

Food environments and obesity— neighbourhood or nation?

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Obesity arises from an imbalance between energy input and output¹ but in this commentary we focus exclusively on environmental issues in energy *intake* in the developed world. Our aim is both to provide an overview of recent findings on obesogenic environments² and to point to cross national variations in their distribution.

It has recently been suggested that individually focused interventions attempting to reduce obesity have had limited success,³ and that the widespread and increasing prevalence of obesity is inadequately explained by individual-level psychological and social factors associated with diet or physical activity.^{1,2,4,5} This suggestion is part of a broader critique of the over-emphasis on the role of individual health behaviours, which has tended to ignore the influence of the complex social and physical contexts in which individual behavioural decisions are made.^{4,6} Such critiques have led to a new focus on 'environmental' exposures that encourage excessive food intake and discourage physical activity.^{7–10}

Obesity and SES

Higher rates of obesity are likely to be found in those with the lowest incomes and the least education, particularly among women and certain ethnic groups.^{11–13} Some authors have viewed this association, with hunger and obesity co-existing side-by-side, as something of a paradox.¹⁴ This apparent paradox may be explained by the relatively low cost of energy dense foods,^{9,15} the high palatability of sweets and fats associated with higher energy intakes,¹⁶ and the association of lower incomes and food insecurity with lower intakes of fruit and vegetables.^{17–19}

Recent observational studies have found that dietary patterns and obesity rates vary between neighbourhoods, with living in a low-income or deprived area independently associated with the prevalence of obesity and the consumption of a poor diet. Such associations have been consistently reported in countries such as the UK,^{20–24} The Netherlands,^{25,26} Sweden,²⁷ Australia,^{28,29}

US^{30–32}, and Canada³³. It has been suggested that this may be due to a process of 'deprivation amplification',³⁴ whereby exposure to poor quality food environments amplifies individual risk factors for obesity such as low income, absence of transport, and poor cooking skills or knowledge.

Environmental influences on diet are partly considered to involve two pathways: access to foods for home consumption from supermarkets and grocery stores, and access to ready made food for home and out-of-home consumption (e.g. takeaways, restaurants). In this commentary we review and assess the role of these two elements of the local food environment in producing the patterning of obesity by socioeconomic status.

Evidence for the influence of grocery stores and supermarkets

It has been suggested that the price and availability of food may be an important mediating factor in the relationship between neighbourhood environment, diet quality, and obesity.³⁵ One recent study in the US found that the presence of supermarkets was associated with a lower prevalence of obesity.³⁶ Studies in the US and Canada have found neighbourhood differences in the price and availability of food, with 'healthier' foods generally more expensive, and less readily available, in poorer than in wealthier communities. Accessibility to supermarkets is poorer in low-income neighbourhoods, with fewer supermarkets and more small independent grocery stores available to local residents.^{37–42} These independent stores tend to charge higher prices than supermarkets.^{37–39} Similar deficiencies in food access are observed in predominately African-American neighbourhoods.^{40,41} In one study supermarkets were, on average, 1.15 miles further away for residents of black compared with white neighbourhoods,⁴³ leading to the suggestion that racially biased business decisions may well be in operation.⁴⁴ Grocery stores in black neighbourhoods are also less likely to stock healthy food items or healthier versions of standard foods (e.g. low-fat, low-salt).⁴⁵ Lack of access to supermarkets has also been reported in rural areas.⁴⁶

Lesser allocation of shelf-space in community grocery stores to 'healthier' (low-fat and high-fibre) products has been associated with lower consumption of such foods among local residents.⁴⁷ Proximity to a supermarket has been associated with higher fruit and vegetable intake and better diet quality among low-income households⁴⁸ and pregnant women.⁴⁹ For black neighbourhoods a significant dose-response relationship was found, with a

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32% increase in fruit and vegetable intake for each additional supermarket in the area.⁵⁰ African-American women shopping at supermarkets and speciality stores consumed fruit and vegetables more often, on average, than those shopping at independent grocers.⁵¹

The picture from North America is thus reasonably consistent; places inhabited by poorer people and black people have poorer access to 'healthier' foods. However, the picture outside North America is different, the UK research undertaken in the late 1980s and early 1990s did suggest similar inequalities, with high prices and poor availability being associated with area deprivation.⁵²⁻⁵⁴ However, these findings were derived from mainly small-scale local surveys and in some cases data have been misinterpreted by policy-makers.⁵⁵ More recently, larger and more robust empirical observational studies in major urban centres in the UK have found no independent association between neighbourhood food retail provision, individual diet, and fruit and vegetable intake^{56,57}; no differences in food price, food availability, and access to supermarkets between deprived and affluent areas⁵⁸⁻⁶⁰; and reasonable availability of a range of 'healthy' foods across contrasting urban areas.^{58,61} Researchers have also found that, in England, few low-income consumers report any problems in using supermarkets, despite transport difficulties, or perceived problems in the choice of shops or fruit and vegetables.⁶² Studies in Northern Ireland found that even though consumers who used small stores within their local area were at a price disadvantage,⁶³ there was little evidence that consumers regarded travelling to edge-of-town supermarkets as problematic.⁶⁴

Similarly, a study in Brisbane, Australia, found no socioeconomic differences in shopping infrastructure for fruit and vegetables,⁶⁵ and little difference in fruit and vegetable purchasing patterns between households in socioeconomically disadvantaged and advantaged areas once household income had been taken into account.²⁸ A study in Eindhoven, The Netherlands, found increasing proximity to food stores with increasing neighbourhood deprivation.⁶⁶

For the most part, evidence concerning the links between diet and the retail food environment has been purely observational and thus cannot determine the direction of causality. For example it may be that lower availability of healthier foodstuffs in poorer or black areas is due to low demand. However, two studies have attempted to evaluate the effects on fruit and vegetable intake of the introduction of supermarkets in deprived communities.^{67,68} In an uncontrolled before/after study undertaken in Leeds, England, some small improvements in fruit and vegetable consumption were found, with larger improvements found for individuals initially consuming two or fewer portions per day.⁶⁸ Positive impacts were reported to be particularly pronounced for those who 'switched' to the new supermarket as their main food source compared with those who continued to use their existing provision. In comparison, a controlled before and after study in Glasgow (Scotland)^{67,69} found little evidence for any effect on fruit and vegetable consumption overall or for a 'switchers' subgroup. Fruit and vegetable consumption increased slightly in the area with the new superstore, but positive changes also occurred in the control area. The quasi-experimental design of the Glasgow study is important, as unadjusted changes within the intervention area were similar in magnitude to the Leeds study, suggesting that what was being observed was a product of

general secular (or other) change rather than a direct effect of the intervention itself.

Evidence for the influence of fast-food and other outlets

Foods purchased from fast-food outlets, restaurants, and other places are becoming an increasingly important part of people's diet, particularly in the US.⁷⁰⁻⁷³ Such foods are up to 65% more energy dense than the average diet,⁷⁴ and intakes of selected nutrients are lower in the population groups who consume more of them.⁷⁵ Those consuming these foods tend to be heavier than those who do not, even after controlling for a range of socio-demographic variables, including income.⁷⁶⁻⁷⁸ Portion sizes of out-of-home meals are relatively large compared with home prepared foods.⁷⁹ It has been suggested that fast-food outlets are more prevalent in poorer areas,⁸⁰ and that this might help to explain higher rates of obesity in these neighbourhoods.

A limited number of ecological and multi-level studies have investigated this hypothesis. Associations have been found between area deprivation and density of fast-food outlets in Melbourne, Australia, with poorer neighbourhoods having 2.5 times more fast-food outlets,⁸¹ and in New Orleans where there were more fast-food outlets in predominately black census tracts.⁸² Ecological correlations between obesity rates and the prevalence of fast-food outlets have been found for US states and account for ~6% of the variance in obesity in a model which explained 70% of the state-level geographic difference.⁸³ In Los Angeles, poorer neighbourhoods with higher proportions of African Americans had fewer healthy options available in away-from-home outlets and more advertising and promotional prompts to consume unhealthy alternatives.⁸⁴ CHD mortality and hospitalization has also been associated with regional fast-food service density in Canada.⁸⁵ In England and Scotland, McDonald's restaurants tend to be located in more deprived areas.⁸⁶

However, conflicting findings have also been reported within each of these countries. No relationships between obesity and proximity to take-away outlets were found for adults in Victoria, Australia,⁸⁷ and for children in Cincinnati, USA.⁸⁸ Density of fast-food and other outlets was not found to be associated with area deprivation in Glasgow, UK,⁸⁹ nor were density measures associated with area-based measures of wealth and racially based residential segregation in areas of the US.⁴⁰ Fast-food restaurants were found to charge more for food in black neighbourhoods in New Jersey and Pennsylvania, USA.⁹⁰

Does living in North America make you fat?

So what does this all mean? In the United States the observational evidence tends to support the idea that access to supermarkets and grocery stores is constrained for those who live in low-income or black neighbourhoods, and that consequent price and choice disincentives to healthy eating might help to explain higher rates of poor diet and of obesity. Outside the US the most recent observational studies suggest that this is not the case. Though experimental studies, undertaken in the UK, have produced mixed results, the study with the most

robust design did not find convincing evidence for an effect on diet of introducing a supermarket into a poor area.⁹¹

In general, current evidence for an effect of the out-of-home fast-food environment is mixed. Some US and UK studies indicate a plausible role for the fast-food environment in promoting neighbourhood differences in obesity, but these are counter-balanced by other, more negative, findings. Studies in this area tend to be primarily ecological in design and to be relatively few, so it is no surprise that consensus is difficult with a body of evidence that is only emerging now.

Even though neighbourhood differences in obesity exist in many countries good evidence for a 'contextual' effect of the food environment is really only evident in North America. Why should this be the case? It is probably not that the food environment is important in the USA and Canada and unimportant elsewhere but rather that the environmental processes that explain geographic differences in obesity may be different. The social, cultural, economic, and regulatory environment that governs the provision, purchase, and consumption of food is likely to differ markedly between nations and these differences may be expressed at the neighbourhood level within countries.

For example, residential segregation along socioeconomic and racial lines may be more pronounced in the USA and planning regulations less focused on compensating for such segregation than in the UK, continental Europe, or Australia. In Glasgow we found supermarkets more prevalent in poorer areas, possibly because of lower land prices and regulatory controls on new supermarkets in out-of-town sites.⁵⁹ We found out-of-home food outlets concentrated in the City Centre, where there is a likelihood of high levels of demand during the daytime and evening and low levels of residential deprivation.⁸⁹ In contrast, in the USA richer people have tended to move to the outskirts of cities leaving poorer and blacker neighbourhoods closer to the urban centre—a process of residential segregation colloquially known as 'white-flight'.^{92,93} Though this process slowed in the 1990s some cities, such as Detroit, appear to have been subjected to a permanent spatial re-ordering leading to differential exposure to neighbourhood environmental risks on the basis of income and race. A recent report from The Brookings Institution suggests that, in Philadelphia, the 'poor pay more' because businesses perceive the personal and economic risks of operating in low-income communities as higher and thus charge higher prices to compensate for it.^{94,95}

Similarly the magnitude and importance of the effects of the diet-related contextual determinants of obesity may also differ between countries. Outside North America, differences in the provision of opportunities to consume more or less healthy food may not be as important in promoting obesity as other determinants such as physical activity (which may be influenced by other environmental factors such as urban design and transport patterns).

It should also be noted that, with few exceptions, studies in this field are cross-sectional. Although it is often assumed that there is a straightforward direction of causality from supply (availability and price) to behaviour (food purchasing and consumption), it may be that the processes are much more dynamic. Relationships may operate in the opposite direction or have positive or negative feedback loops; where there is no demand for healthier foods (because of preferences or lack of

income, transport, or time) such foods are less likely to be stocked. Such supply restrictions may then reinforce residents' negative perceptions of choice and availability.

Conclusion

Good, albeit mostly cross-sectional, evidence for neighbourhood level environmental influences on diet and obesity only exists for those who live in North American neighbourhoods, with the most consistent evidence available from US studies. The possibility that relationships between socioeconomic factors may be more observable in the US than in other developed nations has been hinted at by researchers who have noted that a contextual relationship between income-inequality and health found in the US is not found elsewhere.^{96,97} Intriguingly, this may point to a situation where residents of the US are particularly susceptible to the contextual determinants of health at the neighbourhood level or may suggest that macro-level processes currently make the US a very different place to live compared with other developed nations. Whatever the reason, much work is still required to determine whether the food- and diet-related environmental determinants of obesity will remain purely a US phenomenon or that other developed nations are playing 'catch-up'—either in terms of the available evidence or in terms of the magnitude and existence of neighbourhood level contextual effects.

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