.1
Onions brown	86.7	86.5	86.8	86.0	75.4
Oranges	83.8	90.7	86.3	92.0	87.8
Pears	88.3	84.6	87.5	86.9	86.1
Potatoes	92.2	95.2	93.1	85.9	86.0
Tomatoes	92.2	92.3	95.1	76.0	72.7
Total (mean)	93.3	94.5	93.0	84.0	79.5

40% respectively). Meat was usually sold frozen in remote areas and fresh in urban areas, possibly accounting for the price not increasing. Non-core foods in the healthy food basket, such as sugar, fats and oils, cost 32% more in remote areas. The price of the small selection of non-perishable, heavily marketed “junk foods” cost about 35% more and cigarettes cost 14% more in very remote areas than capital cities. The additional cost of these items in very remote communities could be a disincentive to consumption; however, at this time there are no dietary surveys available to explore this further. Bussey, C (2012) found people living in remote communities were more likely to feel that they had enough money to buy healthy food if the stores they accessed were selling a range of nutritious foods, had good management, and promoted and marketed healthy food.<sup>45</sup>

#### ***Affordability of food***

The affordability of food changes as it competes with other fixed (eg. housing, transport, power) or unexpected (eg. medical emergency, car maintenance) household expenses. Housing, food and non-alcoholic beverages expenditure (in that order) accounted for the greatest proportion of goods and services costs in WA in 2010 (website <http://www.abs.gov.au/ausstats>). Decreases in house affordability in WA has led to higher rental demand affecting availability and price, and increases in homelessness. The sociodemographic characteristics of people suffering food insecurity includes low income, renting (as opposed to home ownership), homelessness, single parent households, and Indigenous peoples.<sup>5</sup> An Australian study of people accessing emergency food relief services in 2012 found that 94% of private renters experienced “rental stress” (with >30% of household income spent on rent).<sup>5</sup> Half said it was difficult to access fresh food, meat, fruit and vegetables due to their cost. For many, foregoing fresh foods and relying on smaller servings of cheaper carbohydrate based cereal foods was how they extended their food dollar.

#### ***Quality of fresh produce by geographic location***

The quality rating in this current study required 75% of the produce on display to meet all quality criteria, possibly measuring a higher standard of quality than the NEMS-S unacceptable rating based on the majority (>50%) being bruised, old looking, over ripe or spotted.<sup>36</sup>

Although overall fruit and vegetables quality was good, the quality of specific produce was rated poorer in remote stores. Poorer quality fresh produce may result from food supply transport logistics issues including insufficient refrigeration and storage over long distances. Long haul refrigerated transportation is expensive and contributing to food cost in remote locations.

#### ***Geographical impact***

Overall in WA, the impact of retail grocery stores that are located further from the capital city, is higher food pricing and poorer quality of fruit and vegetables. The affordability of food for people living in geographically isolated areas is of particular concern, as along with higher food prices, many people residing these areas suffer social and economic disadvantage. The availability of competitively priced fresh fruits and vegetables is clearly an issue in remote communities in WA.

Many of the foods that cost disproportionately more in geographically isolated areas are the very foods that are promoted in dietary guidelines for health; fresh fruit, fresh vegetables and dairy foods. While food security is access for all to sufficient amounts of good quality food, based on healthy eating habits, (without adversely affecting the future food system); food sovereignty respects the right to maintain and develop local capacity to produce staple foods, respecting productive and cultural diversity.<sup>46</sup> Food sovereignty plans could be developed as part of food security strategies to foster local production of culturally relevant and healthy food, provision or sharing strategies, and promotional activities to assist in developing local food economies.

#### ***Transport logistics and supply chain efficiencies***

Transport and freight costs have been identified as major contributors to the cost of food in remote communities.<sup>16</sup> Factors impacting remote transport logistics include distance, delivery mode (road or barge), temperature extremes, road conditions and access issues.<sup>43</sup> The disproportionate food costs highlight the need to review supply chain efficiencies and identify actions to reduce the costs in remote communities. The elevated cost is found across all foods; however, focus should be on fresh perishable foods where quality may be affected by transport. These findings support the call for government to provide subsidies for rural and remote area transport of fresh foods to

reshape the food supply to encourage equitable access to healthier foods in rural and remote communities.<sup>47</sup>

### **Policy response**

Policy to improve the affordability and quality of food requires cross sector collaboration. Monitoring food price and quality is essential to develop effective interventions to improve food supply and food security. Complex and diverse sustained actions at many levels are required to eliminate food and nutrition insecurity, including social, educational, economic, and agricultural production and food distribution responses.<sup>48</sup> Seed et al (2014) identified government agencies (including Ministries of Public Health (health promotion and health protection), Agriculture, Employment and Income Assistance, Education), civil society (food security and Aboriginal networks, health and non-government organisations) and the food supply chain as stakeholders in the food security response.<sup>49</sup> This current study limits its focus to food grocery store location, food price and quality as potential influencers of food choice and food security. The authors acknowledge the complexity of factors influencing food affordability in WA including a resource boom in the mining sector, reduction in affordable housing (particularly in remote areas), unemployment, the global economic crisis, and increasing fuel costs.<sup>50</sup>

Regulatory interventions have been used to increase the supply of food in the Australia's Northern Territory through the licensing of remote community stores, however, even with this type of response, further work is needed to improve the affordability of and demand for food items, particularly fresh healthy food.<sup>51</sup>

In WA the 2009 Royalties for Regions (RFR) Act returns 25% of mining and onshore petroleum royalties to regional areas each year by investing in projects, infrastructure and community services. RFR made available AU\$1,200 million to supplement basic and essential regional infrastructure and services in 2010/11.<sup>50</sup> Food security initiatives included: Gascoyne Food Bowl Initiative for horticultural development and expansion and to reduce the impact of flooding (AU\$25 million); improving water quality in remote aboriginal communities (AU\$12.1 million); school breakfast programs expansion to regional areas (AU\$0.2 million).<sup>50</sup>

The COAG Food Security Strategy outlined a comprehensive approach to improving food security in Australian remote Indigenous communities.<sup>15</sup> Political will, effective partnerships, and adequate resources are required to effectively implement this strategy. Publically available results are limited; however, the WA government funded FACS to inform the strategy. The FACS has informed food and health policy and prompted stakeholders from various sectors, including the Department of Health, Agriculture, Commerce and Trade to come together with academics to explore policy options at the Food Security and Healthy Food in WA Workshop.<sup>52</sup> The workshop highlighted differing agendas and perceptions regarding food security and the need to define the policy problem. In addition to action to improve supply chain efficiencies, the report recommended social and economic responses. The FACS provided evidence for social policy advocacy through the West Australian Council of Social Service

Cost of Living Report.<sup>53</sup>

The ACWP acknowledges that social disadvantage and remoteness lead to "pockets" of food insecurity and asserts that lack of food affordability and access requires changes to "social" rather than agricultural policy. The ACWP takes comfort in the view that "In Australia food is available and most Australian families have the income to afford it", and cites Australia is ranked as 15th of 107 nations food security.<sup>54,17,55</sup> Ratings used to give Australia's score on this index when compared with other countries include: 841.3 billion GDP (\$PPP); 22.8 million population; 7,682,300 km<sup>2</sup>; land area; 5% prevalence of undernourishment, 4 kcal/person/day intensity of food deprivation and 0.94/1.00 on the Human Development Index. It is reasonable to expect high domestic food security in a country as rich, conflict free and agriculturally self-sufficient as Australia. However, this rating does not address the sentiment of the former NFP that "in a country as wealthy as Australia is, no-one should go hungry". There is a need for a more comprehensive and ongoing food and nutrition monitoring and surveillance system in Australia to measure the severity of food insecurity and its consequence.

Given the failure of the current Australian food policy to address domestic human nutrition, health and food security, the authors would recommend that the state of WA develop an integrated food and nutrition food supply strategy or plan, with human health as both a policy driver and an outcome. Public health's vision is for "a safe, nutritious, affordable, secure and environmentally sustainable food system accessible to all Australians for health, wellbeing and prosperity now and into the future".<sup>56</sup>

### **Pricing and food choice**

Research has shown that influencing food pricing can alter dietary behaviour. As little as a 10% reduction in the cost of vegetables could facilitate a seven percent increase in purchase.<sup>57</sup> Increasing the price of soft drinks by 10% would reduce consumption by 8 to 10% for soft drinks.<sup>58</sup> The findings from this current study would suggest that there are opportunities to reduce the comparative cost of foods to improve consumption of fruit, vegetable and dairy foods in remote stores.

Governments are considering options to reduce obesity such as changing the food system to increase supply, availability and demand for healthier foods relative to unhealthy foods.<sup>47</sup> In Australia, as in many countries, food insecurity co-exists with increased overweight and obesity. The relationship between food insecurity and obesity is complex as the solution to one will not "fix" the other at the same time.<sup>59</sup> This study highlights the need to focus on all aspects of the food environment, including geographical determinants such as supermarket locations, and supply chain logistics and their impact on the price of food. The availability, quality and affordability of all foods should be considered to encourage the consumption of a dietary pattern consistent with dietary recommendations.

### **Conclusion**

The design of the FACS study addressed some of the



limitations of previous market basket surveys including: the ability to generalize findings across the state by geographic area; pricing a number of specific high market share brands reduced the impact of brand specific pricing fluctuation; inclusion of discretionary foods enabled price comparisons of competing foods counter to dietary recommendations. The inclusion of a crude objective food quality assessment is novel and did show differences between foods and with geographic variation. More research is needed to further develop this instrument.

Policy options to improve diet need to consider the modifiable factors that impact of on food pricing and quality. A whole of government approach, with strategic industry partnerships and remote community participation is required to address these issues. It would appear that in WA, improving transport logistics and reducing freight costs to geographically isolated areas may lower food costs and improve quality, particularly for perishable foods such as fruit and vegetables. Transport and freight costs, whose controls lie outside the health sector, appeared to significantly influence food pricing and quality. Interventions to improved transport logistics and subsidise freight costs to geographically remote areas are required to reduce food costs, particularly for healthy foods.

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#### AUTHOR DISCLOSURES

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## Original Article

## Geographic factors as determinants of food security: a Western Australian food pricing and quality study

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### 地理因素作为食品安全的决定因素：西澳大利亚的食品价格和质量研究

食品可购性和质量影响食品的选择。本研究探讨了地理因素对西澳大利亚食品价格和质量的影响。用一个健康食品进入篮 (HFAB) 评估了 144 家有代表性的食品杂货店的 13 种经常食用的新鲜农产品的价格、外观和质量。2010 年西澳大利亚的零售环境为 447 家食品杂货商店服务 290 万人口，38% 的商店是位于人口密集地区的两大连锁超市 (Coles® 澳大利亚超市和 Woolworths® 有限公司)，50% 为位于小区的小型独立经营的商店 (独立杂货商协会®)，另外 12% 的商店是位于非常偏远地区的土著社区。非常偏远地区的 HFAB 价格比大城市高 24% ( $p < 0.0001$ )，水果、蔬菜和奶制品分别高 32% ( $p < 0.0001$ )、26.1% ( $p < 0.0005$ ) 和 40% ( $p < 0.0001$ )。价格与质量无关，在非常偏僻的店，只有 80% 的新鲜农产品满足所有的标准，而在 Perth 高达 93%。约有 30% 非常偏僻的店的香蕉、绿豆、生菜和西红柿不符合质量标准。越偏离城市，大部分食品价格越高，而新鲜农产品的质量越低。在地理上与世界隔绝的社区，食品的可购性和质量可能阻碍了健康食品的选择。改善偏远社区营养食品的可购性和质量可能会对食品选择产生积极影响，提高食品保障，预防对膳食敏感的慢性病。政策制定者应该考虑通过影响农业、贸易、商业、运输和货运来改善当地食品经济。

**关键词：**食品、可购性、质量、地理因素、食品安全