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A national study of the association between neighbourhood access to fast-food outlets and the diet and weight of local residents

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ABSTRACT

Differential locational access to fast-food retailing between neighbourhoods of varying socioeconomic status has been suggested as a contextual explanation for the social distribution of diet-related mortality and morbidity. This New Zealand study examines whether neighbourhood access to fast-food outlets is associated with individual diet-related health outcomes. Travel distances to the closest fast-food outlet (multinational and locally operated) were calculated for all neighbourhoods and appended to a national health survey. Residents in neighbourhoods with the furthest access to a multinational fast-food outlet were more likely to eat the recommended intake of vegetables but also be overweight. There was no association with fruit consumption. Access to locally operated fast-food outlets was not associated with the consumption of the recommended fruit and vegetables or being overweight. Better neighbourhood access to fast-food retailing is unlikely to be a key contextual driver for inequalities in diet-related health outcomes in New Zealand.

Background

The link between diet and health is well established with poor dietary intake being associated with a higher incidence of a multitude of adverse health outcomes (World Cancer Research Fund/American Institute for Cancer Research, 2007) including many of the leading causes of death such as stroke (Joshipura et al., 1999), heart disease (Kushi et al., 1985) and various types of cancer (Danaei et al., 2005). Further, social variations in diet-related morbidity and mortality are well established with people of lower socioeconomic position and people living in more deprived areas tending to have worse diet-related health outcomes (Davey Smith and Brunner, 1997).

The explanations for the socioeconomic patterns in dietary intake have been related to a number of factors including educational level, employment status, income and cultural differences (Dowler, 2001). However, it has been suggested that there has been an over emphasis on individual-level factors (Egger and Swinburn, 1997), and that individual-based interventions have had limited success. These critiques have led to a renewed interest in the potential neighbourhood or contextual explanations of diet-related health outcomes (Cummins and Macintyre, 2006; Hill and Peters, 1998; Macintyre, 2007). One contextual mechanism that may help to explain inequalities in diet is that fast-food outlets selling less healthy food are disproportionately over represented in low income, high ethnic minority and more socially deprived neighbourhoods. Research in the US (Morland et al., 2002b; Block et al., 2004), England and Scotland (Cummins et al., 2005b; MacDonald et al., 2007; Macintyre et al., 2005) and Australia (Burns and Inglis, 2007; Reidpath et al., 2002) has overwhelmingly demonstrated that less advantaged areas tend to have better locational access to fast-food retailers. Similar findings were noted in New Zealand where, at the national level, neighbourhood median travel distance to both multinational fast-food outlets and locally operated outlets were found to be at least twice as far in the least socially deprived neighborhoods compared to the most deprived neighborhoods (Pearce et al., 2007a).

Although the weight of international evidence demonstrates a greater opportunity to procure fast-food in more deprived neighbourhoods, the role of the local food environment in influencing people's dietary choices and on obesity is unclear. The evidence from the US suggests that, with some exceptions (Wang et al., 2007), worse access to food retailing facilities (supermarkets and convenience stores) has a deleterious impact on diets and obesity (Laraia et al., 2004; Morland et al., 2002a, 2006; Zenk et al., 2005), although outside of the US the findings tend to be more mixed (Cummins et al., 2005a; Wrigley et al., 2002, 2003; Pearce et al., 2008b). The explanations for the inconsistent results between the US and elsewhere are likely to be

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multifaceted, but may include the stronger role that residential neighbourhoods in the US exert on the health of local residents (Cummins and Macintyre, 2006). It is plausible that neighbourhoods in the US may influence individual-level health outcomes to a greater extent than elsewhere due to the higher levels of residential segregation in US cities (Johnston et al., 2007). Increased residential segregation has resulted from the selective migration streams of higher income and white residents into the suburbs of the major metropolitan areas, whilst low income and black residents remaining in the urban centres (Charles, 2003; Massey and Denton, 2003). Residential segregation is likely to exacerbate disparities in neighbourhood exposure to healthy and unhealthy components of the food environment through various pathways including the concentration of targeted consumers in specific geographical localities, differences in land use planning strategies, and neighbourhood variations in residents' abilities to influence political decision making (Kwate, 2008). Few studies have examined the effects of neighbourhood access to fast-food outlets on individual health outcomes. The studies that have taken place have all been in the US, and there is scant evidence for an association between access to fast-food retailing and individual health outcomes (Burdette and Whitaker, 2004; Jeffery et al., 2006; Morland et al., 2002a).

This New Zealand study builds on earlier research that found locational access to fast-food outlets to be stratified by neighbourhood deprivation (Pearce et al., 2007a). Using data from a national health survey, we assess whether neighbourhood access to fast-food outlets is associated with individual diet-related health outcomes, after taking into account individual-level sociodemographic characteristics and potentially confounding neighbourhood features.

Methods

Data on the addresses of each multinational and locally operated fast-food outlet were collected from all 74 Territorial Authorities (TAs) across New Zealand during 2005. TAs have regulatory responsibility for the hygiene inspection of all premises in their region used in the manufacture, preparation or storage of food for sale. For each outlet, information was requested on the street address as well as its name. The data were verified using the online telephone directory (i.e., Yellow Pages) (Yellow Pages, 2006) and in cases of missing data or incomplete records, the data were supplemented with additional address information. The data were coded into two groups: multinational fast-food outlets (McDonald's, Burger King, Kentucky Fried Chicken, Pizza Hut, Subway, Domino's Pizzas, and Dunkin' Donuts), and the remaining locally operated outlets (e.g. fish and chip shops). A total of 2930 fast-food outlets in New Zealand were registered, of which 474 were multinational outlets. Geographical access to multinational and locally operated fast-food outlets was calculated separately for all 38,350 census meshblocks across New Zealand. On average, meshblocks contain approximately 100 people, and due to their small size, are the closest representations of a 'neighbourhood' in New Zealand. Each neighbourhood was represented by its population-weighted centroid and the travel distance to the nearest multinational and locally operated outlet along the road network was calculated using the network functionality in a Geographical Information System (GIS) (Pearce et al., 2006).

The 2002/03 New Zealand Health Survey (NZHS) is a national survey of the health status of 12,529 adults aged 15+ (target population 2.6 million) posing a range of questions including dietary intake (Ministry of Health, 2004). Respondents were asked two nutrition-related questions on their average daily servings of fruit and vegetables. Fruit included fresh, frozen, canned or stewed fruit but not fruit juice or dried fruit. Vegetables included fresh, frozen or canned vegetables but not vegetable juices. For each respondent, two dichotomous outcome variables were developed: consuming the recommended two servings of fruit per day, and three servings of vegetables. In addition, for each respondent height and weight measurements were taken which enabled the Body Mass Index (BMI) value to be calculated. A dichotomous variable was developed to indicate whether the respondent was overweight or not (the overweight definition was ethnicity-specific: BMI > 25.0 for European, Asian and other; BMI > 26.0 for Māori and Pacific peoples (Swinburn, 1998)).

The two neighbourhood measures of fast-food retail access were divided into two categories (above and below the national-level median distance) and appended to each respondent in the survey. For confidentiality reasons, the Ministry of Health as the suppliers of the health survey data, specified the number of variables that could be appended to health survey outcome variables. The 12,529 respondents were distributed across 1178 meshblock neighbourhoods and there were between 1 and 83 respondents per neighbourhood, although in most neighbourhoods the total number of respondents was less than 20.

Two-level logistic regression models with a random intercept were fitted in the multilevel software package MLWin (version 2.0) using second-order penalised quasilikelihood (PQL) estimation methods. Due to multicollinearity with the exposure variables, we limited our analyses to the main (minimum population 30,000) and secondary urban (population 10,000–29,999) areas. Variables were added in four stages. First, we included design variables to account for the sample stratification and oversampling of ethnic minorities. The design variables were: stratum (ethnic composition of the meshblock), deciles of number of respondents in the meshblock, number of adults in the household and ethnicity (Māori, Pacific people, Asian, or Other). Sex and age were also included in all models. Age was divided into four lifecycle groups (15–24, 25–44, 45–64, 65 or older). Second, individual-level socioeconomic variables were added. The socioeconomic variables included educational qualifications (none, school (16 is the minimum school leaving age in New Zealand), post-school), social class (professional/managerial, other non-manual, skilled manual, semi and unskilled manual), benefits receipt (recipient or not of family support, domestic purposes and/or unemployment benefits), employment status (working or not working) and household income (< $25k, $25–50k, > $50k). For the BMI analysis additional controls were made for the potentially confounding effects of other health-related behaviours (smoking status and physical activity).

Two potential ecological confounders (at the neighbourhood-level) were added in the third and fourth stages: area deprivation measured using the 2001 New Zealand Deprivation Index (NZDep 2001) (Salmond and Crampton, 2002) divided into quintiles and an area type variable (main urban area, secondary urban area) derived from the 5-level 2001 Urban Area Classification (Statistics New Zealand, 2005). All neighbourhood variables were included as categorical variables to satisfy confidentiality requirements. Potential individual socioeconomic and ecological confounders were selected *a priori* for model building. Potential interactions between the main effects, and ethnicity, age, sex individual SES, area deprivation and area type were also examined.

Results

We found that the consumption of the recommended daily intake of *fruit* was not associated with neighbourhood access to multinational or locally operated fast-food outlets (Table 1) with odds ratios (OR) of 1.05 and 1.02, respectively. All of the 95%

Table 1
Odds ratios of eating recommended fruit and vegetables, and BMI⩾25 (95% confidence intervals) predicted from access to multinational and locally operated fast food outlets

	Stage 1[a] baseline	Stage 2[b] individual SES	Stage 3[c] NZDep	Stage 4[d] area type
Recommended fruit				
Access to multinationals	Model 1	Model 2	Model 3	Model 4
Best (<2.8 km)	1	1	1	1
Worst (2.8+ km)	1.09 (0.96–1.24)	1.09 (0.96–1.24)	1.05 (0.92–1.19)	1.05 (0.92–1.19)
Access to locally operated	Model 5	Model 6	Model 7	Model 8
Best (<1.0 km)	1	1	1	1
Worst (1.0+ km)	1.08 (0.95–1.21)	1.07 (0.95–1.20)	1.01 (0.89–1.14)	1.02 (0.90–1.16)
Recommended vegetables				
Access to multinationals	Model 9	Model 10	Model 11	Model 12
Best (<2.8 km)	1	1	1	1
Worst (2.8+ km)	1.17 (1.01–1.37)	1.17 (1.00–1.37)	1.17 (1.00–1.36)	1.17 (1.00–1.37)
Access to locally operated	Model 13	Model 14	Model 15	Model 16
Best (<1.0 km)	1	1	1	1
Worst (1.0+ km)	1.01 (0.87–1.16)	1.01 (0.87–1.16)	0.99 (0.85–1.14)	0.98 (0.85–1.14)
Overweight (BMI)				
Access to multinationals	Model 17	Model 18	Model 19	Model 20
Best (<2.8 km)	1	1	1	1
Worst (2.8+km)	1.10 (0.98–1.24)	1.11 (0.98–1.25)	1.16 (1.03–1.31)	1.17 (1.03–1.32)
Access to locally operated	Model 21	Model 22	Model 23	Model 24
Best (<1.0 km)	1	1	1	1
Worst (1.0+km)	1.00 (0.90–1.12)	1.00 (0.89–1.12)	1.06 (0.94–1.18)	1.04 (0.92–1.16)

[a] Models include design, and individual-level sex and age variables.
[b] Individual-level socio-economic variables (education, social class, benefits receipts, employment status and household income) and health-related behaviour for BMI models included in models containing design, sex and age variables.
[c] Neighbourhood-level deprivation included in models containing individual-level design, sex, age and socio-economic variables (plus health-related behaviour for BMI models).
[d] Neighbourhood-level urban area classification included in models containing neighbourhood-level deprivation and individual-level design, sex, age and socio-economic variables (plus health-related behaviour for BMI models).

confidence intervals included 1.0 (Models 4 and 8). However, the consumption of the recommended daily intake of *vegetables* was associated with access to multinational fast-food outlets (Models 5–8). After adjustment for individual SES plus neighbourhood deprivation and type, neighbourhoods with poorer access to multinational fast-food outlets than the national median, had a 17% (OR 1.17, 95% CI 1.00–1.37) higher odds of eating the recommended vegetable intake compared to neighbourhoods with the best access (Model 12). There was no association between neighbourhood access to locally operated fast-food outlets and vegetable consumption. The odds ratio in the fully adjusted model was 0.98 and the 95% CIs included 1.0 (Model 16).

There was evidence that neighbourhood access to multinational fast-food outlets was associated with BMI. Contrary to expectations, in the adjusted model the odds ratio of being overweight was greater in neighbourhoods with poorer access to multinational fast-food outlets (OR 1.17, 95% CI 1.03–1.32) compared to neighbourhoods with the closest access (Model 20). However, there was no association between access to the closest locally operated fast-food outlet (Models 21–24) with the most accessible neighbourhoods having an OR of being overweight close to the null, and CIs that included 1.0 (Model 24). None of the interactions that were tested included subgroups with non-overlapping confidence intervals.

Discussion

As has previously been noted, quality of diets and nutrition-related health outcomes tend to be worse in lower socioeconomic neighbourhoods. Earlier work found that locational access to both multinational and locally operated fast-food outlets are strongly patterned by neighbourhood deprivation in New Zealand, with better access in more deprived areas (Pearce et al., 2007a). In isolation, these findings would suggest that access to fast-food outlets is an important contextual driver of individual-level nutrition and diet-related health outcomes in New Zealand. Despite these earlier findings, the current research found little evidence that neighbourhood access to fast-food retailing was associated with a poorer diet and being overweight at the individual level. There was some evidence that neighbourhoods with poorer locational access to multinational fast-food outlets were more likely to consume the recommended amount of vegetables. However, survey respondents living in neighbourhoods with poorer locational access to multinational fast-food outlets also had a higher odds of being overweight, and there was no association with the recommended daily fruit intake. Further, neighbourhoods with poorer access to multinational fast-food outlets also had a higher BMI. There was no association between neighbourhood access to locally operated fast-food outlets and any of the individual-level health-related measures.

What sources of error may have biased our results? First, we used data for all outlets in New Zealand which ensures representativeness. However, by using secondary data we may have incorporated measurement error of the neighbourhood exposure. Second, our access measures were only of access to fast-food outlets—not to outlets that sell high quality healthy food. It may be that if we had data on this latter construct, we would have found a result in the expected direction. Nonetheless, our primary hypothesis is about the impact of access to fast-food outlets, not access to healthy food per se. Third, it is possible that neighbourhood-level confounding may be occurring. Multinationals may select outlet locations using more precise socio-demographic information on neighbourhood composition, lifestyle and consumption patterns than is available to or used by local operators. It may be that geographic access to fast-food outlets (the exposure) is also correlated with other health promoting/damaging characteristics and behaviours that we could not include in our model such as urban design (Lopez, 2004; Bedimo-Rung et al., 2005; Cohen et al., 2007).

Possible improvements to future research, therefore, include simultaneously examining all components of the neighbourhood food environment including retail outlets that sell both 'healthy' and 'unhealthy' food. Second, more precise and direct measures of the food environment are required including the preference of individuals with regard to the type and location of fast-food outlets. Third, data on fast-food purchasing and consumption behaviours as well as fruit and vegetable consumption would enable more precise understanding of the association between access to food outlets and dietary behaviours to be developed. Fourth, evaluating the effects of changes to the food environment over time on changes in dietary and BMI profiles would provide a stronger research design than cross-sectional analyses such as reported here.

Our findings do not concur with studies in the US where neighbourhood access to fast-food outlets is often associated with various diet-related health outcomes (Laraia et al., 2004; Morland et al., 2002a, 2006; Zenk et al., 2005). Whilst fast-food access in New Zealand is patterned in a similar way to outlets in the US, with a concentration of fast-food outlets in lower socioeconomic areas, access to 'healthier' outlets including large supermarkets and local convenience stores in New Zealand were patterned by neighbourhood deprivation in a similar way (Pearce et al., 2007a, b, 2008a). Further, compared to the US, New Zealand has lower levels of urban residential segregation (Johnston et al., 2007), which is likely to result in less disparity in neighbourhood exposure to fast-food retailing across New Zealand neighbourhoods. Our results are consistent with earlier New Zealand work that found little evidence for an association between neighbourhood access to supermarkets/convenience stores and fruit and vegetable consumption (Pearce et al., 2008b).

In conclusion, and assuming our findings are valid for the New Zealand context, good neighbourhood access to fast-food outlets is unlikely to be a key contextual driver for variations in diet-related health outcomes in New Zealand. We encourage researchers in other countries to examine these associations.

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