The Nutrition Society Summer Conference 2022 was hosted collaboratively by Sheffield Hallam University, the University of Sheffield and Sheffield City Council on 12–15 July 2022

Conference on 'Food and nutrition: Pathways to a sustainable future' Rank Prize Lecture

Opportunities to improve population health: possibilities for healthier food environments

Amelia A. Lake[1,3]* , Helen J. Moore[2,3], Matthew Cotton[2,3] and Claire L. O'Malley[1,3]

[1]*School of Health and Life Sciences, Teesside University, Middlesbrough, UK*
[2]*School of Social Sciences, Humanities and Law, Teesside University, Middlesbrough, UK*
[3]*Fuse, The Centre for Translational Research in Public Health, Newcastle upon Tyne, UK*

The recent Covid-19 pandemic highlighted stark social inequalities, notably around access to food, nutrition and to green or blue space (i.e. outdoor spaces with vegetation and water). Consequently, obesity is socio-economically patterned by this inequality; and while the environmental drivers of obesity are widely acknowledged, there is currently little upstream intervention. We know that living with obesity contributes to increasing health inequalities, and places healthcare systems under huge strain. Our environment could broadly be described obesogenic, in the sense of supporting unhealthful eating patterns and sedentary behaviour. Evidence points to the existence of nearly 700 UK obesity policies, all of which have had little success. Obesity prevention and treatment has focused on educational and behavioural interventions targeted at individual consumers. A more sustainable approach would be to try and change the environments that promote less healthy eating and high energy intake as well as sedentary behaviour. Approaches which modify the environment have the potential to assist in the prevention of this complex condition. This review paper focuses on the role of wider food environments or foodscapes. While there is an imperfect evidence base relating to the role of the foodscape in terms of the obesity crisis, policy, practice, civic society and industry must work together and take action now, in areas where current evidence suggests change is required. Despite the current cost-of-living crisis, shaping the foodscape to better support healthful eating decisions has the potential to be a key aspect of a successful obesity prevention intervention.

Key words: Food environments: Public health nutrition: Obesity: Obesogenic environments: Food security: Urban planning

There has never been a time when the importance of food, the cost of food and the impact of food on our health been more discussed[1,2]. Emerging from a global pandemic and entering into a global cost-of-living crisis has had significant impacts on the wider food system and ultimately the food environment. The *food environment*, or *foodscape*, encompasses any opportunity to obtain food and includes physical, socio-cultural, economic and policy influences at both micro and macro-levels[3]. The foodscape can include both physical and virtual (online; grocery and takeaway foods) food offering; the online food environment has grown significantly since the first 2020 Covid-19 pandemic[4].

*Corresponding author: Amelia A. Lake, email Amelia.Lake@tees.ac.uk

Our food-related behaviours occur within an environment that promotes and actively encourages less healthy, sedentary lifestyles. This is important in terms of health outcomes, and specifically those related to obesity[5].

The wider food system has a huge effect on the health of populations and upon planetary health. Dietary guidelines need to reflect both underlying health and environmental sustainability goals if food system changes are to address the twin challenges of climate change and food insecurity[6]. *Dietary sustainability* is a fast-evolving field with increasing buy-in from nutritional professionals[7]. However, as highlighted by the Lancet EAT-Commission on Food, Planet and Health[8], there is a need to reduce the intake of animal sourced foods (primarily in G20 countries) and increase the intake of healthy plant-based foods globally. Yet the cost and unaffordability of healthy diets remains a key challenge[9]. Much research has focused on two 'end-points' within the wider food system: agricultural production and consumer dietary intake[10]. Less research and policy attention has focused upon changes to food supply chains, including food processing, transport, surplus redistribution and waste management: a problem often described as the 'missing middle' of food system sustainability[11].

The food environment is never static, food supply and demand respond to a range of socio-political factors and influences. The 'perfect storm' scenario[12] of the Covid-19 pandemic, worsening climate threats, global geopolitical instability (notably the impact on grain production in the wake of Russia's invasion of Ukraine in February 2022) and political institutional change (replacing the EU Common Agricultural Policy with domestic legislation through the Agriculture Act 2020) has added layers of complexity to the long-term food security landscape. The current global cost-of-living crisis has resulted in marked rises in food insecurity. The physical food environment, in terms of 'high-streets' and hospitality industries, has faced challenges before and since the lockdowns of the Covid-19 pandemic[13].

Obesity and inequalities

The Covid-19 pandemic and subsequent national lockdowns illustrate both the structural weaknesses and adaptability of the food system. Of note is how the pandemic exposed systemic reliance upon emergency food aid and food charities amongst members of vulnerable communities[14]. However, societal reliance upon food banks/food parcel deliveries to meet chronic food insecurity needs has subsequently raised political controversy: actors across food policy networks highlight how food charity masks the economic unsustainability of this approach[15], how it normalises food insecurity, and fails to tackle the root causes of poverty[16]. Moreover, the unpredictable just-in-time retail supply of food resources makes it difficult to coordinate the redistribution of perishable produce (and other critical food items). Consequently, food banks struggle to meet fluctuating patterns of supply and demand[17], resulting in limited provision of nutrient-dense foods (including meat, dairy, vegetables and fruits)[18].

The Kings Fund reported in 2022[19] that the 2020/2021 period saw rising rates of deprivation and obesity across England, in step with growing inequality between the least and the most deprived populations: the gap grew by 1·5 percentage points (from 16·1 % in 2019/2020 to 17·6 % in 2020/2021). Rising rates of obesity amongst vulnerable populations is associated with subsequent rises in future population ill health, and increased stress on health services. A healthy diet helps to protect against malnutrition in all its forms, and reduces the risks of multiple non-communicable diseases[20]. People who live in more deprived areas find it harder to consume a healthy diet for a multitude of reasons, though the rising cost of healthy food is a significant factor for many. A report by the Food Foundation[21] showed that for anyone in the lowest income decile trying to follow the Eatwell Guide[22] would cost them almost 30 % of their disposable income. This report was published in 2018, and does not account for the contemporary cost-of-living-crisis within food and energy consumption – a crisis that compounds food insecurity risks[23]. Additionally, households at risk are likely to be those who self-identify as 'too rich to be poor' and who are experiencing in-work poverty[24].

A recent systematic review and meta-analysis of 36,113 adults and children showed statistically significant associations between food insecurity and obesity (OR 1·503, 95 % CI: 1·432, 1·577, $P < 0.05$); highlighting that food insecurity increased risk of obesity among adults and children[25]. Within this same review, the narrative synthesis showed association between *different types* of food environments and obesity – for example between the home-food environment or food obtained from charitable sources – moreover, barriers to purchasing fruit and vegetables were identified as significant risk factors[25]. Findings from qualitative studies regarding a reliance on energy-dense, nutrient-poor foods owing to their affordability and accessibility aligned with findings from quantitative studies. Results from both the qualitative and quantitative studies explored potential links between increased body weight and participation in food assistance programmes such as food banks. This comprehensive systematic review confirms that obesogenic food environments and food insecurity significantly contribute to obesity[25], adding to existing evidence that cheap energy-dense foods are favoured over healthier foods, notably fruits and vegetables. Research by Yau et al.[26] confirms that those who are food insecure have poorer diets, however, emergency food aid may not remedy this situation. An earlier international mixed-methods systematic review by Oldroyd et al.[27] updated evidence on the nutritional adequacy of food parcels provided by food banks and reported that pre-prepared food parcels supplied by food banks struggle to meet the nutritional needs of their users.

Out-of-home food environment and deprivation

Access to healthy food is seen as an element to promote policy, systems and environmental change[28,29]. Important within the broader concept of food access are the terms

'affordability' and 'availability'. For example, in England, there is a strong correlation between a higher number of fast-food outlets in more deprived areas[30]. It has also been demonstrated that deprived areas have more takeaway food outlets close to schools[31] as well as having an increased amount of bus shelter advertising of unhealthy food and drinks[32].

Changing behaviours

Many of our food choices are automatic rather than reflective[33]. Habits and behaviours shape food choices[34]; food is intrinsically linked to cultures and social practices of domestic life[35]. Our food choices therefore both determine, and are determined by, our food environments, making them a critical point of intervention in food-related health and wellbeing. Preparing, sharing and eating food is both an everyday occurrence and a socio-culturally complex phenomenon[36] – it is determined through multi-scalar national and international policies and governance-driven decisions[37]. Our food environment mediates our eating behaviours through the mechanisms of availability and accessibility of food. Individual behaviours are influenced by our surrounding environments. Using frameworks, such as the ecological model from Story *et al.*, can be helpful in conceptualising this relationship[38]. However, measuring this association has been problematic[39], with studies in the area presenting conflicting results. Lake[39] describes two studies[40,41] that sought to understand the link between food environments and behaviour. Since then, a study has been published using smartphone self-reported data from 164 926 US participants (MyFitnessPal app users) and 2·3 billion food entries to study the independent contributions of fast-food and grocery store access, income and education to diet health outcomes[42]. This new work indicated there was an association between higher access to grocery stores, lower access to fast food, higher income and high educational attainment with higher consumption of fruit and vegetables, lower intakes of fast food and soda and lower risk of overweight or obesity[42]. Notably, there were significant variations across areas (zip codes) which had predominately black, Hispanic and white demographic sub-groups[42].

Though the burden of obesity and non-communicable disease is a global problem, it is one that is transferring from high-income to low- and middle-income countries with the global distribution and marketing of ultra-processed food[43]. Studies in Brazil[44], South Africa[45] and India[46] highlight the public health risks to people's food choices and health associated with advertising of ultra-processed, high in fat, sugar, or salt (HFSS) foods on free-to-air television. Moreover, in South Africa, a recent study using household survey data with publicly available geospatial (Google) data on modern food retailer locations showed that proximity to bigger-chain supermarkets and fast-food restaurants was significantly associated with overweight and obesity[47].

Successive government strategies have sought to address obesity in the last thirty years. Between 1993 and 2020, there were fourteen obesity strategies published by the UK Government, containing fourteen strategies and 689 policies[48]. However, these policies were not easily implemented in practice, and have overwhelmingly put an emphasis and reliance on individual-level behaviour change. Actions to shape public behaviour are ineffective in the absence of wider environmental–structural changes necessary to support such measures[49]. Theis and White suggested that the emphasis and reliance on individual-level behaviours is an important factor in the UK's high rates of obesity and significant health inequalities[48].

Opportunities to improve population health

In England, the wide-reaching and ambitious National Food Strategy was bold in its vision to create a food system that was good for our health and for planetary health alongside addressing inequalities[50]. However, the lack of a committed political response to this document has proved disappointing and frustrating; this includes the potential shelving of the long-awaited health inequalities white paper[51]. While policy continues to place the individual, rather than the environment, at the heart of government strategy, there is little scope for meaningful upstream intervention, such as the relatively successful UK Government sugar levy[5].

Food retail and the out-of-home food environment

Given the clear evidence that the food environment has an impact on population health, there are surprisingly few studies that decisively demonstrate clear evidence supporting the food retail space as a successful opportunity for influencing health. A recent systematic review[52] aimed to quantify the *spatial* methods used to measure the 'retail food environment', and found great diversity in how retail food environments were measured among the 113 studies included in the analysis.

While food access and availability would intuitively appear to be important areas of opportunity, access and availability are often difficult to measure, and results remain conflicting. A recent North American example[53] found that the introduction of a food store, in what had been described as a 'Food Desert', had little impact on people's behaviours – highlighting that behaviour change involves more than simply increasing accessibility. However, within food supermarkets, there is evidence that purchasing behaviours can be changed by increasing the availability and promotions of healthier foods[54].

While there is an acknowledged proliferation of fast-food outlets, particularly in more deprived areas, research has explored how to work with these food outlets (usually independent and locally owned) to improve the dietary profile of the food they serve[55]. Working with food businesses and the wider food industry, including suppliers[56,57], can help make small but important changes. In England, the effectiveness of such changes were well illustrated by the NIHR School of Public

Health Research Foodscape study[58]. A combined process of literature and scoping reviews, with co-design input from businesses and practitioners, identified successful interventions that modified meals offered by takeaways with the aim of improving diets and/or reducing obesity[55,59]. Examples of these meaningful interventions included the introduction of five-hole rather than the regular seventeen-hole saltshaker, which reduced salt intake by over 66 %[60,61]; and the use of 'light bite' fish and chip boxes, significantly moderating portion sizes and energy intake[56]. The ready adoption of this intervention by the industry points towards long-term sustainability and potential to be used by other out-of-home food retailers. Other interventions, such as 'masterclasses' for businesses, can improve the healthiness of the food on offer[57] by changing the cooking practices and menu options in takeaway food outlets among those who attend training[57]. Such interventions were deemed to be acceptable to business owners, required minimal effort and were cost-effective with the potential for wider use.

Other approaches that have been evaluated include the Gateshead council (a local authority in the north-east of England) multi-pronged, planning policy. Gateshead aimed to reduce childhood obesity rates locally. One aspect of this strategy was to implement three types of planning guidance (a school exclusion zone, restricting new outlets by retail density and restricting new outlets by childhood obesity rates). Brown et al.[62] found that this multi-pronged planning approach can significantly change the proportion and density of fast-food outlets in the short term (four years) compared with other local authorities in the north-east of England.

Though such interventions have proved effective in local and national policy, health strategy and planning must compete with economic growth priorities. In the current economic climate, these tensions may be clearer[5]. For example, local authorities and planning professionals have to decide which problem is better to live with; boarded up, not-in-use, retail units or allowing those units to become fast-food outlets[63].

The changing food environment

The dynamic nature of the food environment could be seen as an opportunity for change. This dynamism was highlighted by the Covid-19 pandemic and subsequent national lockdowns. In England, the government introduced temporary measures to relax food-related planning regulations; allowing pubs and restaurants to operate as hot food takeaways to support people having to stay at home and support businesses[63]. These temporary regulations permitted the change of use without the need for a planning application. In research[63] with local authority professionals (in north-east England) about these temporary regulations, there were high levels of concern about the impact these measures would have on the food environment, influencing food access and population-level public health. This included worries about the implication an increase in the availability of

hot food takeaways could have for dietary intake and levels of obesity[63], as observed in other studies[64]. The growth of the 'online food ordering and delivery platforms' industry, which, in the UK has grown 40·5 % per year on average between 2017 and 2022[65], with further growth predicted[66] as the 'at-home' trend expands after the lockdowns cease, has fuelled these concerns.

Many of the new at-home delivery platforms are serviced by 'dark kitchens'[67]. This is an international phenomenon and can be defined as restaurants without a shopfronts, no direct customer interaction and delivery-only commercial kitchens that rent out shared or private kitchen spaces to food businesses[68]. However, there is potential for opportunities to improve choices made within these platforms using tools such as the design of a web-augmentation-based template to disrupt platform provider behaviours, empower service users and increase individual agency[69] or the use of a universal 'healthiness' rating[70]. This is an emerging field and there is still much to explore.

Food advertising/marketing

The Transport for London 'junk food advertising ban', which placed restrictions on the advertising of foods and beverages high in fat, salt or sugar in order to help tackle childhood obesity, appeared controversial in February 2019 and garnered much negative press[71]. However by April 2022, five local authorities (Bristol and four London boroughs (Southwark, Haringey, Greenwich and Merton)) had announced plans to take similar action[72]. In June 2022, Barnsley announced similar measures[73] with Brighton and Hove to make a final decision in December 2022[74]. The impact of the Transport for London advertising ban and the subsequent evaluation of the ban found a relative reduction in energy, sugar and fat purchased from high fat, sugar and salt products[75]; supporting policies using advertising bans as a method to reduce the purchase of these products.

Outdoor food advertising has received less attention compared with television and digital media: a recent review[76] highlighted a need to understand more about its influence on consumer behaviour and health. Finlay et al.[32] note the complexities of measuring and monitoring outdoor advertising, whilst exploring the value of working with local authorities to shape the outdoor advertising environment to produce positive health outcomes for consumers.

Healthy planning

Shaping the spatial environment has been seen as a credible option to improving the health of populations. In England, The National Planning Policy Framework explicitly states the need to promote healthy communities[77], and that decisions involving the use of planning policies should 'enable and support healthy lifestyles'. The Office for Health Improvement and Disparities

actively encourages local authorities to use their planning system to create 'healthy weight environments'[78]. However, the development and use of local 'healthy weight environment' policies is not a mandatory requirement. Multidisciplinary working across planning and health will result in improved health and more equitable communities[79]. Planning policy and implementation is an important factor in creating sustainable and healthy communities, however, it is not a quick fix, and the wider issues around health and inequality cannot be addressed by planning alone[79].

There is growing acknowledgement of shared responsibility between professions for broad wellbeing gains, including the promotion of a health environment[80]. Research has suggested that 50 % of English local government areas have a planning policy related to the regulation of fast-food outlets[81]. The most common approach is the use of 'exclusion zones' around schools[81]. It is only recently that data have emerged around the effectiveness of such approaches. Brown *et al.*[82] explored the short-term (three-year) impact of planning guidance restricting new fast-food outlets within 400 m of a secondary school and its influence on the food environment in the local authority of Newcastle Upon Tyne, UK. Using food outlet data three years pre-intervention (2012–2015), the intervention year (2016) and three-years' post-intervention (2016–2019); a difference-in-difference approach compared postcodes within the school fast-food outlet exclusion zone to those outside the fast-food exclusion zones[82]. The effects of this guidance in the short term (three years) were not statistically significant when compared with a control zone. However, the authors and others in this field agree that the use of planning to improve population health is likely to be a long-term policy plan to create a sustainable healthy food environment[79,82].

Food security

The current cost-of-living-crisis and rising rates of inflation means that even more of the global population will be pushed towards food insecurity[83]. This is described by the World Bank as a 'global crisis' and is driving many millions to poverty, hunger and malnutrition[83], while the status quo of expansion of food banks normalises food poverty and fails to address the deeper social challenges of food insecurity. The defined long-term solution is to take action to end income and health inequalities, and to ensure populations have access to affordable and nutritious food[84]. In the short term, populations, including those living in high-income countries, need to find models of food supply to those who are food insecure. While research has highlighted the nutritional inadequacy of pre-prepared food parcels given to individuals experiencing food insecurity from foodbanks[27], there is scope to improve the quality of the food provided by these life-lines to people who are in need. Overall, there is an urgent need to plan and holistically redesign food systems to improve access to healthy affordable food.

Understanding how we can reduce food insecurity and stigma, improve access and availability to healthier foods in deprived communities is important in addressing health inequalities across all ages. One solution is the 'social supermarket': a social enterprise model which sells surplus food, available at discounted prices in low-income areas[85,86]; these are usually open to the wider community (not always the case for food banks). Co-produced research is currently underway by the authors to understand more about this food insecurity intervention, examine and generate an understanding of the best ways to help social supermarket customers use healthier produce, thus having a positive impact on health and wellbeing outcomes, cost savings and food system sustainability improvements by reducing the waste of surplus food[87]. Some population groups appear to be more at risk of food insecurity; this includes individuals living with a severe mental illness (SMI). There is an urgent need to understand feasible and acceptable approaches to assist people with SMI to access healthy, affordable food. This is a new field of work and collaborative research with people living with SMI is currently underway[88]. Partnership-working with communities is core within a broad whole systems approach model[89].

Conclusions

Opportunities to create healthier food environments and reduce rates of non-communicable diseases associated with obesity remain challenging within ongoing global economic and environmental crises. Solutions will require social innovation, design thinking and partnership working to be successful. For the food system, this may include, for example, upstream interventions such as alternative distribution and delivery models to improve long-term access, availability and uptake of healthier diets. Regional and national policy must ensure that local food environments allow populations to have access to food with dignity, ensuring that it is healthy, nutritious, culturally appropriate and desirable. Food systems must also improve community wellbeing and resilience to supply 'shocks' through supply chain disruption. Food is rooted in cultural identity and social practices, cutting across ethnicity, generational divides and geography[90], requiring bottom-up community-focused social innovation to be successful. Local and national policies, such as planning regulations, must therefore adapt to fit with the dynamism of the food environment and address the widening inequalities.

Financial Support
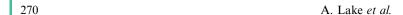
Conflicts of Interest

None.

Authorship

A. A. L. conceived the paper and drafts were developed collaboratively by C. L. O.'M., H. J. M. and M. C. All authors reviewed the final version.

References

1. Goddard A (2022) The cost of living crisis is another reminder that our health is shaped by our environment. *Br Med J* **377**, 1.
2. The Lancet Public Health (2022) The cost of living: an avoidable public health crisis. *The Lancet Public Health* **7**, e485.
3. Townshend T & Lake A (2009) Obesogenic urban form: theory, policy and practice. *Health and Place* **15**, 909–916.
4. NESTA (2022) How improving online food environments can support our health. https://www.nesta.org.uk/blog/how-improving-online-food-environments-can-support-our-health/ (accessed November 2022).
5. Lake A, O'Malley CL & Moore HJ (2022) Environmental drivers of obesity: individual willpower versus societal responsibility. *Nutr Bull* **47**, 277–281.
6. IPCC (2022) Special report: climate change and land. https://www.ipcc.ch/srccl/ (accessed November 2022).
7. Pettinger C (2018) Sustainable eating: opportunities for nutrition professionals. *Nutr Bull* **43**, 226–237.
8. Loken B & DeClerck F (2020) *Diets for a Better Future: Rebooting and Reimagining Healthy and Sustainable Food Systems in the G20*. Oslo: EAT.
9. FAO, IFAD, UNICEF *et al.* (2020) *In Brief to the State of Food Security and Nutrition in the World 2020. Transforming Food Systems for Affordable Healthy Diets*. Rome: FAO.
10. Fanzo J, Bellows AL, Spiker ML *et al.* (2021) The importance of food systems and the environment for nutrition. *Am J Clin Nutr* **113**, 7–16.
11. Veldhuizen LJL, Giller KE, Oosterveer P *et al.* (2020) The missing middle: connected action on agriculture and nutrition across global, national and local levels to achieve sustainable development goal 2. *Glob Food Sec* **24**, 1–6.
12. Rivington M, King R, Duckett D *et al.* (2021) UK food and nutrition security during and after the COVID-19 pandemic. *Nutr Bull* **46**, 88–97.
13. Centre for Cities (2022) Will Covid-19 kill the high street? https://www.centreforcities.org/reader/cities-outlook-2022/will-covid-19-kill-the-high-street/ (accessed November 2022).
14. Eskandari F, Lake A & Butler M (2022) COVID-19 pandemic and food poverty conversations: social network analysis of twitter data. *Nutr Bull* **47**, 93–105.
15. Caraher M & Davison R (2019) The normalisation of food aid: what happened to feeding people well? *Emerald Open Res* **1**, 1–24.
16. May J, Williams A, Cloke P *et al.* (2020) Food banks and the production of scarcity. *Trans the Inst Br Geogr* **45**, 208–222.
17. Moran D, Cossar F, Merkle M *et al.* (2020) UK food system resilience tested by COVID-19. *Nature Food* **1**, 1.
18. Bazerghi C, McKay FH & Dunn M (2016) The role of food banks in addressing food insecurity: a systematic review. *J Community Health* **41**, 732–740.
19. Holmes J (2022) Obesity, deprivation and Covid-19: why rowing back on the obesity strategy could prove to be a costly error: The Kings Fund.
20. WHO (2020) Healthy diet. https://www.who.int/news-room/fact-sheets/detail/healthy-diet (accessed November 2022).
21. Scott C, Sutherland J & Taylor A (2018) *Affordability of the UK's Eatwell Guide*. London, UK: The Food Foundation.
22. Public Health England (2018) Guidance: the Eatwell Guide. https://www.gov.uk/government/publications/the-eatwell-guide (accessed November 2022).
23. Goudie S (2022) Government data on food insecurity during the pandemic: a data story. https://foodfoundation.org.uk/publication/government-data-food-insecurity-during-pandemic-data-story (accessed November 2022).
24. Poulter H, Eberhardt J, Moore H *et al.* (2022) 'Bottom of the pile': health behaviors within the context of in-work poverty in North East England. *J Poverty*, 1–20, doi: 10.1080/10875549.2021.2023721.
25. Eskandari F, Lake AA, Rose K *et al.* (2022) A mixed-method systematic review and meta-analysis of the influences of food environments and food insecurity on obesity in high-income countries. *Food Sci Nutr* **10**, 3689–3723.
26. Yau A, White M, Hammond D *et al.* (2020) Socio-demographic characteristics, diet and health among food insecure UK adults: cross-sectional analysis of the international food policy study. *Public Health Nutr* **23**, 2602–2614.
27. Oldroyd L, Eskandari F, Pratt C *et al.* (2022) The nutritional quality of food parcels provided by food banks and the effectiveness of food banks at reducing food insecurity in developed countries: a mixed-method systematic review. *J Hum Nutr Diet* **35**, 1202–1229.
28. Lake AA, Townshend TG & Burgoine T (2017) Obesogenic neighbourhood food environments. In *Public Health Nutrition*, pp. 327–338 [J Buttriss, A Welch, J Kearney S Lanham-New editors]. Oxford: Wiley-Blackwell Publishing Ltd.].
29. Lyn R, Aytur S, Davis TA *et al.* (2013) Policy, systems, and environmental approaches for obesity prevention: a framework to inform local and state action. *J Public Health Manag Pract* **19**, S23–S33.
30. Public Health England (2018) Obesity and the environment: density of fast food outlets. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/741555/Fast_Food_map.pdf (accessed November 2022).
31. Blow J, Gregg R, Davies I *et al.* (2019) Type and density of independent takeaway outlets: a geographical mapping study in a low socioeconomic ward, Manchester. *BMJ Open* **9**, e023554.
32. Finlay AH, Lloyd S, Lake A *et al.* (2022) An analysis of food and beverage advertising on bus shelters in a deprived area of Northern England. *Public Health Nutr* **25**, 1989–2000.
33. Jebb SA (2018) Interventions to accelerate change towards a healthier diet. *Proc Nutr Soc* **77**, 106–111.
34. Enriquez JP & Archila-Godinez JC (2022) Social and cultural influences on food choices: a review. *Crit Rev Food Sci Nutr* **62**, 3698–3704.
35. Neuman N (2019) On the engagement with social theory in food studies: cultural symbols and social practices. *Food, Cult Soc* **22**, 78–94.
36. Corvo P (2016) *Food Culture, Consumption and Society*. Berlin: Springer.
37. Lake AA & Midgley JL (2010) Food policy and food governance – changing behaviours. In *Obesogenic Environments: Complexities, Perceptions and Objective*

Measures, p. 248 [AA Lake, T Townshend and S Alvanides, editors]. Oxford: Wiley-Blackwell.

38. Story M, Kaphingst KM, Robinson-O'Brien R *et al.* (2008) Creating healthy food and eating environments: policy and environmental approaches. *Annu Rev Public Health* **19**, 253–272.

39. Lake AA (2018) Neighbourhood food environments: food choice, foodscapes and planning for health. *Proc Nutr Soc* **77**, 239–246.

40. Tyrrell RL, Greenhalgh F, Hodgson S *et al.* (2016) Food environments of young people: linking individual behaviour to environmental context. *J Public Health* **39**, 95–104.

41. Vogel C, Lewis D, Ntani G *et al.* (2017) The relationship between dietary quality and the local food environment differs according to level of educational attainment: a cross-sectional study. *PLoS ONE* **12**, e0183700.

42. Althoff T, Nilforoshan H, Hua J *et al.* (2022) Large-scale diet tracking data reveal disparate associations between food environment and diet. *Nat Commun* **13**, 1–12.

43. Dicken SJ & Batterham RL (2022) Ultra-processed food: a global problem requiring a global solution. *The Lancet Diabetes & Endocrinol* **10**, 691–694.

44. Guimarães JS, Mais LA, Leite FHM *et al.* (2020) Ultra-processed food and beverage advertising on Brazilian television by international network for food and obesity/non-communicable diseases research, monitoring and action support benchmark. *Public Health Nutr* **23**, 2657–2662.

45. Reddy K (2020) Protecting children as consumers: obesity and the regulation of unhealthy food product marketing in South Africa. *J South African Law/Tydskrif vir die Suid-Afrikaanse Reg* **2020**, 441–459.

46. Mehta R & Bharadwaj A (2021) Food advertising targeting children in India: analysis and implications. *J Retail and Consum Serv* **59**, 1–10.

47. Otterbach S, Oskorouchi HR, Rogan M *et al.* (2021) Using Google data to measure the role of Big Food and fast food in South Africa's obesity epidemic. *World Dev* **140**, 1–13.

48. Theis DRZ & White M (2021) Is obesity policy in England fit for purpose? Analysis of government strategies and policies, 1992–2020. *Milbank Q* **99**, 126–170.

49. Swinburn B, Kraak V, Rutter H *et al.* (2015) Strengthening of accountability systems to create healthy food environments and reduce global obesity. *Lancet* **385**, 2534–2545.

50. Dimbleby H (2020) *The National Food Strategy*. London: The National Food Strategy.

51. McCay L (2022) Why a health inequalities white paper is still so vital and should not be scrapped. *Br Med J* **278**, 1–2.

52. Wilkins E, Radley D, Morris M *et al.* (2019) A systematic review employing the GeoFERN framework to examine methods, reporting quality and associations between the retail food environment and obesity. *Health Place* **57**, 186–199.

53. Sadler RC, Gilliland JA & Arku G (2013) A food retail-based intervention on food security and consumption. *Int J Environ Res Public Health* **10**, 3325–3346.

54. Piernas C, Harmer G & Jebb SA (2022) Testing availability, positioning, promotions, and signage of healthier food options and purchasing behaviour within major UK supermarkets: evaluation of 6 nonrandomised controlled intervention studies. *PLoS Med* **19**, 1–17.

55. Hillier-Brown FC, Summerbell CD, Moore HJ *et al.* (2017) A description of interventions promoting healthier ready-to-eat meals (to eat in, to take away, or to be delivered) sold by specific food outlets in England: a systematic

mapping and evidence synthesis. *BMC Public Health* **17**, 1–17.

56. Goffe L, Hillier-Brown F, Hildred NJ *et al.* (2019) Feasibility of working with a wholesale supplier to co-design and test acceptability of an intervention to promote smaller portions: an uncontrolled before-and-after study in British Fish & Chip shops. *BMJ Open* **9**, e023441.

57. Hillier-Brown FC, Lloyd S, Muhammad L *et al.* (2019) Feasibility and acceptability of a takeaway masterclass aimed at encouraging healthier cooking practices and menu options in takeaway food outlets. *Public Health Nutr* **22**, 2268–2278.

58. NIHR School for Public Health Research (2017) Transforming the 'foodscape': development and feasibility testing of interventions to promote healthier take-away, pub or restaurant food. https://sphr.nihr.ac.uk/research/foodscape/ (accessed November 2022).

59. Hillier-Brown FC, Summerbell CD, Moore HJ *et al.* (2016) The impact of interventions to promote healthier ready-to-eat meals (to eat in, to take away, or to be delivered) sold by specific food outlets open to the general public: a systematic review. *Obes Rev* **18**, 227–246.

60. Goffe L, Hillier-Brown FC, Doherty A *et al.* (2016) Comparison of sodium content of meals served by independent take-aways using standard versus reduced holed salt shakers: cross-sectional study. *Int J Behav Nutr Phys Act* **13**, 1–6.

61. Goffe L, Wrieden WL, Penn L *et al.* (2016) Reducing the salt added to take-away food: within-subjects' comparison of salt delivered by five and 17 holed salt shakers in controlled conditions. *PLoS ONE* **11**, 1–9.

62. Brown H, Xianga X, Albania V *et al.* (2022) No new fast-food outlets allowed! Evaluating the effect of planning policy on the local food environment in the north east of England. *Soc Sci Med* **306**, 115126.

63. Moore H, Lake A, O'Malley C *et al.* (2022) The impact of COVID-19 on the hot food takeaway planning regulatory environment: perspectives of local authority professionals in the North East of England. *Perspect Public Health*, doi: 10.1177/17579139221106343.

64. Keeble M, Adams J, Vanderlee L *et al.* (2021) Associations between online food outlet access and online food delivery service use amongst adults in the UK: a cross-sectional analysis of linked data. *BMC Public Health* **21**, 1–12.

65. IBIS World (2022) Online food ordering & delivery platforms in the UK – market size 2011–2029. https://www.ibisworld.com/united-kingdom/market-size/online-food-ordering-delivery-platforms/ (accessed November 2022).

66. IBIS World (2022) Online food ordering & delivery platforms in the UK – market research report. https://www.ibisworld.com/united-kingdom/market-research-reports/online-food-ordering-delivery-platforms-industry/ (accessed November 2022).

67. Rinaldi C, D'Aguilar M & Egan M (2022) Understanding the online environment for the delivery of food, alcohol and tobacco: an exploratory analysis of 'dark kitchens' and rapid grocery delivery services. *Int J Environ Res Public Health* **19**, 1–16.

68. Hakim MP, Dela Libera VM, Zanetta LD *et al.* (2022) What is a dark kitchen? A study of consumer's perceptions of deliver-only restaurants using food delivery apps in Brazil. *Food Res Int* **161**, 1–10.

69. Goffe L, Chivukula SS, Bowyer A *et al.* (2021) Web augmentation for well-being: the human-centred design of a takeaway food ordering digital platform. *Interact Comput* **33**, 335–352.

70. Goffe L, Uwamahoro NS, Dixon CJ *et al*. (2020) Supporting a healthier takeaway meal choice: creating a universal health rating for online takeaway fast-food outlets. *Int J Environ Res Public Health* **17**, 1–12.

71. Thompson C, Clary C, Er V *et al*. (2021) Media representations of opposition to the 'junk food advertising ban' on the Transport for London (TfL) network: a thematic content analysis of UK news and trade press. *SSM – Population Health* **15**, 1–10.

72. Tatum M (2022) The towns and cities taking junk food bans into their own hands. https://www.thegrocer.co.uk/health/the-towns-taking-junk-food-bans-into-their-own-hands/666492.article (accessed November 2022).

73. Sustain (2022) Barnsley becomes first northern town to introduce junk food advertising restrictions. https://www.sustainweb.org/news/may22-barnsley-advertising-policy/ (accessed November 2022).

74. Booker-Lewis S (2022) Fast food advert ban in Brighton and Hove wins health board backing. In *The Argus*, p. 1. High Wycombe: Newsquest Media Group Ltd.

75. Yau A, Berger N, Law C *et al*. (2022) Changes in household food and drink purchases following restrictions on the advertisement of high fat, salt, and sugar products across the Transport for London network: a controlled interrupted time series analysis. *PLoS Med* **19**, 1–23.

76. Finlay A, Robinson E, Jones A *et al*. (2022) A scoping review of outdoor food marketing: exposure, power and impacts on eating behaviour and health. *BMC Public Health* **22**, 1–48.

77. Ministry of Housing Communities and Local Government (2022) *National Planning Policy Framework*. London: UK Government.

78. Public Health England (2020) *Using the Planning System to Promote Healthy Weight Environments. Guidance and Supplementary Planning Document Template for Local Authority Public Health and Planning Teams*. London: Public Health England.

79. McKinnon G, Pineo H, Chang M *et al*. (2020) Strengthening the links between planning and health in England. *The BMJ* **369**, m795.

80. Lake AA, Henderson EJ & Townshend TG (2017) Exploring planners' and public health practitioners' views on addressing obesity: lessons from local government in England. *Cities & Health* **1**, 185–193.

81. Keeble M, Burgoine T, White M *et al*. (2019) How does local government use the planning system to regulate hot food takeaway outlets? A census of current practice in England using document review. *Health Place* **57**, 171–178.

82. Brown H, Kirkman S, Albani V *et al*. (2021) The impact of school exclusion zone planning guidance on the number and type of food outlets in an English local authority: a longitudinal analysis. *Health Place* **70**, 1–8.

83. The World Bank (2022) Food security update; World Bank response to rising food insecurity. https://www.worldbank.org/en/topic/agriculture/brief/food-security-update (accessed November 2022).

84. D'Odorico P, Carr JA, Davis KF *et al*. (2019) Food inequality, injustice, and rights. *BioScience* **69**, 180–190.

85. Holweg C, Lienbacher E & Zinn W (2015) Social supermarkets – a new challenge in supply chain management and sustainability. *Supply Chain Forum: Int J* **11**, 50–58.

86. Nott G (2022) The unfortunate rise of social supermarkets: saving surplus food for those in need. https://www.thegrocer.co.uk/supermarkets/the-unfortunate-rise-of-social-supermarkets-saving-surplus-food-for-those-in-need/664913.article (accessed November 2022).

87. O'Malley CL (2022) Community social supermarkets: understanding how they shape access and availability to healthier foods in food insecure communities. https://research.tees.ac.uk/en/projects/community-social-supermarkets-understanding-how-they-shape-access (accessed November 2022).

88. Giles E & Smith J (2021) A mixed methods study using co-production to explore food insecurity in adults with severe mental illness living in Northern England. https://fundingawards.nihr.ac.uk/award/NIHR203466 (accessed November 2022).

89. Bagnall AM, Radley D, Jones R *et al*. (2019) Whole systems approaches to obesity and other complex public health challenges: a systematic review. *BMC Public Health* **19**, 8, https://doi.org/10.1186/s12889-018-6274-z.

90. Blake MK (2019) More than just food: food insecurity and resilient place making through community self-organising. *Sustainability* **11**, 1–22.