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Scoping supermarket availability and accessibility by socio-economic status in Adelaide

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Introduction

The relationship between socio-economic status (SES) and diet has been examined extensively. People who are socio-economically disadvantaged are more likely to run out of food; are less likely to purchase recommended healthy alternatives that are lower in fat, salt and sugar, and high in fibre; and generally consume fewer types of fruit and vegetables, and less regularly, than higher SES groups.¹ Most research has focused on behavioural approaches to explaining these patterns, so that other possible factors to explain SES differences in diet and food purchasing patterns are less well understood. The role of geographical distribution of affordable, healthy food retail outlets is a recent avenue of investigation. Research suggests that foods that are beneficial to health may be more expensive and more difficult to obtain in disadvantaged areas compared with more affluent areas and that this may help to explain the lower adherence to healthy eating guidelines consistently reported in less affluent areas.^{1,2}

This paper reports the results of a pilot study examining the availability and accessibility of supermarkets in areas of different

socio-economic status in the Adelaide metropolitan area. The inclusion of contextual or structural factors in public health nutrition is a distinct departure from the individual and behavioural factors (such as personal mobility and knowledge of nutrition) that have been the main focus of research in this field. Accordingly, this paper documents the scale of food availability and accessibility to inform possible policy responses.

The research questions asked include: does accessibility and availability of supermarkets vary by socio-economic status? Are there food deserts within larger areas?

Background

Research interest in the role of the location of supermarkets first arose in Britain with the increasing exodus of the big supermarkets to out-of-town locations, leaving 'food deserts' behind and growing spatial inequalities in food access between deprived and more affluent communities. Food deserts are defined as "areas of relative exclusion where people experience physical and economic barriers to accessing healthy food".³ Although Australia has not experienced the same type of

Abstract

Issue addressed: Lower socio-economic status (SES) populations are known to have poorer diets than high SES populations. We explore the extent to which factors in the built environment may contribute to this social health inequality and determine whether 'food deserts' exist in Australian cities.

Methods: We use a geographic information system to measure availability and accessibility of supermarkets in four case study local government areas (LGAs). The location of supermarkets is analysed in relation to residential dwellings, car ownership and in terms of travel distance along the road network.

Results: This methodology identifies differences in both availability and accessibility between and within LGAs. It shows that a local-level approach to the issue of food deserts is warranted and suggests that generalisations based on large geographic areas are unlikely to be meaningful.

Conclusions: A significant number of households live in 'food deserts' in Adelaide and these can only be identified using a local-level approach.

Key words: Food deserts, Geographic Information Systems (GIS), accessibility, availability, socio-economic inequality.

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So what?

Local governments should consider residential access to food when planning new developments and when zoning existing land uses. Incentives can be used at local and State level to encourage supermarket developers to locate in or nearby food deserts. Measures to improve mobility can be targeted to specific neighbourhoods.

movement of supermarkets, other factors, of which some may be specific to Australia's urban structure, may cause similar outcomes. Several researchers argue that people in deprived communities, particularly those without cars, the elderly and people on low incomes, have no option but to rely on smaller stores where prices are higher and the quality and variety of fresh food is more limited.^{2,4,5} However, Cummins and Macintyre⁶ suggested that the issue of 'food deserts' has become a 'factoid', with little supporting evidence. This has spurred the development of ways to identify and measure food deserts. Most of these studies have taken a geographic approach.^{1,4,7-11} Dowler and Blair¹² were among the first to use descriptive mapping combined with qualitative methods, finding large networks of streets and estates without any shops selling fresh fruit and vegetables and where any available fruit and vegetables were expensive. Inexpensive, good-quality food, including fresh fruit and vegetables, was available, but only in small concentrated shopping areas to which the majority of the population would have to travel by car or public transport. The study concluded that eating patterns in this district may be determined by socio-economic and geographical factors rather than real choice or knowledge.

Moreland et al.⁸ found that the locations of food shops in Mississippi, North Carolina, Maryland and Minnesota, in the United States (US), are associated with the wealth and racial makeup of neighbourhoods, with almost three times as many supermarkets in wealthier neighbourhoods compared with lowest-wealth areas. They also found different types of food stores in poor and wealthy neighbourhoods. Wealthier areas had many more large supermarkets and fewer small grocery stores and fast food restaurants.

Even where many supermarkets may be available, their proximity

or distance to residences is a consideration, particularly for households without cars. Distance from home to food store has been found to be inversely associated with household fruit consumption.⁹ Dependence on local stores means that food shopping becomes a question of not what one would like to buy, but what is available given mobility restrictions. Unless a household is small, lives in a walkable neighbourhood, is able to shop more than once per week or has a supermarket within 500 metres,³ the difficulty of carrying home the weekly shopping for a household of two or more makes walking as transport very difficult, especially if one is accompanied by small children.¹³ People who have no option but to walk to do their shopping have been found to have relatively poorer diets, which can be partly attributed to the difficulty they experience carrying their shopping home.^{8,14,15} Public transport is often ill suited for most household food shopping because of the limited range of destinations and schedules available.⁷ In sum, socio-economic disadvantage may constrain many low-income families to their local food environment because they are the most likely to lack access to a car.¹³

Winkler, Turrell and Patterson¹¹ reported minimal or no SES differences in the availability of shopping infrastructure. Unfortunately, significant methodological shortcomings in this study limit its usefulness; these include the use of the 'as the crow flies' measure of distance and the modifiable areal unit problem in the use of Collection Districts (CDs) as the basic spatial unit. Studies involving geographical concepts such as distance, proximity, areal units and location, as in the issue of accessibility and availability of food, should ideally involve more sophisticated use of geographic information systems and methodologies.

In sum, the literature identifies a range of structural factors

Table 1: Selected characteristic of case study local government areas (LGAs).

LGA	Selected indicators			
	% Unemployed	% managers and professionals	Median weekly income category	Distance (km) from city centre to LGA centroid
Burnside	2.7	27.3	\$400-499	5.9
Onkaparinga	4.9	10.7 ^a	\$300-399	29.7
Playford	7.4	8.1	\$200-299	25.4
Port Adelaide – Enfield	5.9	9.7	\$200-299	10.9

(a) Ranges from approximately 7% in SLAs comprising former Noarlunga LGA to 18.6% in Hills SLA (previously Happy Valley LGA).

Table 2: Availability of supermarkets in relation to population.

LGA	Persons ^a	Households ^a	Number of supermarkets ^b	Number of persons per supermarket	Number of households per supermarket
Burnside (C)	40,752	16,429	9	4,528.0	1,825.4
Onkaparinga (C)	144,878	53,690	28	5,174.2	1,917.5
Playford (C)	66,928	24,348	12	5,577.3	2,029.0
Port Adelaide – Enfield (C)	98,569	40,877	32	3,080.3	1,277.4

Source: (a) 2001 Census (b) 2005 Yellow Pages Online.

influencing access to food. Foremost among these are the presence or absence of a nearby supermarket, its proximity to residential areas, and car ownership. The presence or absence of public transportation is another key factor. Clearly, the importance of any one of these factors varies according to distance and location in relation to people's homes. The food desert debate must move from a yes/no approach towards a more sensitive approach investigating variations in different levels of access between different places and SES groups, particularly those disadvantaged by multiple barriers, and it must do so at the local spatial level.

Method

As Donkin and Dowler¹⁶ point out, availability, or provision, is a key factor that needs to be systematically defined and examined before accessibility, whether economic or physical, can be measured. There can be no accessibility without availability. Availability is defined simply as the number of food outlets present in an area in relation to its population, expressed as a ratio. We are primarily interested here in the availability of the large chain supermarkets, which typically provide the whole range of food groups at the most economic prices. While we acknowledge that factors other than the availability of local supermarkets can and do influence where households do their shopping (such as the location of employment or relatives), food shopping is generally an activity that takes place in households' local areas or neighbourhoods for practical reasons.

The local government area (LGA) is used as the areal unit for comparing case study areas because:

- This unit is large enough to exhibit substantial internal spatial variation and patterning in food-type outlets and demographic groups.
- It is small enough that its population profile is distinct from those of other LGAs.
- There is a sufficient number of units that can be matched and compared in terms of location and socio-economic status.
- It is a standard unit for official demographic data.
- Local government has a significant role in meeting local needs and planning services for its residents and in local development in terms of planning approval and land use zoning.

Table 3: Mean distance to closest supermarket.

Mean distance (km) to closest supermarket	
Burnside (C)	2.1
Onkaparinga (C)	4.2
Playford (C)	3.8
Port Adelaide Enfield (C)	2.4

Table 4: Accessibility classification.

Level of accessibility	Closest supermarket	Second closest supermarket
1. Excellent	Within 1 km	Within 1 km
2. Good	Within 1 km	Within 2.5 km
3. Average	Within 1 km	Further than 2.5 km
4. Fair	Within 2.5 km	Within 2.5 km
5. Poor	Within 2.5 km	Further than 2.5 km
6. Bad	Further than 2.5 km	Further than 2.5 km

Several other geographic levels of analysis are used in this study including metropolitan, small (local) area, and addresses (points) to reveal the degree of variation within the larger unit of the LGA. This spatial level of analysis will establish the validity of a local-level approach to accessibility.

Our study was part of a larger project examining location, health and social disadvantage. For that study, four LGAs with contrasting SES were identified based on Socio-Economic Index for Areas (SEIFA) data and the 2001 Census, produced by the Australian Bureau of Statistics. Two were located close to the city centre (one of each level of SES) and two had outer suburban locations (also with contrasting SES). An inner area of mixed SES (Prospect) was part of the larger study, but as we were particularly interested in socio-economic disadvantage, we substituted Port Adelaide-Enfield to represent an inner area of low SES. The location of the LGAs within metropolitan Adelaide is shown in Figure 1. Selected demographic indicators are presented in Table 1.

A list of the addresses of all the food outlets where healthy foods were available (defined as supermarkets, greengrocers and butchers) was compiled using the online search function of the Telstra Yellow Pages for each LGA and the areas in the buffer zones around them. They were then geocoded (assigned a

Table 5: Comparison of supermarket accessibility indices by case study LGA.

Index category	Percentage of all individual dwellings in LGA			
	Burnside n=14,325	Onkaparinga n=48,558	Playford n=25,527	Port Adelaide – Enfield n=45,256
1. Excellent	4.4	6.5	1.4	3.9
2. Very good	24.5	8.9	10.5	21.4
3. Good	4.2	4.6	6.3	5.9
4. Fair	47.2	35.8	20.6	45.1
5. Poor	11.9	18.6	16.0	17.2
6. Bad	7.7	25.6	45.2	6.4

geographic co-ordinate) and plotted on a map of the road network.

We created a buffer zone of 2.5 kilometres around each of the case study LGAs (consistent with the buffer measurement used by Winkler et al.¹¹). Buffer zones provide a more realistic representation of the food outlets available to persons living within an arbitrarily defined boundary, because people travel outside these boundaries to nearby food outlets. People living near boundary edges may represent a substantial proportion of an area's population.

Census data on car ownership was used to identify the geographic distribution of households without cars within each of the case study LGAs at the CD level, the smallest spatial unit for which Census data are available. CDs in each LGA were identified as having a high concentration if the percentage of households with no car was in the top quartile range of the distribution for the Adelaide Statistical Division (i.e. over 15.8%).

We emphasise that where CD-level data is used to characterise an area as having low car ownership, this does not mean that all persons in the area have that characteristic. It means that there are more people or households with that characteristic in that area relative to other areas (see the classic Robinson¹⁷ paper on the ecological fallacy).

Geocoded address data showing the precise locations of all residential dwellings in the case study LGAs were obtained from the SA Department of Environment and Natural Resources. All individual land parcels with a land use code indicating residential use were selected. The centroid of each parcel is used as the point from which distances are measured.

We used the MapInfo product Drivetime 9.5, which uses the road network to find the distance between two points, in this case the three supermarkets closest to each residential dwelling. Supermarkets only were used for the initial analysis to keep it as straightforward as possible and on the grounds that all types of healthy foods are available there.

Results

Availability of supermarkets by socio-economic status of LGA

Port Adelaide-Enfield has the most supermarkets available to its population, with one supermarket for every 3,080 people (see Table 2). Supermarkets in Playford serve nearly twice (1.8 times) as many people as supermarkets in Port Adelaide-Enfield.

Table 6: Number of households located in food deserts by LGA.

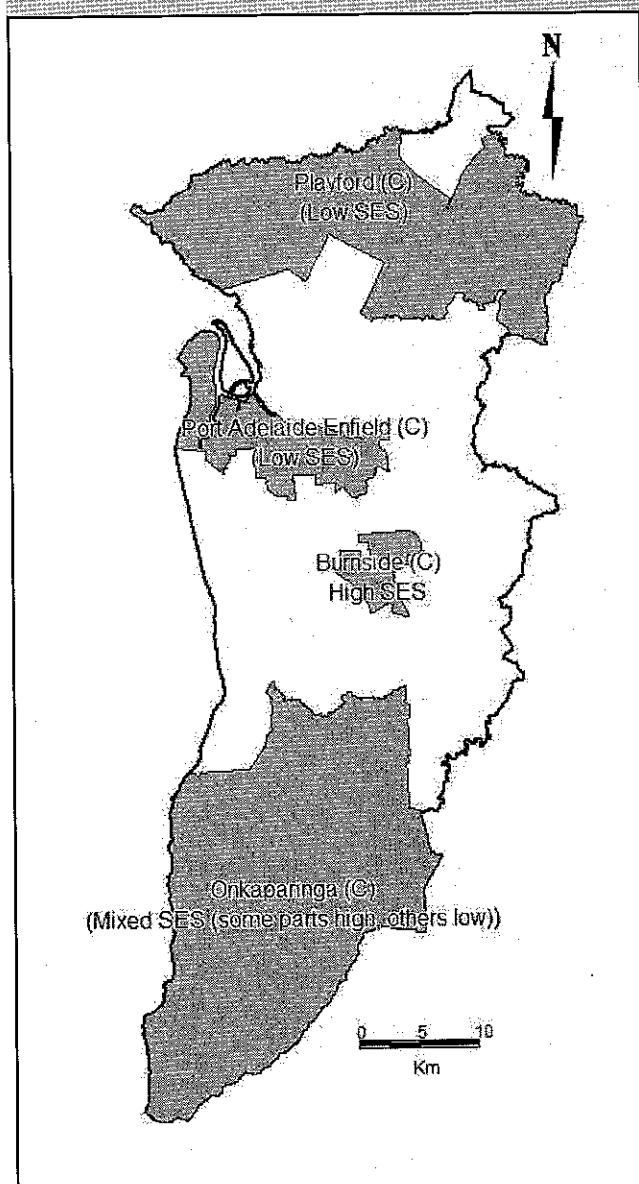
LGA	Number of dwellings/ households	Number of deserts
Burnside	0	0
Onkaparinga	1,296	3
Playford	4,605	5, including one very large cluster
Port Adelaide - Enfield	3,407	4 large, 8 smaller desert islands

However, shopping for food is generally (not always) done on a household basis, where one or more members of the household choose and purchase food for the entire household. If we look at the ratio of supermarkets to households, the differences in the number of available supermarkets between the LGAs is considerably reduced. Port Adelaide-Enfield still has the lowest ratio of households per supermarket, and thus apparently the best availability, and Playford the highest ratio in terms of rank order, but there is relatively little difference between Burnside, Onkaparinga and Playford, which are all around the mark of one supermarket per 2,000 households.

Average distances to nearest supermarkets by socio-economic status of LGA

Table 3 shows that households in the two outer LGAs of Playford and Onkaparinga have further to travel to supermarkets, with Onkaparinga households travelling slightly further than Playford households. Burnside and Port Adelaide-Enfield appear to have

Figure 1: Location of case study LGAs in metropolitan Adelaide.



Conclusions

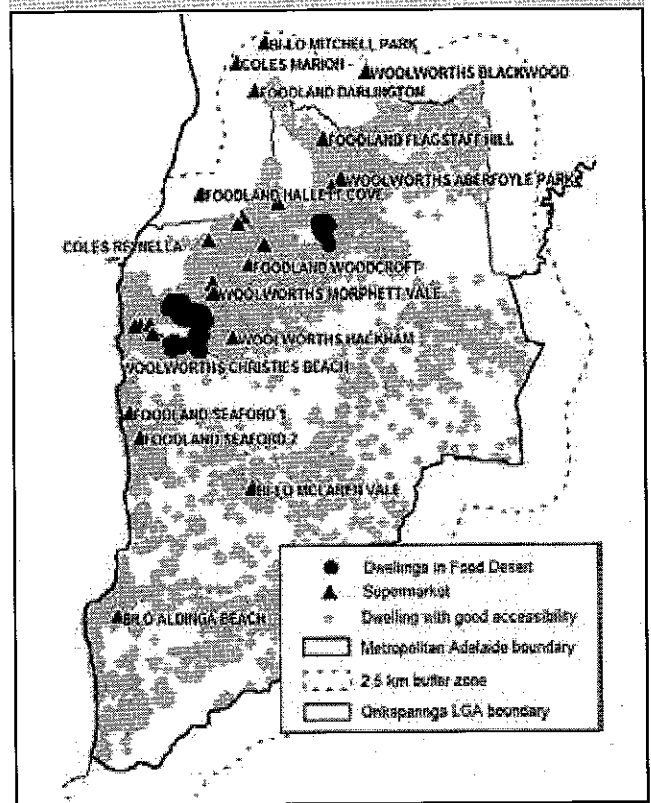
This paper illustrates the application of a methodology that can reveal some important patterns. The use of point-level data and the road network are a significant advance in the measurement of accessibility to food outlets. At this stage we can conclude that there are indeed socio-economic differences in access to food and the availability of food outlets; and that food deserts appear to exist. Food deserts are best identified by accounting for patterns and features of local environments rather than larger areas based on administrative spatial units as generally used in the literature to date.

The analysis of food outlets per head of population shows the value of including buffer zones around selected areas. The inclusion of food outlets in buffer zones radically changes the picture of food outlet availability, as shown by the number of supermarkets located within 2.5 km of the case study LGA boundaries.

The role of demographic status at the individual level and the measures people adopt to survive in a food desert will be validated and explored with qualitative fieldwork in the next phase of this study. Further research incorporating other food outlets, such as greengrocers, butchers and convenience stores, is also necessary to refine the picture of food availability and accessibility. It is also possible to use this methodology to address the supply of take-away foods.

The scale of the food desert problem in terms of the number and types of households affected appears sufficient to warrant ameliorative measures. Availability is a structural constraint, although it may be amenable to land use planning measures and location incentives for businesses.¹⁸⁻²¹ Because the supply of supermarkets, road and path construction and residential development is influenced partly by local government zoning and development planning, local government has some ability to influence its residents' access to food. Local governments are

Figure 4: Food deserts in Onkaparinga LGA.



also well placed to account for local travel and shopping patterns in their planning and development. Access to food may need to be placed higher on the local government planning agenda. However, there are also clear implications for State-level policy directives, both in the health and urban development and planning portfolios. This may involve co-ordinating actions between spatially adjacent local governments and considering the role of food supply in future urban regeneration in areas such as Playford and Port Adelaide.

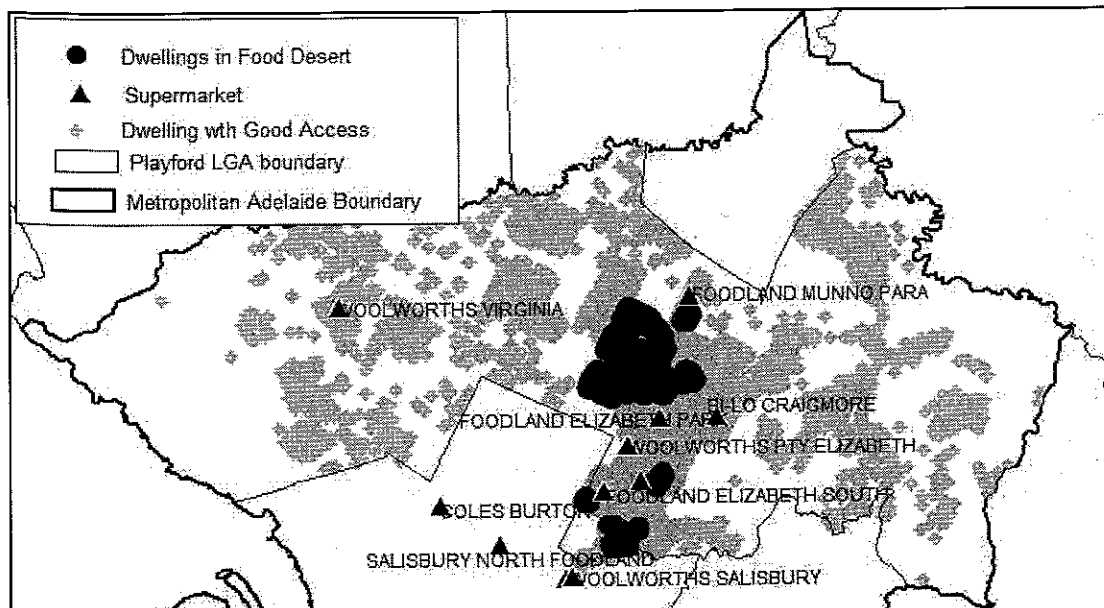


Figure 3: Food deserts in Playford LGA.

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