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## Contextual correlates of dietary behaviours in adults across Europe

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## ENGLISH SUMMARY

Unhealthy dietary behaviours are considered to be a major risk factor for mortality, such that in 2017, 11 million deaths were attributed to dietary behaviours such as low intake of whole grains and fruit and vegetables, and high intake of sodium. Dietary behaviour is any behaviour that relates individuals to food, and it captures different dietary aspects such as food choices, eating behaviour, and dietary intake. Both individual factors such as biological (e.g., age, sex) and psychological and social-cognitive factors (e.g., preferences, beliefs and intentions), as well as contextual factors, such as aspects of the social and built environments, can influence dietary behaviours. While individual determinants of dietary behaviours have frequently been investigated, in recent decades attention has shifted to their potential contextual determinants. The general objective of this thesis was to explore how individual-level and environmental-level factors were associated with dietary behaviours in Europe, and how methodological decisions on the definition of exposure to the food environment may influence these associations.

On the individual-level, in Chapter 2, we explored associations between various perceived barriers to healthy eating and dietary behaviours among 5,900 adults from urban regions in five European countries from the SPOTLIGHT study, and examined whether associations differed across regions and socio-demographic backgrounds. We found that individuals who perceived any barrier were less likely to report higher consumption of healthier foods and more likely to report higher consumption of fast food. For example, those who perceived to have a busy lifestyle generally ate less vegetables (odds ratio (OR) = 0.54; 95% confidence interval (CI) = 0.47 – 0.62) and more fast food (OR = 2.07; 95% CI = 1.57 – 2.73) as compared to individuals who reported to not perceive to have a busy lifestyle. The association between various barriers and lower intake of fruit and vegetables was somewhat more pronounced among younger participants and women. Regarding environmental-level factors, little is known about how the food environment is associated with aspects of eating behaviours such as home-cooking - a behaviour that is linked to healthier diets. Therefore, in Chapter 3, we explored the independent and combined associations between residential neighbourhood access to restaurants and grocery stores with home cooking in 5,076

European adults. We found that greater access to restaurants was associated with lower frequency of home cooking (relative risk ratio (RRR) = 0.42; 95%CI = 0.23-0.76), largely independent of access to grocery stores. Most studies in food environment research define exposure to the food environment considering only one type of food retailer, while ignoring the relative influence of a variety of food retailers. In Chapter 4, we explored the associations of absolute and relative measures using simpler and more complex measures of exposure to food retailers with dietary patterns. We did not find evidence for a relation between the food environment and dietary pattern with any of the measures used. We found some indication that absolute and relative measures of exposure assess different aspects of the food environment. However, potentially due to the lack of significant associations, we did not find evidence that more complex measures of exposure to food retailers produce stronger associations with dietary patterns. This could be further explored in future studies that use different outcomes and focus on different settings. Another common challenge of investigating the impact of the food environment on dietary behaviours is how to define the relevant areas of exposure to the food environment. In the Dutch adult population of 1,245 adult participants from the SPOTLIGHT study, we tested the association of density of restaurants with home cooking using different definitions of residential neighbourhoods in Chapter 5. Unlike our findings in the European SPOTLIGHT population, no significant associations between food environment and home cooking were observed and the effect sizes were negligible. In addition to that, although the exposure in terms of density of restaurants was different according to different neighbourhood definitions, we found no evidence that the area under study (i.e. various buffer sizes, administrative neighbourhood boundaries and a self-defined neighbourhood boundary) influences the association between density of restaurants and home-cooking in a Dutch adult population. Still, concerning relevant areas of exposure to the food environment, changes in the distribution of food retailers across a determined geographical area (foodscape) are likely to influence dietary behaviours. We explored if and how the availability of different food retailers, adjusted for the number of inhabitants per neighbourhood, has changed over a 14 years period in the Netherlands in Chapter 6. We also explored whether this change was different according to neighbourhood socioeconomic status (SES) and urbanisation levels. Including almost all Dutch

neighbourhoods between 2004 (n=9,956) and 2018 (n=11,751), we observed a 120% and 35% increase in the counts of food delivery outlets and restaurants respectively, and a 26% decrease in the counts of local shops. Effect modification analyses showed that in more urban and lower SES neighbourhoods an increase in the availability of supermarkets and convenience stores was observed, while a decrease was observed in the less urbanised and higher SES neighbourhoods. In general, the foodscape appears to have changed towards offering a higher supply of convenience and ready-to-eat foods. Finally, in Chapter 7, in an elderly Dutch population of 8,104 participants from the EPIC-NL cohort, we explored the association between exposure to the food environment and the consumption of ultra-processed foods (UPF). We used a comprehensive approach to define exposure to the food environment that included the use of both measures of availability of and proximity to different types of food retailers within buffers of different sizes. Furthermore, we used more complex methods for deriving exposure variables, such as street network distances and kernel density estimates. We found that higher consumption of UPF was associated with unhealthier dietary intake. We also found evidence that higher exposure to supermarkets, fast food restaurants, full-service restaurants, convenience stores and candy stores and cafés in the residential neighbourhood was weakly associated with a lower consumption of UPF.

In general, the studies included in this thesis did not generate convincing evidence for a link between the geographically measured food environment and diet in European adults. In addition, despite our efforts to try to capture the complexity of exposure to the food environment using a range of methods such as deriving more complex absolute and relative measures, exploring different neighbourhood definitions and adjusting our analysis for the broader food environment, we could not demonstrate that such methodological decisions result in more consistent associations. Despite the lack of consistent evidence, the potential influence that the food environment exerts on dietary behaviour is well accepted by researchers in the field, and the fact that the body of evidence is not robust does not necessarily have to prevent public health policies and interventions to be implemented. Future research should move from the large focus on the geographic availability of food retailers to embrace other understudied aspects of the food environment such as quality of foods offered in stores, economic accessibility,

and food advertisements. An indirect effect of the food environment should also be explored as the relation between the food environment and diet may be mediated by individual level factors related to food choice, such as taste preferences, food preparation skills, use of food retailers and the individual perception of the food environment.