Junk-food filled neighbourhoods

Building a local evidence base for change

Junk food filled neighbourhoods: building a local evidence base for change

28th October 2020

This research report has been prepared for Cancer Council WA by Dr Gina Trapp, Deputy Head of the Health Promotion and Education Research Team at the Telethon Kids Institute and Dr Paula Hooper, Co-Director of the Australian Urban Design Research Centre, The University of Western Australia.

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Summary of key findings

- Outdoor advertising near Perth schools constitutes a frequent source of children's exposure to unhealthy (non-core) foods and alcohol:
  - 74% of all outdoor food advertising within 500m of 64 Perth schools was for unhealthy (non-core) foods, with alcohol being the most frequently advertised food product, followed by fast food (e.g., burgers, chips, pizza) and sugar sweetened beverages.
  - There were nine times as many outdoor advertisements for unhealthy (non-core) foods within 500m of Perth schools than healthy (core) foods.
  - Perth schools located in areas of low socio-economic status (SES) had a higher proportion of total outdoor food advertisements, unhealthy (non-core) food advertisements and alcohol advertisements, but not healthy (core) food advertisements within 250m of schools.
  - 87% of outdoor food advertisements on bus shelters within 500m of Perth schools were for unhealthy (non-core) foods and alcohol.
  - 70% of all outdoor food advertisements on digital signs and billboards within 500mn of Perth schools were for alcohol.

- When examining fast food outlet availability near Perth schools using data from 2018/19 we found:
  - On average, Perth schools had 2 fast food outlets within 400m, 6 fast food outlets within 800m and 8 fast food outlets within 1km.
  - 11% of Perth schools had at least one of the "Top 4" fast food chains (McDonalds, Hungry Jacks, KFC and Subway) within just 400m; 32% had at least one "Top 4" fast food outlet within 800m.
  - Secondary schools were significantly more likely than Primary and K-12 schools to have at least one fast food outlet or "Top 4" fast food chain outlet within 1km.
  - Schools located in low SES areas had a significantly *higher* frequency of fast food outlets within 400m and "Top 4" fast food chain outlets within 400m and 1km than schools located in high SES areas.
  - An increase in the number of "Top 4" fast food chain outlets within 400m, 800m and 1km of a school was significantly associated with an increase in the frequency of secondary school students purchasing discretionary (i.e., 'junk' food) foods from food outlets near their school.

- When examining fast food outlet availability across the Perth metropolitan area using data from 2018/19 we found evidence of a socio-economic gradient whereby:
  - The density (count) of fast food outlets and "Top 4" fast food chain outlets was greater in areas with more relative disadvantage

- We found evidence of a relationship between fast food outlets and "Top 4" chain fast food outlet availability near homes and vegetable intake and BMI whereby:
  - An increase in the number of "Top 4" chain fast food outlets within 800m or 3km of home or having at last one "Top 4" chain fast food outlet present within 800m of home was significantly associated with a reduction in daily vegetable intake frequency in adults aged 25-64 years.
  - An increase in the number of "Top 4" chain fast food outlets within 800m or 3km of home or having at last one fast food outlet present within 1600m of home was significantly associated with a reduction in daily vegetable intake frequency in older adults aged 65+ years.
  - An increase in the number of "Top 4" chain fast food outlets within 3km of home was significantly associated with an increase in BMI in older adults (aged 65+ years).

Overview of commissioned projects

Healthway provided funding for Cancer Council Western Australia (CCWA) to work in partnership with the Telethon Kids Institute to establish a **Rapid Obesity Policy Translation** program. Thanks to this program we have been able to undertake the following two research projects in collaboration with the Australian Urban Design Research Centre (AUDRC) answering a combined total of six key research questions.

Commissioned Project 1: Investigate the outdoor food advertising environment near Perth schools

Research Questions:

1. What is the volume and nature of outdoor food advertising within 500m of Perth schools?
2. Are there differences in the nature and volume of food advertising within 500m of schools between: (a) school type (i.e., primary vs secondary); (b) area-level socio-economic advantage (low versus high); (c) population density (low versus high); and (d) presence of a shopping area?

Commissioned Project 2: Research to build the evidence base for regulatory interventions to limit fast food outlet density in Perth

Research Questions:

3. What is the density of fast food outlets within 500m of all Perth schools (primary, secondary and both) and does this differ between schools located within low and high SES areas?
4. Is there a relationship between fast food outlet availability around secondary schools and the frequency of secondary school children's purchases of discretionary foods from food outlets near their school?
5. Does fast food outlet density differ by area-level disadvantage across metropolitan Perth?
6. Is the availability of fast food outlets in Perth associated with dietary intake and weight status?

Research Question 1: What is the volume and nature of outdoor food advertising within 500m of Perth schools?

What did we do?

We followed the International Network for Food and Obesity/NCDs Research, Monitoring and Action Support (INFORMAS) Protocol for outdoor advertising within school zones, which will enable intra and inter-country comparisons with our findings.

To select schools for inclusion in the study, all Perth metropolitan local government areas (LGAs) were stratified by population density (high vs low) and area-level socio-economic status (high vs low, using SEIFA), creating 4 quadrants. Four LGAs were then randomly sampled from within each quadrant (n=16 LGAs). Four schools from each of the 16 LGAs were then randomly selected. Where possible, two schools servicing primary students and two schools servicing secondary students were selected; with care taken to minimise the overlapping boundaries (see Table 1.1 for the characteristics of the sampled schools).

Table 1.1. Characteristics of the 64 Perth schools sampled

SEIFA	Density	K-12	Secondary	Primary	Total
High	High	3	4	9	16
High	Low	4	4	8	16
Low	High	2	4	10	16
Low	Low	1	7	8	16
TOTAL		10	19	35	64

For each of the 64 selected schools, a navigation map was created in ArcGIS (ESRI, version 10.5) to identify the area within a 500m radial (I.e., as the crow flies) buffer around the school boundary (see Figure 1.1). This ensured that the area surveyed for each school was the same; and was not impacted by the area of the school footprint or the connectivity of the surrounding street networks.

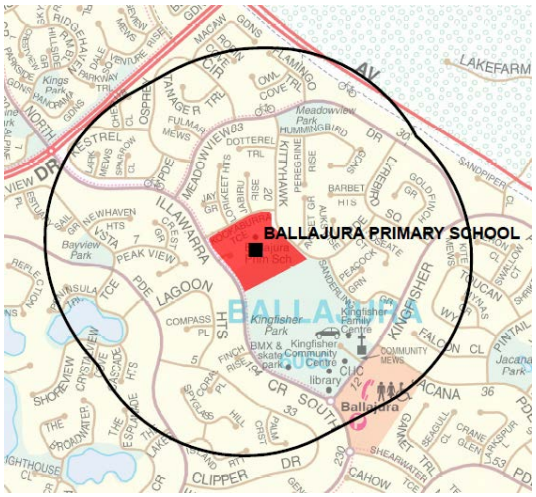


Figure 1.1. Example map showing the 500m radial buffer around the school's boundary (in red)

For each school, teams of trained Research Assistants (RAs) used the navigation maps to traverse each road within the 500m radial buffer around the school boundary on foot and/or by car. The research team worked in pairs and carried with them Samsung Galaxy Tablets loaded with a customised data collection application (ODK Collect). For each outdoor advertisement identified, the geolocation was recorded along with a digital photograph. The following advertisement characteristics were also recorded:

- Size (small ≥A4 but <1.3m x 1.9m, medium >1.3m x 1.9m but <2.0m x 2.5m or large >2.0m x 2.5m)
- Type (billboard, poster or banner, free-standing, painted building/wall, digital signs/LED, merchandising)
- Setting (within or attached to food shop, within or attached to non-food shop or business, roadside, on a building, bus shelter, train station)
- Food or non-food advertisement

Food advertisements were further coded and assigned to four major groups, using a food classification system developed to align with the INFORMAS protocol and the Australian Guide to Healthy Eating (AGTHE) food categories. This included:

- Core or healthy foods i.e., foods recommended to meet daily nutritional requirements (11 sub-categories).
- Non-core or unhealthy foods i.e., foods which are surplus to daily requirements (14 sub-categories)
- Miscellaneous food i.e., tea, coffee, spices (4 sub-categories)
- Branding only i.e., food advertisements which consist of only a business logo or brand - no actual product is advertised.

Non-food advertisements were further coded into the following categories: retail, entertainment and leisure, motor vehicles, finance, communications, travel/accommodation, media/TV/news, Government/Council.

The majority of the data collection occurred during July – December 2019.

Training and reliability

Research assistants were provided with a training manual detailing the data collection protocols and given training in how to identify, record and code each outdoor advertisement. Particular attention was given to the definition of advertising (vs. signage) and what characteristics should be captured for each advertisement. Field training was conducted, and inter-rater reliability checked. This involved the principal researcher and all research assistants traversing an identical area around a school site independently. The identified advertisements and how they were coded was then compared between the research assistants and the principal researcher ('gold standard'). The number of food advertisements identified as well as how each advertisement was coded was compared, and calculated using the formula:

$$\frac{\text{Number of agreements}}{\text{(Number of agreements + number of disagreements)}} \times 100$$

A minimum of 98% inter-rater reliability was expected. If this minimum level was not achieved, then the discrepancies were investigated and discussed, and further training was provided.

Data collection team

The data collection effort required a large team of investigators and research staff (Figure 1.2). It also provided opportunities for the research training and capacity building of six post-graduate students all of whom completed their University practicum placements by working on this project, as well as 14 undergradute student volunteers, several of whom have gone on to paid employment within the Telethon Kids Institute or enrolled in post-graduate studies to continue to pursue a career in research.

Investigators, research staff & students

Dr Gina Trapp (Project Lead)
Dr Paula Hooper (GIS/Map support)
Assoc/Prof Lukar Thornton (App support)
Joelie Mandzufas (Project Co-ordinator)
Wesley Billingham (Statistician)
Emma Charlton (Research Assistant)
Naomi Plummer (Research Assistant)
Olivia Catchick (Research Assistant)
Michaela Johnston (Research Assistant)
Amy Sievers (Practicum student)
Monica McDonald (Practicum student)
Nicole Wickens (Practicum student)
Benedetta Giuntini (Practicum student)
Smriti Sikri (Practicum student)
Harindra Vidyattilake (Practicum student)

Volunteers

Nicole Davidson
Lisa Anne Spalding
Aida Noordin
Campbell Peters
Cassie Murphy
Dylan Ferrier
Emily Chan
Jacinta Kernaghan
Kalyisah Farid
Megan Baker
Serena Louie
Isabel Dunstan
Holifiah Bahar
Hayley Caratti

Figure 1.2. The project and data collection team

What did we find?

In total, 5636 outdoor advertisements were identified within the 500m buffers of the 64 selected schools. Of these30% (n=1709) were food advertisements and 70% (n=3928) were non-food advertisements. Of the 1708 food advertisements, 74% were for unhealthy (non-core) foods. Only 8% (n=144) of the food advertisements were for healthy (core) foods, 11% (n=189) featured branding information only and 6% (n=104) were for miscellaneous foods.

The most frequently advertised foods were alcohol (24% of all food advertisements), fast food such as burgers, chips, pizza and kebabs (14% of all food advertisements) and sugar-sweetened beverages (13% of all food advertisements).

The frequency of unhealthy (non-core) advertised food products by sub-category is provided in Table 1.2.

Table 1.2. Frequency of unhealthy (non-core) advertised food products

UNHEALTHY (NON-CORE) FOOD CATEGORY	Number of food ads	% of total food ads
Alcoholic beverages	403	24%
Fast food meals (e.g., burgers, chips, pizza, fish and chips, kebabs)	242	14%
Sugar sweetened drinks (e.g., soft drinks, energy drinks, flavoured & electrolyte drinks)	215	13%
High fat/salt meals (e.g., fried foods, curry)	178	10%
Ice-cream and iced confection	123	7%
Sweet breads, cakes, muffins, biscuits, pastries	69	4%
Full cream milks/yoghurts (>3g/100g fat), cheese (>15g/100g fat) and their alternatives	61	4%
Flavoured noodles/ fried rice products	38	2%
Savoury snack food with added salt/fat including chips (crisps), coated nuts	27	2%
Chocolate and candy	27	2%
Meat and meat alternatives processed or high in salt (e.g., frankfurts, tinned meats)	20	1%
Other high fat/salt products (e.g., butter, animal fats, high fat savoury sauces)	20	1%
Sweet snack foods (e.g., jelly, sugar coated fruits/nuts, tinned fruit in syrup)	14	<1%
High sugar/low fibre breakfast cereals	4	<1%
Fruit juices less than 98% fruit	3	<1%

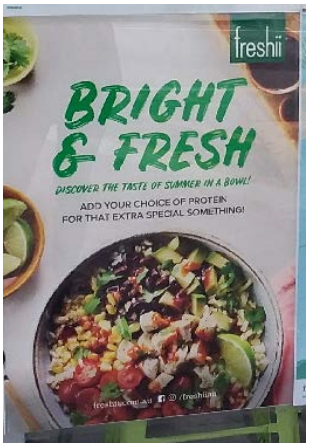
Examples of unhealthy (non-core) food advertisements that were identified are provided below.

The frequency of healthy (core) advertised food products by sub-category is provided in Table 1.3.

Table 1.3. Frequency of healthy (core) food advertisements

HEALTHY (CORE) FOOD CATEGORY	Number of food ads	% of total food ads
Low fat meals (e.g., soups, sandwiches, salads, sushi)	104	6%
Meat and meat alternatives, nuts and seeds	55	3%
Fruits and fruit juice >98% fruit	48	3%
Vegetables	45	3%
Breads, rice and rice products (nothing fried)	41	2%
Bottled water (unflavoured mineral/sodas)	10	<1%
Healthy snacks – based on core foods (fruit/veg, grain, dairy, meat, meat alternatives)	5	<1%
Low in sugar and high in fibre cereals (<20g sugar, >5g of dietary fibre per 100g)	3	<1%
Milk, yoghurt, cheese, probiotic drinks	2	<1%
Mono/ polyunsaturated fats e.g. olive oils, plant-based margarines	2	<1%
Baby foods (not formula)	0	<1%

Examples of healthy (core) food advertisements that were identified are provided below.

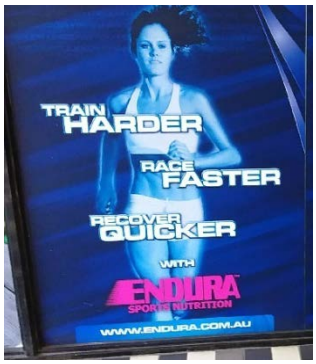


The frequency of miscellaneous food advertisements by sub-category is provided in Table 1.4.

Table 1.4. Frequency of miscellaneous food advertisements

MISCELLANAEOUS FOOD CATEGORY	Number of food ads	% of total food ads
Tea and coffee	191	11%
Vitamin / mineral /other dietary supplements, sugar free gum	32	2%
Recipe additions including soup cubes, herbs, seasonings	11	<1%
Baby formula	0	0%

Examples of miscellaneous food advertisements that were identified are provided below.



The majority of the n=1708 food advertisements featured one sub-category of food (81%, n=1387).

Three schools did not have any outdoor advertisements (food or non-food), most likely because they were located in very low population dense areas on the fringe of the metropolitan area with no shops nearby.

Other key findings:

- 75% of schools had at least one food advertisement within 500m (mean=36 food advertisements; range 3-190).
- 70% of schools had at least one unhealthy (non-core) food advertisement within 500m (mean=28 unhealthy food advertisements; range 1-136).
- 55% of schools had at least one alcohol advertisement within 500m (mean=10 alcohol advertisements; range 1-62).
- 37% of schools had at least one healthy (core) food advertisement within 500, (mean=6 healthy food advertisements; range 1-19).

Type of outdoor food advertisement

Figure 1.3 shows the count of total food ads within 500m by advertisement type. The majority of food advertisements near schools were posters/banners or free-standing ads, followed by merchandising, painted ads on buildings or walls, digital signs and billboards. This order was consistent across all school type, SES and population density. Of the food advertisements on digital signs and billboards, 70% were for alcohol.

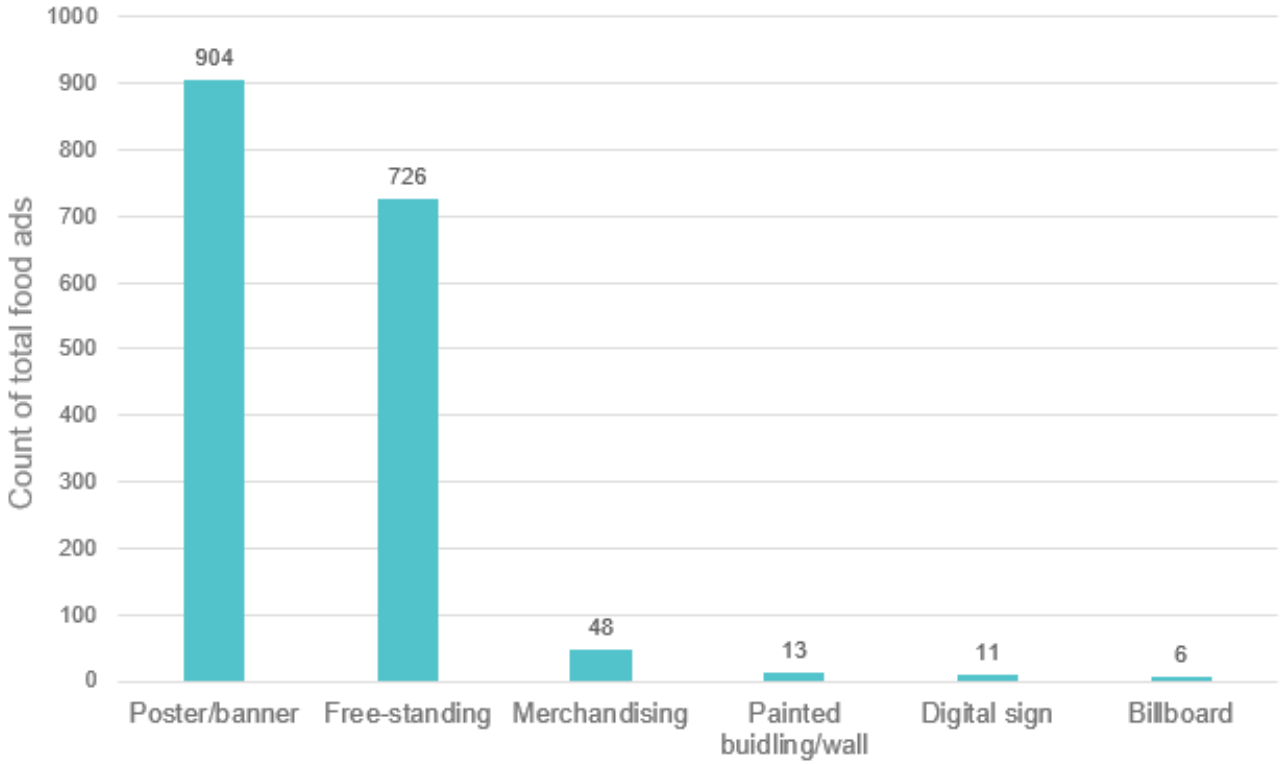


Figure 1.3. Count of total food ads within 500m by advertisement type

Size of outdoor food advertisements

Of all the food addvertisements (n=1708), the majority were small in size (n=1454), followed by medium (n=209) and large (n=45). Of the small-sized advertisements, 75% were advertising unhealthy (non-core) foods, with the most frequent food product advertised being alcohol.

Of the medium-sized advertisements, 70% were advertising unhealthy (non-core) foods, with the most frequent food product advertised being alcohol.

Of the large-sized advertisements, 66% were advertising unhealthy (non-core) foods, with the most frequent food product advertised being alcohol.

Setting of outdoor food advertisements

Figure 1.4 shows the count of food advertisements within 500m of schools by setting. The majority of food advertisements were located next to a food shop or road, followed by a non-food shop or business. There was only one train station that fell within the 500m radius of the selected schools and no food advertisements were identified.

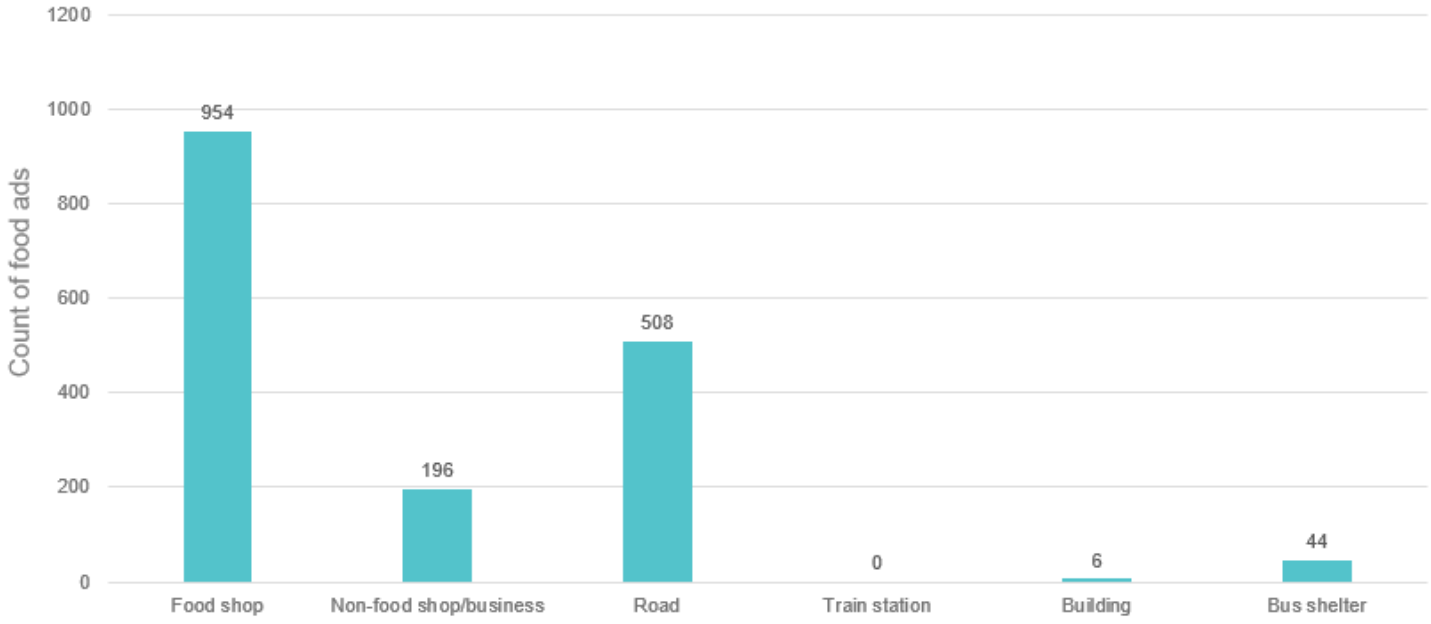


Figure 1.4. Count of total food advertisements within 500m of schools by setting.

Bus shelters

Of the 452 bus shelters identified within the study areas, 44 featured food advertising. Figure 1.5 shows the breakdown of the content of food ads appearing on these bus shelters; the majority (87%) of food advertisements on bus shelters were for unhealthy (non-core) foods or alcohol.

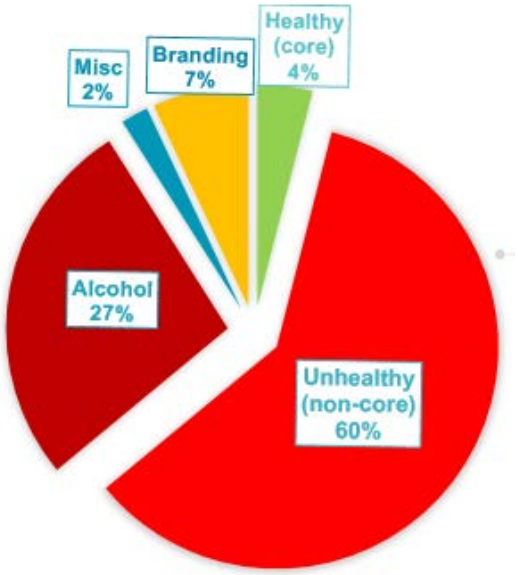


Figure 1.5. Content of food advertisements appearing on bus shelters

Some examples of food advertising on bus shelters are shown below.

Research Question 2: Are there differences in the nature and volume of food advertising within 500m of schools between: (a) school type (i.e., primary vs secondary); (b) area-level socio-economic status (low versus high); (c) population density (low versus high); and (d) presence of a shopping area?

What did we find?

Socio-economic status (SES)

Figure 2.1 shows the total number of non-food and food advertisements within 500m of schools by SES. Schools located in low SES (i.e., disadvantaged) areas had slightly more non-food and food advertisements within 500m of schools compared to high SES areas. When we looked at the proportion of food ads that were for unhealthy (non-core), healthy (core), miscellaneous or branding, we found that schools located in low SES areas had a significantly higher ratio of unhealthy (non-core) food ads to healthy food advertisements.

Other key findings:

- Compared to schools located in high SES areas, schools located in low SES areas had a significantly higher proportion of:
  - Total food ads within 250m (vs 250-500m)
  - Unhealthy food ads (excluding alcohol) within 250m (vs 250-500m)
  - Alcohol ads within 250m (vs 250-500m)

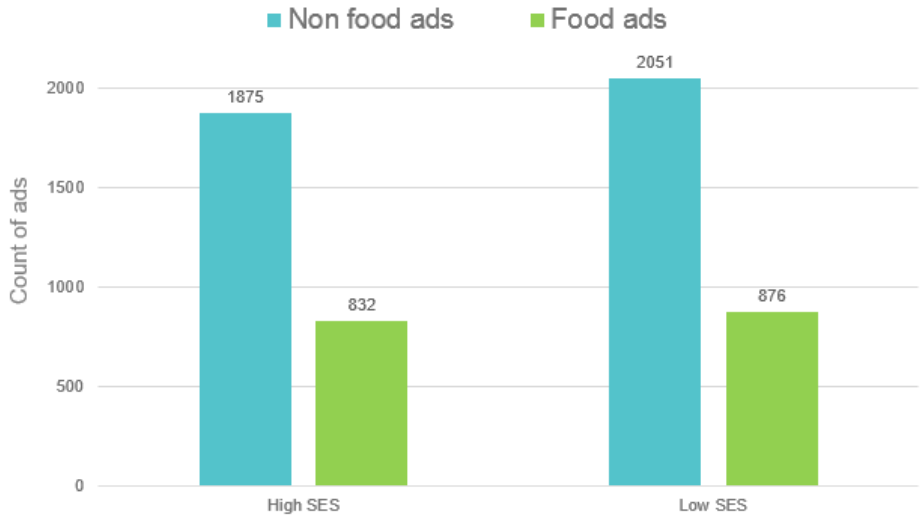


Figure 2.1. Total number of outdoor advertisements within 500m of schools by Socio-economic Status (SES)

Population density

Figure 2.2 shows the total number of outdoor advertisements within 500m of schools by population density. There were significantly more non-food and food advertisements surrounding schools located in high population dense areas than low population dense areas. However, the proportion/ratio of food advertisements to non-food advertisements was higher in low population dense areas. The content of each food advertisement (i.e., food products which were non-core, core, miscellaneous or branding only) was not significantly different between schools located within high and low population dense areas.

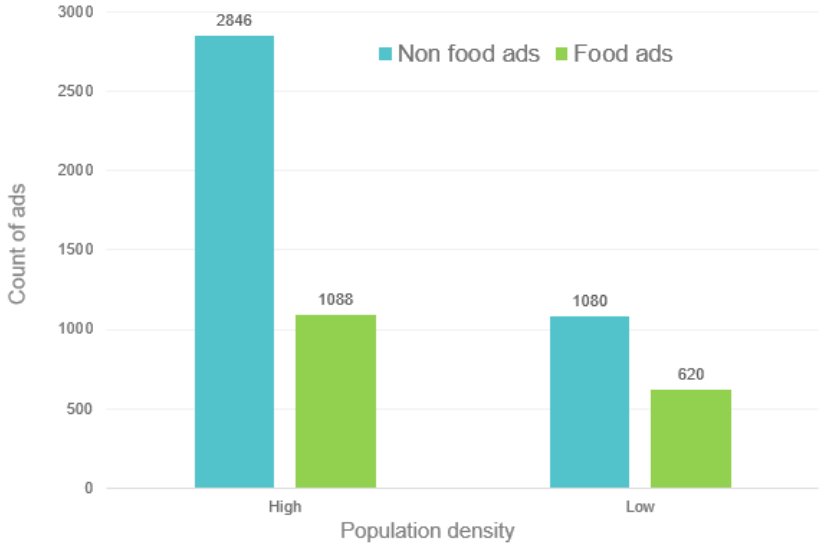


Figure 2.2. Total number of outdoor advertisements within 500m of schools by population density

School type

Figure 2.3 shows the average number of outdoor advertisements within 500m of school by school type. K-12 schools had an average of 41 outdoor food ads (range 0-116) and a significantly higher proportion of total food ads, healthy and alcohol ads within 250m. Primary schools had an average of 25 outdoor food advertisements (range 0-190) and secondary schools had an average of 22 outdoor food advertisements (range 0-94).

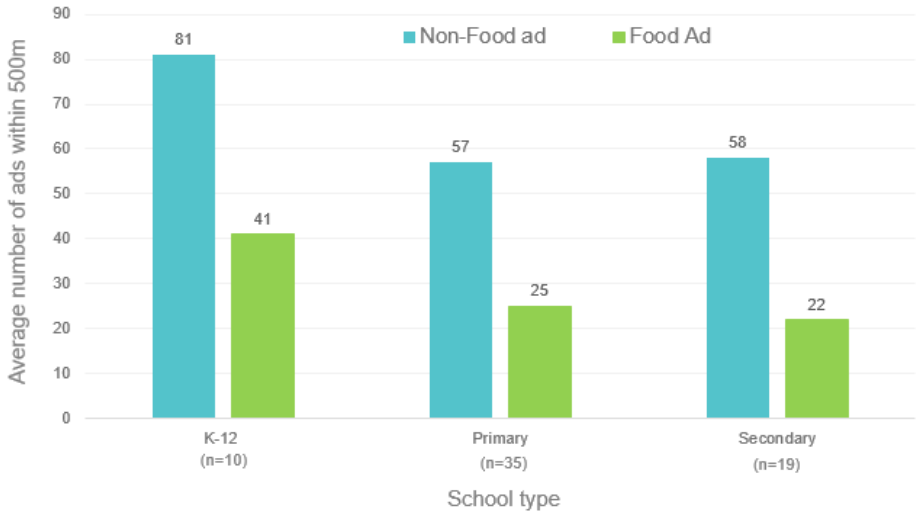


Figure 2.3. Average number of outdoor advertisements within 500m by school type

Presence of shopping area

Figure 2.4 shows the average count of outdoor advertisements within 500m of schools that had a shopping area present vs not present within this 500m radius. We found that if a shopping area was present, the average count of food advertisements present increased nine-fold.

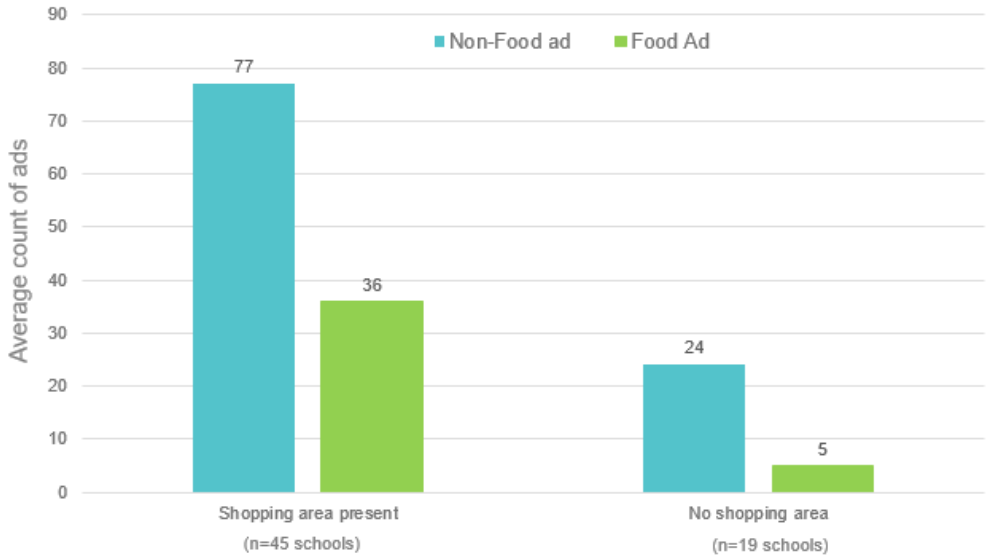


Figure 2.4. Average count of outdoor advertisements within 500m around schools stratified by whether a shopping area was present

Advertisement content and distance from the school

Figure 2.5 shows the average number of outdoor food advertisements within 500m of schools by advertisement content and distance. Across all schools, there were 622 food ads within ≤250m, compared to 1086 food ads within 250-500m.

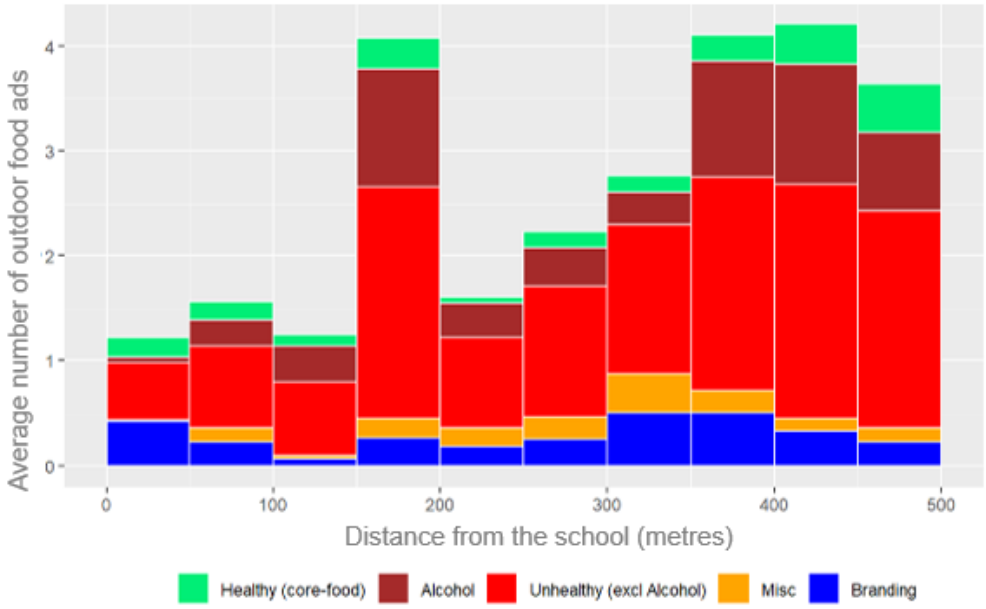


Figure 2.5. Average number of outdoor food advertisements within 500m of each school by ad content and distance

Research Question 3: What is the density of fast food outlets within 400m, 800m and 1km of all Perth schools and does this differ between school type and schools located within low and high SES areas?

What did we do?

We used data collected as part of a currently funded Healthway Exploratory Grant #32981 to answer this research question.

A listing of all schools located within the Perth metropolitan area (n=655) in 2019 was obtained from the WA Education Department. Schools were classified as primary (n=454), secondary (n=107) or K-12 (n=94) and geocoded (i.e., mapped).

In accordance with the WA Food Act 2008, all food businesses that store, prepare, handle, serve and sell food must register with their Local Government Authority. Listings of all food businesses were sourced from each Perth Local Government in 2028/19. A classification framework, developed by the research team, was applied to each food business to ensure consistent classifications of the different types of food businesses. Each food business was then geocoded (i.e., mapped).

This current project focussed on food businesses that were classified as a "fast food outlet", which was defined as a food outlet where food is ordered at the counter, served immediately and can be eaten without cutlery (e.g., burger, ice-cream, donut and pizza shops). We also created a separate sub-variable to distinguish fast food outlets which were a "Top 4" fast food chain (based on market research). These were McDonalds, KFC, Hungry Jacks and Red Rooster.

Using a Geographical Information System (GIS), measures of fast food availability within 1km of all Perth schools were generated.

Distance to the closest fast food outlet was computed by identifying the shortest path between access points on the school boundary and surrounding fast food outlets. Euclidian (radial) buffers were created from the school access points for distances of 400m, 800m and 1 km. Counts of fast food outlets and "Top 4" fast food chains within these buffers were calculated.

The socio-economic status (SES; low, medium, high) of the suburb in which each Perth metropolitan school was located was derived from the Australian Bureau of Statistics Socio-Economic Index for Areas (SEIFA).

Logistic/binomial regression was used to assess whether fast food outlet availability differed by school type (i.e., Primary, Secondary or K-12). Negative binomial or Poisson regression was used to calculate incidence rate ratios to assess whether fast food outlet and "Top 4" fast food chain availability differed by SES.

What did we find?

- On average, Perth schools had 1.8 fast food outlets within 400m, 5.7 within 800m and 8.1 within 1km (Table 3.1).

- 11% of Perth schools had at least one of the "Top 4" fast food chains (McDonalds, Hungry Jacks, KFC and Subway) within just 400m; 32% had one within 800m (Table 3.2).

- 41.1% of Perth schools had one of the "Top 4" fast food chains within 1km, and 86.5% of schools have at least 1 fast food outlet within 1km (Table 3.2).

Table 3.1. Total count and average count per school of fast food outlets and "Top 4" fast food chain outlets

		School type			
		Primary	Secondary	K-12	All schools combined
	Euclidian buffer distance from school boundary	Total count of fast food outlets (average per school)	Total count of fast food outlets (average per school)	Total count of fast food outlets (average per school)	Total count of fast food outlets (average per school)
Fast food outlets	**400m**	724 (1.6)	317 (3)	159 (1.7)	1200 (1.8)
	800m	2282 (5)	982 (9.2)	480 (5.1)	3744 (5.7)
	1km	3261 (7.2)	1351 (12.6)	670 (7.1)	5282 (8.1)
"Top 4" fast food chain	**400m**	71 (0.2)	30 (0.3)	12 (0.1)	113 (0.2)
	800m	242 (0.5)	82 (0.8)	42 (0.4)	366 (0.6)
	1km	287 (0.6)	99 (0.9)	44 (0.5)	430 (0.7)

Table 3.2 Distance from the school to the closest fast food outlet and "Top 4" fast food chain, stratified by school type

Distance from school to closest fast food outlet	School type			
	Count of Primary schools (proportion of primary schools)	Count of Secondary schools (proportion of secondary schools)	Count of K-12 schools (proportion of K-12)	All schools combined n (%)
0-100m	50 (11.0%)	15 (14.0%)	12 (12.8%)	77 (11.8%)
100-200m	53 (11.7%)	11 (10.3%)	15 (16.0%)	79 (12.1%)
200-400m	94 (20.7%)	26 (24.3%)	13 (13.8%)	133 (20.3%)
400-800m	152 (33.5%)	40 (37.4%)	24 (25.5%)	216 (33.0%)
800m-1km	37 (8.1%)	12 (11.2%)	12 (12.8%)	61 (9.3%)
Distance from school to closest "Top 4" fast food chain				
0-100m	4 (0.9%)	2 (1.9%)	2 (2.1%)	8 (1.2%)
100-200m	10 (2.2%)	4 (3.7%)	3 (3.2%)	17 (2.6%)
200-400m	31 (6.8%)	9 (8.4%)	5 (5.3%)	45 (6.9%)
400-800m	96 (21.1%)	28 (26.2%)	17 (18.1%)	141 (21.5%)
800m-1km	39 (8.6%)	12 (11.2%)	7 (7.4%)	58 (8.9%)

School type

Table 3.3 shows the number (count) and odds ratios of schools that had at least one fast food/"Top 4 outlet by school type:

- Secondary schools were significantly more likely than K-12 schools to have a least one fast food outlet within 800m.
- Secondary schools were significantly more likely than both Primary and K-12 schools to have a least one fast food outlet within 1km.
- Secondary schools were significantly more likely than K-12 schools and primary schools to have at least one top 4 fast food chain (McDonalds, Hungry Jacks, KFC and Subway) within 1km.

Table 3.3. School counts and odds ratios of having at least one food outlet by school type

	At Least one Outlet by School Type						
		School Count (Percent)			Odds Ratio (Std Error)		
	Distance	**Primary n (%)**	**K-12 n (%)**	**Secondary n (%)**	**Primary relative to K-12**	**Primary relative to Secondary**	**K-12 relative to Secondary**
Fast food outlet	400m	199 (43.8%)	40 (42.6%)	52 (48.6%)	0.05 (0.23)	-0.19 (0.22)	-0.24 (0.28)
	800m	352 (77.5%)	64 (68.1%)	92 (86.0%)	0.48 (0.25)	-0.58 (0.30)	**-1.06 (0.36) ****
	1km	389 (85.7%)	76 (80.9%)	104 (97.2%)	0.35 (0.29)	**-1.76 (0.60) ****	**-2.11 (0.64) ****
"Top 4" fast food chain	400m	46 (10.1%)	10 (10.6%)	15 (14.0%)	-0.05 (0.37)	-0.37 (0.32)	-0.31 (0.44)
	800m	142 (31.3%)	27 (28.7%)	43 (40.2%)	0.12 (0.25)	-0.39 (0.22)	-0.51 (0.30)
	1km	179 (39.4%)	34 (36.2%)	55 (51.4%)	0.14 (0.24)	**-0.49 (0.22) ***	**-0.62 (0.29) ***

P values: * = 0.05 ** = 0.01 *** = 0.001

Socio-economic status

The SEIFA Index of Relative Socio-Economic Disadvantage were downloaded for suburbs from the ABS website. This indices ranks areas on a continuum from most disadvantaged to least disadvantaged. A low decile / score on this index indicates a high proportion of relatively disadvantaged people in an area (e.g., low SES = many people with no qualifications or low skilled occupations, less car ownership; whilst a higher decile / score indicates a relative lack of disadvantage, e.g., few people with no qualifications or low skilled occupations, greater car ownership).

There were 174 schools located in low SES areas (i.e., SEIFA deciles 1-3), 227 schools located in medium SES areas (SEIFA deciles 4-7) and 254 schools located in high SES areas (SEIFA deciles 8-10).

Table 3.4 shows the food outlet count and differences in the rate of food outlets near schools by SES:

- Schools located in low SES areas had a significantly *higher* frequency of fast food outlets within 400m than schools located in high SES areas.
- Schools located in medium SES areas had a significantly *higher* frequency of fast food outlets within 400m and 1km than schools located in high SES areas.
- Schools located in low SES areas had a significantly *higher* frequency of "Top 4" chain outlets within 400m and 1km than schools located in high SES schools.
- Schools located in medium SES areas had a significantly *higher* frequency of "Top 4" chain outlets within 400m, 800m and 1km than High SES schools.

Table 3.4. Food outlet count and differences in the rate of food outlets near schools by SES

		Differences in Rate of Food Outlet by SES					
		Count (Average)			Incident Rate Ratio (Negative Binomial)		
	Distance	**Low SES**	**Medium SES**	**High SES**	**Medium SES relative to low**	**Low SES relative to high**	**Medium SES relative to high**
Fast Food Outlets	400m	276 (1.6)	512 (2.3)	412 (1.6)	1.09 (0.84-1.42)	**1.32 (1.02-1.71)***	**1.44 (1.14-1.83)****
	800m	1060 (6.1)	1505 (6.7)	1171 (4.6)	1.43 (0.96-2.13)	0.98 (0.66-1.45)	1.40 (0.97-2.00)
	1km	1406 (8.1)	2086 (9.2)	1769 (7.0)	1.14 (0.91-1.43)	1.16 (0.93-1.44)	**1.33 (1.08-1.62)****
"Top 4" Fast Food	400m	28 (0.2)	56 (0.2)	29 (0.1)	0.93 (0.67-1.31)	**1.86 (1.30-2.65)*****	**1.73 (1.24-2.42)****
	800m	122 (0.7)	148 (0.7)	96 (0.4)	1.54 (0.79-2.99)	**1.41 (0.70-2.85)**	**2.17 (1.16-4.07)***
	1km	137 (0.8)	171 (0.8)	122 (0.5)	0.96 (0.73-1.26)	**1.64 (1.23-2.18)*****	**1.58 (1.20-2.07)****

* = p<0.05 ** = p<0.01 *** = p<0.001

Research Question 4: Is there a relationship between fast food outlet availability near secondary schools and the frequency of discretionary food purchases?

What did we do?

We used data from the 'Amped Up: an Energy Drink Study' which surveyed 2389 adolescents in years 7-12 in 2017/18 attending 17 Perth metropolitan secondary schools. Participants were asked, "How often do you purchase snacks (e.g. soft drinks, energy drinks, cakes/biscuits, chocolate, crisps/chips, hot chips, burgers, sausage rolls, pies) from food outlets near your school?". Response options included, 'never', 'monthly or less', 'weekly', 'everyday'. This individual-level behavioural data was then linked to measures of the food environment near the students' school. This included a count of the following food outlets within a 1km Euclidian buffer of the school boundary:

- **Fast food outlets;** defined as a food outlet where food is ordered at the counter, served immediately and can be eaten without cutlery such as burgers, ice-cream, donuts, pizza etc.
- **Top 4 fast food chains** based on market research; McDonalds, KFC, Hungry Jacks and Red Rooster.
- **Supermarkets;** defined as a food outlet mainly engaged in the sale of groceries (fresh foods, canned and packaged foods, dry foods, dry goods).
- **Convenience stores;** including petrol station shops, milk bars/corner stores/deli
- **Other snack/beverage stores;** including cafes/coffee shops, confectionary shops, bakeries/cake/pastry shops.
- **Fruit and vegetable stores;** including supermarkets, fruit and vegetable stores/greengrocers and markets

A mixed effects model was used to analyse the effect of outlet count within 1km of school on the food purchasing habits of students. Gender, age, and socio-economic status were covariates, and the school was treated as a random effect to control for within-school variation.

What did we find?

The proportion of students who 'never' purchased discretionary foods from food outlets near their school was 14% (n=333), compared with 41% (n=284) 'monthly or less', 40% (n=955) 'weekly' and 5% (n=117) 'everyday' (Figure 4.1).

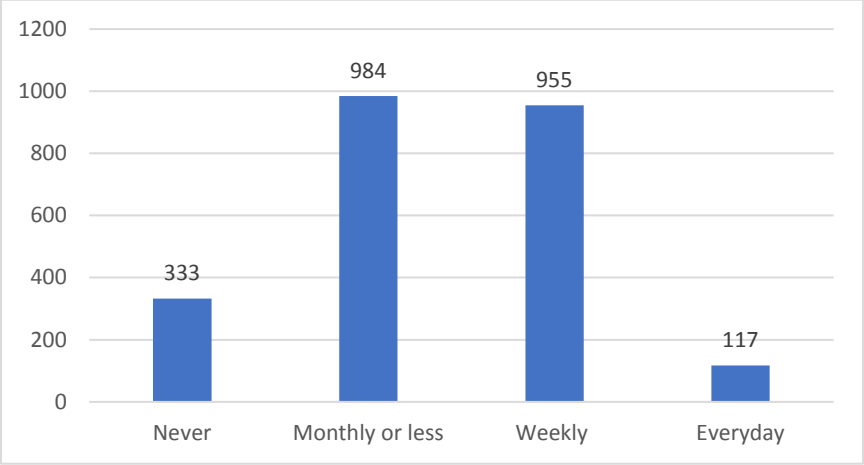


Figure 4.1. Frequency of discretionary food purchases from food outlets near school

For every additional "Top 4" fast food chain (McDonalds, KFC, Hungry Jacks, Red Rooster) within 400m 800m and 1km of a school, the frequency level (i.e., 1: Never, 2: Monthly or Less 3: Weekly 4: Daily) of student food purchasing from a food outlet near their school increased by 26%, 14% and 17%, respectively (Table 4.1).

The count of fast food outlets, supermarkets, convenience stores, other snack/beverage stores and fruit and vegetable outlets within 400m, 800m or 1km of schools were not found to be significantly associated with the frequency of student food purchasing from a food outlet near their school (Table 4.1).

Table 4.1. Density (count) of food outlets by type within 1km of schools on the frequency of discretionary food purchases from food outlets near school

Outlet density (count)	OR (95%CI)	Significance
Within 400m of school		
Fast food outlets	1.03 (0.97, 1.03)	0.396
Top 4 fast food chains	**1.26 (1.05, 1.53)**	**0.015***
Supermarkets	1.07 (0.83, 1.39)	0.579
Convenience stores	0.96 (0.73, 1.26)	0.788
Other snack/beverage stores	0.99 (0.97, 1.00)	0.179
Fruit and Vegetable outlets	1.13 (0.92, 1.39)	0.239
Within 800m of school		
Fast food outlets	1.00 (0.98, 1.01)	0.818
Top 4 fast food chains	**1.14 (1.01, 1.28)**	**0.033***
Supermarkets	1.09 (0.95, 1.26)	0.198
Convenience stores	0.99 (0.84, 1.17)	0.937
Other snack/beverage stores	1.00 (0.99, 1.00)	0.314
Fruit and Vegetable outlets	1.10 (0.98, 1.24)	0.102
Within 1km of school		
Fast food outlets	1.00 (0.99, 1.02)	0.896
Top 4 fast food chains	**1.17 (1.02, 1.34)**	**0.025***
Supermarkets	1.07 (0.96, 1.19)	0.218
Convenience stores	0.95 (0.85, 1.06)	0.379
Other snack/beverage stores	1.00 (0.99, 1.01)	0.419
Fruit and Vegetable outlets	1.03 (0.98, 1.09)	0.267

* = $p<0.05$

Research Question 5: Does fast food outlet density differ by area-level disadvantage in metropolitan Perth?

What did we do?

We used an ecological cross-sectional design to investigate the association between area-level disadvantage, and access to fast food outlets in the Perth metropolitan area. All suburbs that fell within the metropolitan region (n=328) were allocated a decile ranking based on the Australian Bureau of Statistics (ABS) Socio-Economic Index for Areas (SEIFA). Decile 1 (i.e. a low score) indicates suburbs with relatively greater disadvantage (e.g. many people with no qualifications or low skilled occupations, less car ownership), whereas decile 10 indicates a relative lack of disadvantage (e.g. few people with no qualifications or low skilled occupations, greater car ownership). The area in square kilometres of each suburb and population was also obtained from the ABS.

Data collected as part of a currently funded Healthway Exploratory Grant #32981 was used to identify the location of all fast food outlets (sourced from each Perth Local Government in 2018/19) defined as food outlets where food is ordered at the counter, served immediately and can be eaten without cutlery (e.g., burger, ice-cream, donut and pizza shops). We also created a sub-variable of the "Top 4" fast food chains based on market research; i.e., McDonalds, KFC, Hungry Jacks and Red Rooster.

Means and standard deviations were calculated for fast food outlet and "Top 4" fast food chain densities within each suburb by area disadvantage decile based on counts.

A zero-inflated negative binomial regression model (chosen due to its goodness of fit) examined whether area disadvantage decile was associated with the count of fast food outlets/"Top 4" fast food chains within the suburbs. To ensure that any trends observed with area socio-economic disadvantage were independent of the population structure and area of the suburb, analyses adjusted for these variables.

What did we find?

Table 5.1 shows the distribution of all suburbs across Perth (n=328) from each area-level disadvantage decile, with decile 1 indicating greater disadvantage and decile 10 indicating a relative lack of disadvantage and the mean count of fast food outlets and "Top 4" fast food chain outlets in Perth suburbs by area-level disadvantage decile.

Table 5.1. Mean count of fast food outlets and Top 4 chain bran fast food outlets in Perth suburbs by area-level disadvantage decile

SEIFA Decile	Number of suburbs	Mean (SD) count of Fast food outlets	Mean (SD) count of Top 4 Fast food chain outlets
1	27	10.81 (14.58)	1.15 (1.63)
2	26	8.00 (11.59)	0.96 (1.64)
3	32	5.69 (5.81)	0.50 (0.98)
4	31	7.77 (8.68)	1.19 (1.62)
5	15	8.93 (17.94)	0.27 (0.46)
6	35	6.57 (11.89)	0.77 (1.24)
7	27	10.74 (25.25)	0.89 (1.80)
8	41	7.07 (10.80)	0.46 (0.90)
9	34	5.44 (5.90)	0.32 (0.59)
10	60	4.38 (7.56)	0.43 (0.83)

SD=standard deviation

We found evidence of an association between area-level disadvantage and access to fast food outlets and "Top 4" fast food chain outlets in the Perth metropolitan area (Table 5.2). Specifically:

- The density (count) of fast food outlets decreases by 6% for each increase in area-level disadvantage decile ($p < 0.01$).
- The density (count) of "Top 4" fast food chain outlets decreases by 10% for each increase in area-level disadvantage decile ($p < 0.001$).

Thus the density (count) of fast food outlets and "Top 4" fast food chain outlets was greater in areas with more relative disadvantage.

Table 5.2. Zero-inflated negative binomial regression results of the association between area-level disadvantage and access to fast food outlets and Top 4 chain brand fast food outlets in the Perth metropolitan area

	Incident Rate Ratio (count)	p-value (count)	Odds (excess zeros)	p-value (excess zeros)
Fast Food outlets	0.94 (0.89-0.98)	0.0085	0.18	<0.001
Top 4 chain brand fast food outlets	0.90 (0.85-0.95)	0.0002	0.11	<0.001

Research question 6: Is the availability of fast food outlets in Perth associated with dietary intake and weight status?

What did we do?

We were granted ethical clearance to use the WA Department of Health's 2016/17 Health and Wellbeing Surveillance System (HWSS) data, which included the geocoded home addresses of 6500 Perth residents as well as measures of their dietary intake and Body Mass Index (BMI, based on self or parent-reported height and weight).

Using a GIS, we linked our 2018/2019 food outlet location GIS data layer created as part of a currently funded Healthway Exploratory Grant #32981 to this HWSS data. For each HWSS participant, we generated measures of fast food and "Top 4" fast food chain availability within 800m and 3km of their home address and examined the association between this availability and dietary intake/BMI in different age groups using ordinal regression and adjusting for age, sex, socio-economic disadvantage, education and employment status.

Dietary intake outcome variables:

Daily vegetable intake: Participants aged <16 years were asked: How many serves of vegetables does [CHILD] usually eat each day? A serve of vegetables is equal to half a cup of cooked vegetables or 1 cup of salad. Data represent the number of daily serves.

Participants 16+ years were asked: How many serves of vegetables do you usually eat each day? A serve of vegetables is equal to half a cup of cooked vegetables or 1 cup of salad. Responses were coded as: 0 Doesn't eat vegetables; 1 Eats vegetables less than daily; 2 Eats one to two serves of vegetables daily; 3 Eats three to four serves of vegetables daily; 4 Eats five or more serves of vegetables daily

Daily fruit intake: How many serves of fruit does [CHILD] usually eat each day? A serve of fruit is equal to one medium piece, two small pieces of fruit or one cup of diced fruit. Data represent the number of daily serves.

Participants 16+ years were asked: How many serves of fruit do you usually eat each day? A serve of fruit is equal to one medium piece, two small pieces of fruit or one cup of diced fruit. Responses were coded as: 0 Doesn't eat fruit; 1 Eats fruit less than daily; 2 Eats one serve of fruit daily; 3 Eats two or more serves of fruit daily.

Weekly fast food intake: How many times a week on average, do you have meals or snacks such as burgers, pizza, chicken or chips from places like McDonalds, Hungry Jacks, Pizza Hut or Red Rooster? Data represent the number of times per week.

Weekly takeaway intake: Usual number of times takeaway is eaten each week. Response options were coded as 0 Never; 0.5 Less than once a week; 1 Once or twice a week; 2 Three or four times a week; 3 five or more times a week.

What did we find?

- We did not find evidence of a relationship between the availability of fast food outlets or "Top 4" chain fast food outlets near home and dietary intake or BMI in children aged ≤12 years or adolescents aged 13-17 years (Table 6.1 and 6.2).
- There was some evidence for a relationship between the availability fast food outlets and "Top 4" chain fast food outlets near home and vegetable intake in adults and older adults:

- For adults (aged 25-64 years), an increase in the number of “Top 4” chain fast food outlets within 800m or 3km of home or having at last one “Top 4” chain fast food outlet present within 800m of home was significantly associated with a reduction in daily vegetable intake frequency (Table 6.4).
- For older adults (aged 65+ years), an increase in the number of “Top 4” chain fast food outlets within 800m or 3km of home or having at last one fast food outlet present within 1600m of home was significantly associated with a reduction in daily vegetable intake frequency (Table 6.5).

- The only significant association between the availability of fast food outlets and “Top 4” chain fast food outlets near home and BMI was for older adults (aged 65+ years) whereby an increase in the number of “Top 4” chain fast food outlets within 3km of home was significantly associated with an increase in BMI (Table 6.5).
- Some significant relationships were identified that went in the unexpected direction:
  - For young adults aged 18-24 years, having a fast food outlet within 800m of home was significantly associated with a reduction in weekly takeaway intake (Table 6.3).
  - For adults aged 25-64 years, an increase in the number of fast food outlets within 3km of home or having at last one fast food outlet present within 800m or 3km of home was significantly associated with an increase in fruit intake frequency (Table 6.4). Furthermore, having at least one fast food outlet within 800m of home was significantly associated with a decrease in weekly takeaway intake (Table 6.4).

Table 6.1. Regression results showing the relationship between fast food outlet availability and dietary intake and BMI in children aged 1-12 years.

Children aged ≤12 years (n=445)					
	Ordinal Regression (Odds Ratios)				Linear Regression
	Daily fruit intake	Daily Vegetable intake	Weekly fast food intake	Weekly takeaway intake	BMI
Distance to Closest Store					
Fast Food outlet	1.088 (0.988 to 1.186), p=0.072	0.992 (0.916 to 1.076), p=0.842	1 (0.925 to 1.078), p=0.997	1.005 (0.929 to 1.09), p=0.897	0.155 (-0.045 to 0.354), p=0.128
Top 4 chain outlet	1.018 (0.963 to 1.075), p=0.531	1.009 (0.965 to 1.056), p=0.708	0.987 (0.945 to 1.028), p=0.54	0.989 (0.946 to 1.031), p=0.599	0.061 (-0.048 to 0.169), p=0.272
Count of Store within 800m					
Fast Food outlet	1.011 (0.942 to 1.084), p=0.763	1.022 (0.954 to 1.095), p=0.526	0.952 (0.886 to 1.02), p=0.167	0.952 (0.885 to 1.022), p=0.173	-0.043 (-0.202 to 0.116), p=0.595
Top 4 chain outlet	1.078 (0.589 to 1.966), p=0.805	1.386 (0.664 to 2.795), p=0.376	0.845 (0.461 to 1.53), p=0.577	0.825 (0.45 to 1.492), p=0.523	0.422 (-0.986 to 1.829), p=0.556
Count of Store within 3000m					
Fast Food outlet	0.996 (0.987 to 1.006), p=0.44	0.999 (0.99 to 1.008), p=0.833	0.996 (0.987 to 1.005), p=0.363	0.995 (0.986 to 1.004), p=0.319	-0.01 (-0.03 to 0.009), p=0.306
Top 4 chain outlet	0.989 (0.898 to 1.088), p=0.815	0.94 (0.855 to 1.034), p=0.204	1.043 (0.95 to 1.145), p=0.376	1.051 (0.956 to 1.156), p=0.301	-0.01 (-0.223 to 0.203), p=0.925
At Least One within 800m					
Fast Food outlet	1.154 (0.802 to 1.663), p=0.44	1.152 (0.805 to 1.649), p=0.439	0.824 (0.576 to 1.178), p=0.29	0.809 (0.564 to 1.16), p=0.25	-0.205 (-1.029 to 0.618), p=0.624
Top 4 chain outlet	1.065 (0.495 to 2.289), p=0.872	1.19 (0.526 to 2.663), p=0.673	0.784 (0.359 to 1.699), p=0.537	0.754 (0.346 to 1.632), p=0.472	0.997 (-0.861 to 2.854), p=0.292
At Least One within 3000m					
Fast Food outlet	1.135 (0.526 to 2.447), p=0.745	1.087 (0.523 to 2.26), p=0.823	1.408 (0.643 to 3.123), p=0.393	1.399 (0.632 to 3.116), p=0.406	-0.491 (-2.345 to 1.362), p=0.602
Top 4 chain outlet	1.272 (0.831 to 1.948), p=0.268	0.823 (0.542 to 1.249), p=0.36	1.087 (0.716 to 1.651), p=0.696	1.069 (0.7 to 1.633), p=0.757	-0.221 (-1.188 to 0.745), p=0.653

Table 6.2. Regression results showing the relationship between fast food outlet availability and dietary intake and BMI in adolescents aged 13-17 years.

Adolescents aged 13-17 years (n=180)					
	Ordinal Regression (Odds Ratios)				Linear Regression
	Daily fruit intake	Daily Vegetable intake	Weekly fast food intake	Weekly takeaway intake	BMI
Distance to Closest Store					
Fast Food outlet	0.939 (0.849 to 1.031), p=0.205	0.961 (0.886 to 1.056), p=0.359	0.979 (0.904 to 1.067), p=0.608	0.982 (0.905 to 1.072), p=0.651	-0.11 (-0.305 to 0.086), p=0.269
Top 4 chain outlet	0.963 (0.914 to 1.013), p=0.152	0.993 (0.946 to 1.051), p=0.789	0.994 (0.951 to 1.044), p=0.804	1 (0.955 to 1.055), p=0.993	-0.085 (-0.195 to 0.024), p=0.126
Count of Store within 800m					
Fast Food outlet	1.101 (0.99 to 1.219), p=0.069	0.98 (0.887 to 1.076), p=0.682	1.001 (0.907 to 1.11), p=0.982	1.008 (0.91 to 1.13), p=0.879	-0.033 (-0.247 to 0.181), p=0.762
Top 4 chain outlet	1.147 (0.514 to 2.522), p=0.733	0.643 (0.304 to 1.337), p=0.235	1.018 (0.464 to 2.217), p=0.964	1.057 (0.46 to 2.543), p=0.898	-0.534 (-2.282 to 1.214), p=0.547
Count of Store within 3000m					
Fast Food outlet	1.009 (0.993 to 1.025), p=0.291	0.985 (0.969 to 1.002), p=0.077	0.988 (0.972 to 1.005), p=0.17	0.987 (0.97 to 1.004), p=0.134	-0.016 (-0.053 to 0.02), p=0.385
Top 4 chain outlet	0.999 (0.854 to 1.169), p=0.987	0.89 (0.757 to 1.045), p=0.156	0.984 (0.838 to 1.155), p=0.844	0.966 (0.818 to 1.141), p=0.686	-0.044 (-0.403 to 0.315), p=0.807
At Least One within 800m					
Fast Food outlet	1.65 (0.925 to 2.962), p=0.091	0.696 (0.39 to 1.234), p=0.216	0.975 (0.542 to 1.756), p=0.933	1.048 (0.567 to 1.957), p=0.881	-0.349 (-1.657 to 0.959), p=0.599
Top 4 chain outlet	1.069 (0.365 to 3.091), p=0.902	0.546 (0.199 to 1.487), p=0.236	1.091 (0.405 to 2.948), p=0.863	1.081 (0.389 to 3.172), p=0.882	-0.593 (-2.961 to 1.776), p=0.622
At Least One within 3000m					
Fast Food outlet	2.165 (0.778 to 6.133), p=0.140	1.043 (0.393 to 2.77), p=0.932	0.871 (0.323 to 2.337), p=0.784	0.735 (0.237 to 2.112), p=0.576	1.065 (-1.341 to 3.472), p=0.383
Top 4 chain outlet	0.986 (0.536 to 1.811), p=0.963	0.679 (0.37 to 1.242), p=0.209	0.819 (0.447 to 1.492), p=0.515	0.757 (0.397 to 1.422), p=0.391	0.79 (-0.603 to 2.182), p=0.264

Table 6.3. Regression results showing the relationship between fast food outlet availability and dietary intake and BMI in young adults aged 18-24 years.

	Young Adults aged 18-24 years (n=225)			
	Ordinal Regression (Odds Ratios)			Linear Regression
	Daily Vegetable intake	Daily fruit intake	Weekly takeaway intake	BMI
Distance to Closest Store				
Fast Food outlet	0.845 (0.614 to 1.142), p=0.286	0.933 (0.719 to 1.216), p=0.604	1.222 (0.908 to 1.649), p=0.188	-0.495 (-1.307 to 0.317), p=0.231
Top 4 chain outlet	0.878 (0.687 to 1.107), p=0.28	0.882 (0.705 to 1.097), p=0.263	0.879 (0.707 to 1.094), p=0.244	-0.354 (-0.966 to 0.257), p=0.255
Count of Store within 800m				
Fast Food outlet	1.046 (0.989 to 1.116), p=0.115	1.081 (0.995 to 1.229), p=0.159	0.986 (0.919 to 1.049), p=0.662	0.08 (-0.102 to 0.262), p=0.389
Top 4 chain outlet	0.557 (0.229 to 1.26), p=0.186	2.677 (1.087 to 9.064), p=0.061	0.828 (0.407 to 1.675), p=0.589	1.506 (-0.63 to 3.643), p=0.166
Count of Store within 1600m				
Fast Food outlet	1.028 (1.003 to 1.055), p=0.026*	1.02 (0.994 to 1.052), p=0.168	1.003 (0.98 to 1.027), p=0.779	0.018 (-0.053 to 0.088), p=0.622
Top 4 chain outlet	1.053 (0.817 to 1.348), p=0.685	1.15 (0.9 to 1.482), p=0.268	1.108 (0.882 to 1.397), p=0.383	0.538 (-0.149 to 1.225), p=0.124
Count of Store within 3000m				
Fast Food outlet	0.999 (0.984 to 1.013), p=0.87	1.001 (0.987 to 1.016), p=0.881	1.003 (0.989 to 1.017), p=0.658	0.002 (-0.039 to 0.043), p=0.926
Top 4 chain outlet	0.95 (0.828 to 1.087), p=0.456	0.98 (0.863 to 1.113), p=0.758	1.017 (0.895 to 1.157), p=0.796	0.228 (-0.152 to 0.607), p=0.238
At Least One within 800m				
Fast Food outlet	1.334 (0.775 to 2.289), p=0.295	1.141 (0.684 to 1.913), p=0.614	**0.435 (0.257 to 0.73), p=0.002****	1.057 (-0.457 to 2.57), p=0.170
Top 4 chain outlet	0.53 (0.145 to 1.7), p=0.307	2.809 (0.905 to 10.563), p=0.091	0.805 (0.264 to 2.472), p=0.7	1.356 (-1.813 to 4.525), p=0.400
At Least One within 1600m				
Fast Food outlet	1.308 (0.669 to 2.635), p=0.44	0.886 (0.47 to 1.648), p=0.704	0.915 (0.47 to 1.766), p=0.792	1.238 (-0.662 to 3.138), p=0.200
Top 4 chain outlet	1.235 (0.71 to 2.136), p=0.452	1.336 (0.787 to 2.283), p=0.286	1.293 (0.765 to 2.199), p=0.34	0.477 (-1.078 to 2.032), p=0.546
At Least One within 3000m				
Fast Food outlet	1.023 (0.599 to 1.758), p=0.933	1.17 (0.706 to 1.939), p=0.541	1.127 (0.678 to 1.872), p=0.645	0.886 (-0.628 to 2.399), p=0.250
Top 4 chain outlet	0.932 (0.421 to 2.134), p=0.864	0.698 (0.316 to 1.493), p=0.361	2.112 (0.963 to 4.654), p=0.062	0.883 (-1.384 to 3.151), p=0.443

Table 6.4. Regression results showing the relationship between fast food outlet availability and dietary intake and BMI in adults aged 25-64 years.

	Adults aged 25-64 years (n=2097)			
	Ordinal Regression (Odds Ratios)			Linear Regression
	Daily Vegetable intake	Daily fruit intake	Weekly takeaway intake	BMI
Distance to Closest Store				
Fast Food outlet	0.967 (0.899 to 1.039), p=0.363	0.962 (0.897 to 1.033), p=0.286	1.009 (0.941 to 1.082), p=0.793	0.123 (-0.094 to 0.339), p=0.267
Top 4 chain outlet	1.033 (0.969 to 1.101), p=0.314	1.028 (0.963 to 1.097), p=0.409	1.007 (0.945 to 1.072), p=0.83	0.017 (-0.181 to 0.216), p=0.864
Count of Store within 800m				
Fast Food outlet	0.996 (0.966 to 1.026), p=0.812	1.009 (0.982 to 1.037), p=0.536	1.006 (0.981 to 1.032), p=0.625	-0.033 (-0.116 to 0.05), p=0.435
Top 4 chain outlet	**0.793 (0.655 to 0.956), p=0.016***	0.888 (0.747 to 1.059), p=0.182	1.109 (0.932 to 1.318), p=0.24	-0.205 (-0.757 to 0.348), p=0.467
Count of Store within 1600m				
Fast Food outlet	1.002 (0.993 to 1.011), p=0.728	1.007 (0.998 to 1.016), p=0.137	0.994 (0.986 to 1.003), p=0.21	-0.024 (-0.051 to 0.003), p=0.085
Top 4 chain outlet	0.967 (0.894 to 1.046), p=0.406	0.989 (0.918 to 1.067), p=0.781	0.997 (0.924 to 1.075), p=0.936	-0.037 (-0.273 to 0.198), p=0.755
Count of Store within 3000m				
Fast Food outlet	0.999 (0.995 to 1.002), p=0.508	**1.005 (1.002 to 1.009), p=0.004****	1 (0.996 to 1.003), p=0.899	-0.007 (-0.018 to 0.003), p=0.16
Top 4 chain outlet	**0.956 (0.92 to 0.993), p=0.02***	0.999 (0.962 to 1.037), p=0.946	1.017 (0.979 to 1.056), p=0.384	-0.021 (-0.138 to 0.097), p=0.73
At Least One within 800m				
Fast Food outlet	1.065 (0.899 to 1.263), p=0.467	**1.197 (1.011 to 1.419), p=0.037***	**0.818 (0.69 to 0.968), p=0.02***	-0.516 (-1.039 to 0.006), p=0.053
Top 4 chain outlet	**0.655 (0.475 to 0.899), p=0.009****	0.762 (0.565 to 1.031), p=0.076	1.128 (0.828 to 1.532), p=0.442	-0.631 (-1.573 to 0.31), p=0.189
At Least One within 1600m				
Fast Food outlet	1.036 (0.852 to 1.26), p=0.724	1.077 (0.884 to 1.309), p=0.46	0.941 (0.775 to 1.144), p=0.54	-0.725 (-1.331 to -0.118), p=0.019*
Top 4 chain outlet	0.955 (0.805 to 1.131), p=0.591	0.919 (0.777 to 1.087), p=0.322	0.946 (0.798 to 1.12), p=0.519	-0.112 (-0.633 to 0.41), p=0.675
At Least One within 3000m				
Fast Food outlet	1.027 (0.865 to 1.22), p=0.761	**1.227 (1.035 to 1.456), p=0.019***	1.154 (0.971 to 1.372), p=0.105	-0.274 (-0.804 to 0.256), p=0.311
Top 4 chain outlet	0.843 (0.659 to 1.078), p=0.173	0.903 (0.703 to 1.156), p=0.422	1.111 (0.87 to 1.424), p=0.401	0.356 (-0.403 to 1.115), p=0.358

Table 6.5. Regression results showing the relationship between fast food outlet availability and dietary intake and BMI in older adults aged 65+ years.

	Older adults aged 65+ years (n=3032)			
	Ordinal Regression (Odds Ratios)			Linear Regression
	Daily Vegetable intake	Daily fruit intake	Weekly takeaway intake	BMI
Distance to Closest Store				
Fast Food outlet	1.059 (1 to 1.121), p=0.05	1.009 (0.951 to 1.072), p=0.77	1.009 (0.947 to 1.073), p=0.783	-0.034 (-0.198 to 0.13), p=0.683
Top 4 chain outlet	1.019 (0.966 to 1.074), p=0.492	0.995 (0.942 to 1.052), p=0.862	0.99 (0.932 to 1.05), p=0.733	-0.099 (-0.256 to 0.059), p=0.219
Count of Store within 800m				
Fast Food outlet	0.987 (0.966 to 1.008), p=0.217	1.003 (0.981 to 1.027), p=0.777	1.002 (0.977 to 1.026), p=0.895	0.039 (-0.025 to 0.103), p=0.233
Top 4 chain outlet	**0.866 (0.755 to 0.992), p=0.038***	1.012 (0.878 to 1.173), p=0.868	0.908 (0.769 to 1.064), p=0.244	0.031 (-0.379 to 0.442), p=0.881
Count of Store within 1600m				
Fast Food outlet	0.995 (0.988 to 1.003), p=0.232	0.999 (0.991 to 1.007), p=0.849	0.999 (0.991 to 1.008), p=0.907	0.004 (-0.019 to 0.027), p=0.731
Top 4 chain outlet	0.951 (0.893 to 1.011), p=0.11	0.975 (0.914 to 1.041), p=0.448	0.99 (0.922 to 1.061), p=0.778	0.112 (-0.073 to 0.298), p=0.235
Count of Store within 3000m				
Fast Food outlet	0.997 (0.994 to 1.001), p=0.114	1 (0.997 to 1.004), p=0.842	0.998 (0.995 to 1.002), p=0.381	0.001 (-0.008 to 0.01), p=0.85
Top 4 chain outlet	**0.961 (0.931 to 0.993), p=0.016***	0.985 (0.953 to 1.019), p=0.397	1.012 (0.977 to 1.049), p=0.508	**0.101 (0.006 to 0.197), p=0.038***
At Least One within 800m				
Fast Food outlet	0.935 (0.814 to 1.074), p=0.34	1.019 (0.882 to 1.179), p=0.797	0.936 (0.802 to 1.093), p=0.405	0.131 (-0.279 to 0.541), p=0.53
Top 4 chain outlet	0.811 (0.641 to 1.024), p=0.079	1.057 (0.824 to 1.361), p=0.667	0.887 (0.675 to 1.156), p=0.382	0.203 (-0.497 to 0.902), p=0.57
At Least One within 1600m				
Fast Food outlet	**0.821 (0.691 to 0.976), p=0.025***	1.088 (0.908 to 1.301), p=0.358	1.039 (0.86 to 1.261), p=0.693	0.302 (-0.204 to 0.808), p=0.242
Top 4 chain outlet	0.895 (0.779 to 1.027), p=0.115	1.028 (0.888 to 1.189), p=0.714	1.063 (0.911 to 1.241), p=0.436	0.197 (-0.214 to 0.609), p=0.347
At Least One within 3000m				
Fast Food outlet	0.969 (0.844 to 1.113), p=0.659	1 (0.864 to 1.156), p=0.997	0.989 (0.847 to 1.155), p=0.886	-0.012 (-0.421 to 0.397), p=0.954
Top 4 chain outlet	0.922 (0.736 to 1.154), p=0.476	0.995 (0.786 to 1.255), p=0.966	0.947 (0.743 to 1.214), p=0.662	0.337 (-0.323 to 0.998), p=0.316