Contextual correlates of dietary behaviours in adults across Europe

Matias de Pinho, M.G.

2019

document version
Publisher's PDF, also known as Version of record

Chapter 6

Changes in the Dutch foodscape over time: socioeconomic and urban-rural differences

MGM Pinho, JD Mackenbach, NR den Braver, JWJ Beulens, J Brug , J Lakerveld

Submitted

Abstract

Background: Changes in the food environment may influence dietary behaviours, but few countries have been able to quantify changes in their foodscape. We explored whether and how the availability of different types of food retailers has changed in the Netherlands, overall and across levels of neighbourhood socioeconomic status (SES) and urbanisation. **Methods**: This was a longitudinal ecological study conducted in the Netherlands with data from 2004 to 2018. Neighbourhoods, defined by administrative boundaries, were the unit of analysis. For all years, geographic location and type of each food retailer were objectively assessed by a commercial company. Food retailers were categorised as local food shops, fast food restaurants, food delivery, full-service restaurants, supermarkets, and convenience stores. Information on neighbourhood SES and level of urbanisation was obtained from Central Bureau of Statistics. To test the change in the counts of food retailers from 2004 to 2018, we used negative binomial generalized estimating equations, with neighbourhoods as the group variable, time as the independent variable and the count of each type of food retailer as outcome. Analyses were adjusted for the number of inhabitants per neighbourhood to account for changes in population density. We tested effect modification by adding an interaction term for neighbourhood SES and urbanisation to the models. **Results**: In Dutch neighbourhoods between 2004 and 2018, a 120% and 35% increase was found in the count of food delivery outlets and restaurants, respectively, and a 26% decrease in count of local shops. Stratified analyses showed that in more urbanised 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. **Conclusions**: We observed considerable changes in the Dutch foodscape over a 14-year period. Changes differed for some food retailers according to neighbourhood SES and urbanisation. Overall, the foodscape appears to have changed towards offering a higher supply of convenience and ready-to-eat foods.

Background

Current dietary patterns in high-income countries are characterized by a great share of animal food products and ultra-processed foods. Such foods are often energy-dense, high in fat, salt or sugar. Intakes of fruits and vegetables, fibre and fresh products are generally low and the preparation of home-cooked meals is decreasing [1-4]. Changes in the food environment may be an important driver of unhealthy dietary patterns and their related health consequences such as obesity, type 2 diabetes and cardiovascular diseases [5-7].

The foodscape (i.e., the distribution of food retailers in a determined geographical area) is an important aspect of the food environment [8]. However, few countries have been able to quantify changes in their foodscape [9-11]. Evidence suggests that some aspects of the foodscape may change relatively quickly, and that the window of change as well as the type of change may differ according to neighbourhood socioeconomic status [9, 12, 11]. A changing food environment may have contributed to the increase of obesity rates; for example, in the Netherlands the prevalence of obesity has doubled over a period of 20 years [13], despite being lower than in most other countries that are part of the Organisation for Economic Co-operation and Development. While research from the Netherlands found evidence for a link between the food environment and dietary patterns and non-communicable diseases [14, 15], no studies have been published to date on how the Dutch foodscape has changed over time. Insight on how the foodscape has changed may be valuable to understand inconsistent results found in current literature, design new studies as well as policies that aim to facilitate a healthier food environment.

Recent developments, such as ongoing urbanisation, differences in levels of affluence, time restraints a growing need for convenience and information technology developments are likely to influence changes in the foodscape. As such, the aim of this study was to analyse if and how the availability of different types of food retailers, adjusted for the number of inhabitants per neighbourhood, has changed between 2004 and 2018, and to explore whether this change (if any) was different according to neighbourhood socioeconomic status (SES) and urbanisation levels.

Methods

This longitudinal ecological study was conducted in the Netherlands. The units of analysis in this study were administrative neighbourhoods as defined by Central Bureau of Statistics (CBS) of the Netherlands.

Data sources

Food environment

The location of all food retailers was determined via geographic coordinates as collected by an independent Dutch company that collects objective data on the Dutch retail landscape (Locatus, https://locatus.com/en/). Since 2004, Locatus systematically performs regular field audits to map the locations and types of stores for commercial purposes; thus, the geographical location of any retailer in the Netherlands is determined. The frequency of field audits varies from once a year - in shopping areas - to once every 2 or 3 years in regions located outside shopping areas. For this study, we included retailers of which the primary activity was to sell food or meals, and excluded other types of retailers that may sell foods as a secondary activity, such as gas stations and drugstores. The validity of Locatus data was tested against a field audit in selected areas across the Netherlands in 2019. This validation study showed the location and classification of grocery stores (e.g., supermarkets, local food shops, green grocers) and food outlets (e.g. restaurants, fast food restaurants) was "good" to "excellent". For instance, the positive predictive value for location of all food retailers was 0.897, concordance was 0.827, and Kappa was 0.576. (Canalia 2019, in preparation). In the current analysis, food retailers were aggregated into the following categories: local food shops; fast food restaurants; food delivery outlets; full-service restaurants; supermarkets; and convenience stores; Table 1 shows the composition of each food retailer category.

Table 1. Categories of food retailers analysed.

Analytical category	Composed of	Food retailers' main provision of foods:
Local food shops	Greengrocers	Potatoes, vegetables and fruit
	Butchery	Meat and meat products
	Poultry shop	Poultry
	Bakery	Bread and pastries. Table service is possible, but this is not be the main store activity
	Fish stores	Fish, crustaceans and molluscs
Fast food restaurants	Fast food chains and locally owned fast food restaurants	Mostly deep-fried products that are ready for consumption in few minutes after ordering. Usually there is no table service available
Food delivery	Food delivery Take away	Meals that are not consumed in the store, but are collected or delivered
Restaurants	Restaurant	Provision of meals *a-la-carte*, table service is present. Drinks are only provided in combination with food
	Café-restaurant	Provision of both drinks and simple meals
	Restaurant in hotels	Overnight in combination with an *a-la-carte* restaurant
Supermarket	Supermarket	Store selling a wide range of food and non-food products which are used on a daily bases. Store size should be at least 150 m^2
Convenience stores	Convenience stores	Same as supermarkets but store size is less than 150 m^2

Neighbourhood level of urbanisation and SES

Based on the density of residential addresses per square-kilometre (km^2), CBS defines 5 levels of urbanisation annually. Due to the distribution of the urbanisation variable (with few neighbourhoods in the lowest three categories), we had to aggregate the three lowest categories of urbanisation for analytical purposes. Therefore, the first, second and third urbanisation categories are composed of areas with 1000 addresses or more per km^2 and indicate the highest urbanisation category. The fifth urbanisation category is composed of areas with less than 500 addresses per km^2 and indicates the lowest urbanisation category.

Information on neighbourhood SES was obtained from the CBS website. The average value of residential properties per neighbourhood per year was used as a proxy for neighbourhood SES [16]. Because in 2018 housing prices were not yet

available at the time of analysis, the average housing price per neighbourhood in 2017 was used for 2018. In order to obtain a similar variable as the neighbourhood urbanisation variable, the continuous variables for average housing price (neighbourhood SES) were split into quintiles, with the first quintile being composed of the lowest values for average house prices (lowest neighbourhood SES) and the fifth quintile representing the highest values for average house prices (highest neighbourhood SES).

For these analyses, only the top and bottom categories of neighbourhood SES and urbanisation were considered. In the results section we present a table describing the percentage of neighbourhoods in each SES and urbanisation category.

Statistical analysis

In order to avoid including non-residential areas -such as natural reserves, neighbourhoods composed mostly of water or big industrial areas- , we included only neighbourhoods with at least 100 inhabitants in the analysis. To obtain the counts of food retailers per neighbourhood, we intersected a layer in ArcGIS® containing the location of food retailers to a layer containing the neighbourhood information. To test the average change in the count of food retailers from 2004 to 2018, we used negative binomial generalized estimating equations (GEE) with the neighbourhood as the group variable, dummy variables for each year as independent variable and the counts of each food retailer as the outcome in separate models. For these analyses, 2004 was considered the baseline value and yearly changes were compared to 2004. Because variation in the count of food retailers could reflect variation in population density over time, we adjusted our models for the number of inhabitants per neighbourhood. We also tested whether the average change in the count of food retailers was different according to neighbourhood SES and urbanisation. For this purpose, we tested effect modification by adding an interaction term between 'year' and 'neighbourhood SES' or 'urbanisation' to each model. Given the large number of neighbourhoods, significant interaction was considered with $p<0.001$. GEE analyses were conducted in STATA and graphs were produced in RStudio.

Results

The total number of neighbourhoods per year included in the analysis ranged from 9,956 (in 2004) to 11,751 (in 2018). Some neighbourhoods emerged and others ceased to exist over time, affecting the number of neighbourhood observations per year. All neighbourhood observations over the fourteen analysed years summed to a total of 151,150 observations. As in the GEE analysis each neighbourhood observed at least once over the 14 years period counts as one unit of analysis, the final analysed number of neighbourhoods was 15,394. Table 2 shows descriptive neighbourhood statistics at baseline. The maximum number of food retailers per neighbourhood in 2004 was 228, ranging from a maximum number of 7 supermarkets to a maximum number of 121 restaurants per neighbourhood. The median counts of food retailers were mostly zero for the totality of neighbourhoods and also by lowest and highest categories of neighbourhood SES and urbanisation. However, considering the interquartile ranges, the average counts of all types of food retailers were higher in the low SES and the highly urbanized neighbourhoods than in the high SES and the low urbanized neighbourhoods (data not shown). Table 3 shows the distribution of neighbourhoods according to neighbourhood socioeconomic status (SES) and urbanisation level. We observed that 75.5% of the lowest SES neighbourhoods were also the highest urbanised neighbourhoods, and 69.3% of all highest SES neighbourhoods were also the least urbanised neighbourhoods.

Table 2. Descriptive baseline characteristics of neighbourhoods.

	Total neighbourhoods (2004) n = 9,956	
	Counts Min-Max	Median (IQR)
Total counts of food retailers	0 – 228	1 (0 – 4)
Counts of fast food restaurants	0 – 35	0 (0 – 1)
Counts of food delivery places	0 – 16	0 (0 – 0)
Counts of supermarkets	0 – 7	0 (0 – 1)
Counts of local shops	0 – 39	0 (0 – 1)
Counts of restaurants	0 – 121	0 (0 – 1)
Counts of convenience stores	0 – 10	0 (0 – 0)
Inhabitants per neighbourhood	100 – 27,500	330 (910 – 2,230)

Table 3. Distribution of neighbourhoods according to neighbourhood socioeconomic status (SES) and urbanisation levels.

Neighbourhood SES		Urbanisation				
		Highest *				Lowest
		1	2	3	4	5
Lowest	1 (n= 27,877)	**26.7%**	**33.2%**	**15.6%**	8.7%	16.0%
	2 (n= 27,735)	15.2%	25.6%	17.1%	16.0%	26.2%
	3 (n= 27,644)	7.8%	17.9%	16.6%	19.1%	38.6%
	4 (n= 27,511)	5.5%	10.1%	12.6%	18.0%	53.8%
Highest	5 (n= 27,523)	3.9%	5.9%	7.2%	13.6%	**69.3%**

* the highest urbanization category is composed of the highest 3 urbanization levels as defined by the Central Bureau of Statistics (CBS). Values in bold represent the overlap between lowest and highest categories of neighbourhood SES and urbanisation.

Figure 1 shows the average change in the counts per neighbourhood of the various types of food retailers in the Netherlands. The biggest changes were observed for food delivery places, restaurants and local shops. Neighbourhoods in 2018, as compared to 2004, had a 120% increase in the count of food delivery outlets (incidence rate ratio (IRR) = 2.22, 95% confidence interval (CI) = 2.04 – 2.41); 35% increase in the counts of restaurants (IRR = 1.35, 95%CI = 1.30 – 1.40); and 24% decrease in count of local shops (IRR = 0.76, 95%CI = 0.74 – 0.79). A weaker increase was observed for convenience stores (IRR = 1.13, 95%CI = 1.04 – 1.23) and fast food restaurants (IRR = 1.06, 95%CI = 1.02 – 1.10) in 2018 as compared to 2004.

For counts of supermarkets, no significant change was observed in 2018 as compared to 2004 (IRR = 1.01, 95%CI = 0.98 – 1.04).

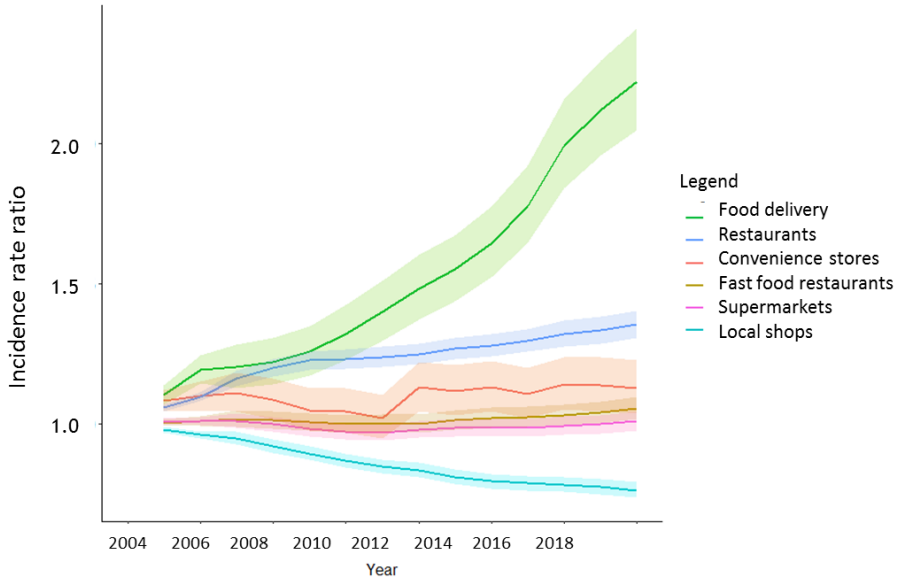

Figure 1. Incidence rate ratio and 95% confidence interval for average change in the neighbourhood counts of food retailers in the Netherlands. Coefficients were derived from negative binomial generalized estimating equations (GEE) analysis. Analyses were adjusted for the number of inhabitants per neighbourhoods.

Significant effect modification (p<0.001) was observed for a change in the availability of convenience stores and supermarkets across lowest and highest neighbourhood SES and urbanisation. Figure 2 shows stratified analyses by neighbourhood SES. The count of both convenience stores and supermarkets was higher in the lowest SES neighbourhoods over the entire study period, with the average counts of convenience stores increasing 58% (IRR = 1.58, 95%CI = 1.38 – 1.80) in the lowest, and decreasing 46% (IRR = 0.54, 95%CI = 0.43 – 0.68) in the highest SES neighbourhood strata in 2018 as compared to 2004. For supermarkets, an increase of 10% and a decrease of 29% was observed for lowest (IRR = 1.10, 95%CI = 1.03 – 1.17) and highest (IRR = 0.71, 95%CI = 0.61 – 0.84) SES neighbourhood, respectively. Food delivery places increased in both lowest (IRR = 2.15, 95%CI = 1.90 – 2.44) and highest (IRR = 3.00, 95%CI = 2.32 – 3.87) SES neighbourhoods. Although

the average counts of food delivery outlets were higher for the highest SES neighbourhoods over the entire study period, no effect modification by neighbourhood SES was found. Local shops decreased and restaurants increased from 2004 to 2018, but there were no differences across lowest and highest SES neighbourhoods and the effect sizes across both neighbourhood types were very similar: local shops had a 29% and 22% decrease for lowest and highest SES neighbourhood respectively, and restaurants had approximately 30% increase in both neighbourhood types. While average count of fast food restaurants was higher for the lowest SES neighbourhood over the study period, no significant change was observed in both lowest and highest SES neighbourhood from 2004 to 2018.

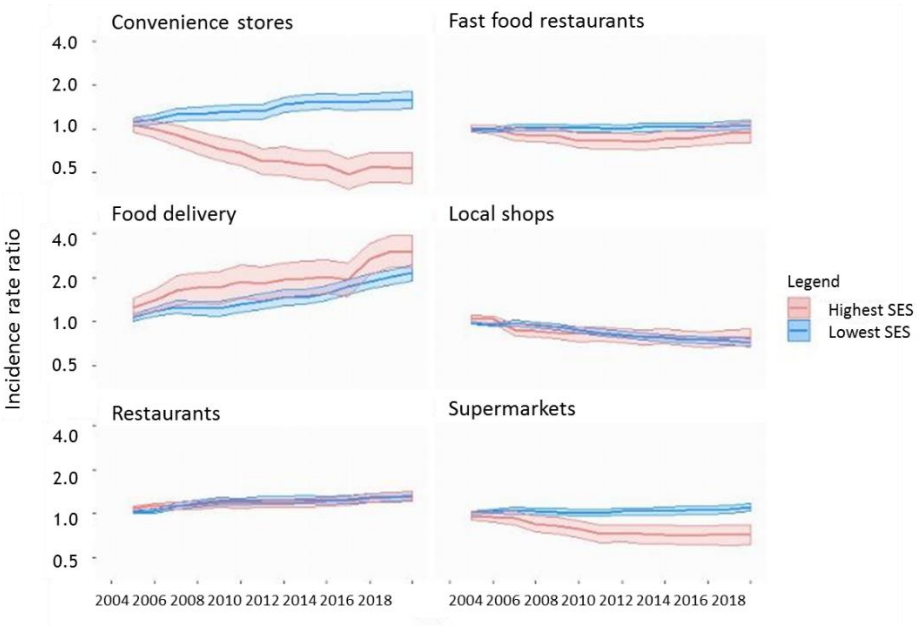

Figure 2. Incidence rate ratio and 95% confidence interval for average change in the neighbourhood counts of food retailers in the Netherlands. Coefficients were derived from generalized estimating equations (GEE) analysis. Analyses were adjusted for number of inhabitants per neighbourhood.

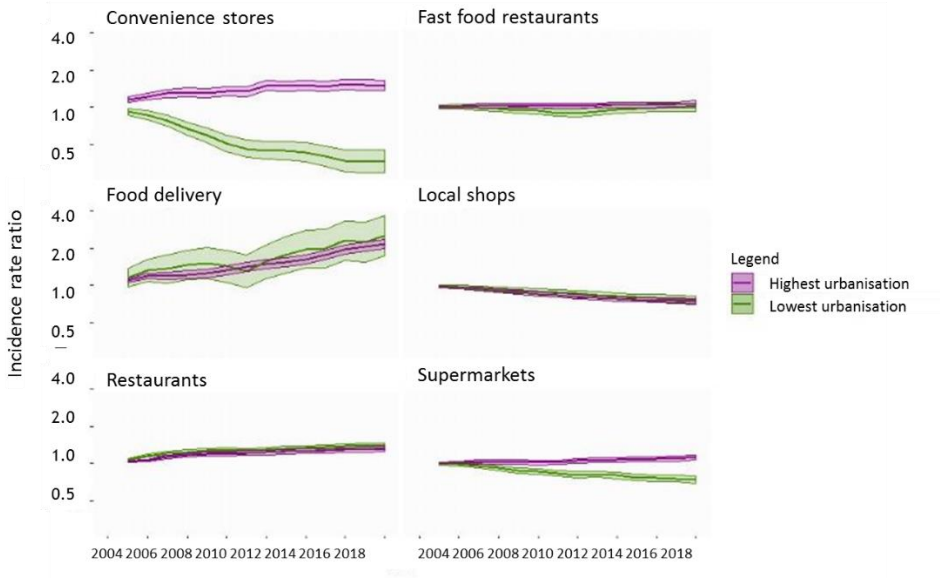

Figure 3. Incidence rate ratio and 95% confidence interval for average change in the neighbourhood counts of food retailers in the Netherlands. Coefficients were derived from generalized estimating equations (GEE) analysis. Analyses were adjusted for number of inhabitants per neighbourhood.

Figure 3 shows the results of stratified analyses by urbanisation level. Similar to the analysis stratified by neighbourhood SES, significant effect modification ($p<0.001$) was observed for a change in the availability of convenience stores and supermarkets across lowest and highest levels of urbanisation. In 2018, as compared to 2004, counts of convenience stores increased by 50% (IRR = 1.50, 95%CI = 1.35 – 1.66) and supermarkets increased by 13% (IRR = 1.13, 95%CI = 1.08 – 1.18) in the highest urbanised neighbourhoods. In the lowest urbanised neighbourhoods, convenience stores decreased 64% (IRR = 0.36, 95%CI = 0.29 – 0.45) and supermarkets decreased 26% (IRR = 0.74, 95%CI = 0.69 – 0.79). Food delivery places and restaurants increased in both levels of urbanisation. Food delivery outlets had a 154% increase in the lowest (IRR = 2.54, 95%CI = 1.75 – 3.68) and a 116% increase in the highest urbanised neighbourhoods (IRR = 2.16, 95%CI = 1.98 – 2.36). Restaurants increased 41% in the lowest (IRR = 1.41, 95%CI = 1.34 – 1.48) and 33% in the highest urbanised neighbourhoods (IRR = 1.33, 95%CI = 1.26 – 1.40). For fast food restaurants, while no significant effect modification was found, in the stratified analysis a small increase of 7% was observed in the highest urbanised neighbourhoods (IRR = 1.07, 95%CI = 1.02 – 1.12). Similarly, no differences across

levels of urbanisation were observed for local shops as a decrease of about 25% was observed for both lowest (IRR = 0.76, 95%CI = 0.71 – 0.81) and highest (IRR = 0.74, 95%CI = 0.70 – 0.77) urbanisation levels.

Discussion

In this study we analysed changes in the Dutch foodscape over the years 2004 to 2018 and explored whether these changes were different according to neighbourhood SES and levels of urbanisation. We found a remarkable increase in the availability of food delivery outlets, restaurants and to a lesser extent in fast food restaurants. A decrease was observed in the availability of local food shops. In the general analysis, the apparent null effect for a change in the availability of supermarkets and convenience stores was most likely due to effect modification by neighbourhood SES and urbanisation levels. In the stratified analysis, more urbanised as well as lower SES neighbourhoods showed an increase in the availability of supermarkets and convenience stores, while a decrease was observed in the less urbanised and higher SES neighbourhoods.

Only few earlier studies analysed trends in their foodscape. In addition, previous studies investigated different kinds of food retailers, used different classifications, or are from countries depicting a different foodscape than in the Netherlands [10, 11]. Nonetheless, a study from the UK found a general increase of 45% in the availability of takeaway outlets over an 18 years period, while a stronger increase of 120% was observed in our study for food delivery places, which included takeaway outlets. Also, they found an increase in the availability of supermarkets, while in our study the availability of supermarkets remained constant in the general analysis [11]. Similar to our findings, a study from the US observed an increase in the availability of restaurants and fast food restaurants and a decrease in the availability of independent grocery stores, while the availability of supermarkets remained relatively constant. Also, they observed an increase in the availability of bakeries, while in our study, bakeries were part of the local shop category, which generally decreased overtime [10]. These general trends of increasing availability of food delivery outlets and restaurants and the decreased availability of local shops are in line with previous changes in dietary patterns of populations that shifted towards fewer home cooked meals and more ready-to-eat meals and eating-out [3, 1, 4]. This scenario may potently lead to less healthy diets

as eating out of home has been associated with poorer diets and weight gain, while eating home-cooked meals have been associated with better quality diets [17-19].

Disparities in the neighbourhood food environment and access to food have been documented before [20, 21], and there is convincing evidence from cross-sectional studies, especially from the US, that residents of lower SES neighbourhoods have higher access to food retailers selling unhealthy foods such as fast foods, and lower access to food retailers selling healthier options [21]. We found that availability of fast food restaurants was higher in the lowest SES neighbourhood over the entire study period. However, there was no significant difference in change in the availability of fast food restaurants and food delivery outlets across neighbourhood SES and urbanisation categories, suggesting that disparities in access to fast food in the Dutch foodscape are not so evident for the analysed period. This is in contrast with a study from the UK which found a greater increase in the availability of fast food restaurants and food delivery outlets in lower SES areas, potentially enlarging socioeconomic differences in the access to food retailers [11]. Evidence from the US showed that residents of lower SES areas had the greater access to fast food retailers over a 40 year-period, however, since more affluent areas had a more steep increase in access to fast food retailers, differences between different strata of neighbourhood SES decreased over time [10]. A significant change, however, was found in our study for an increase in the availability of convenience stores and supermarkets in the lowest SES neighbourhoods. A tendency towards an increase in access to supermarkets across lower SES areas was also found in previous research [10, 11]. This may be due to the fact that it is more expensive for owners to open and maintain stores in more affluent neighbourhoods where the price of real estate is higher. Supermarkets have been mostly considered a source of healthier food options and convenience stores have been considered a source of less healthy foods [22]. However, it is worth mentioning that in the Netherlands convenience stores are mostly small-scale supermarkets found mainly in train stations and shopping areas. These "mini-supermarkets" also offer a range of healthy products such as ready-to-eat salads and chopped fruits to take away. Therefore, based only on the location of food retailers (i.e., community food retail environment), we cannot conclude that lowest SES neighbourhoods developed a less healthy foodscape over this 14 year period. Insight into the consumer food retail environment (i.e., what is sold in each type of food outlet, and how the in-store offer of foods and drinks has changed over time) would therefore be of added value. It also needs to be noted that there was considerable overlap between the SES and urbanization variables. That is, low SES neighbourhoods were often highly urbanized neighbourhoods, and high SES

neighbourhoods were often low urbanised neighbourhoods. Observed SES-disparities may thus be attributable to urbanisation-disparities and vice versa.

This study has some limitations. Although other relevant dimensions of the food environment such as opening times, quality and price of the foods offered in stores have probably changed overtime [23], we had only information on the location of stores, and therefore analysed the foodscape solely in terms of type and geographic availability of food retailers. We highlight the innovative aspect of this study as being the first to analyse the Dutch foodscape. As most previous studies could only analyse a few food retailers, in a limited area and using telephone or governmental directories data [9-11], it is a strength of our study that we analysed a wide range of food retailers, including food delivery outlets, using high quality objectively measured data across the entire country.

Conclusions

In conclusion, we observed important changes in the Dutch foodscape over a 14 years period. In general, the availability of food delivery outlets, restaurants and - to a lesser extent - fast food restaurants increased, while the availability of local food shops such as greengrocers, butchers and bakeries decreased. The only considerable differences across levels of neighbourhood SES and urbanisation were observed for convenience stores and supermarkets. Therefore, although disparities in the Dutch foodscape may not be so evident over the analysed period, in general, the foodscape has changed towards offering a higher supply of convenience and ready-to-eat foods. These findings can help policy makers aiming to promote a healthier food environment. Future studies could link observed changes in the foodscape to national surveillance data on dietary behaviours and non-communicable disease trends.

References – Chapter 6

1. Popkin BM. Global changes in diet and activity patterns as drivers of the nutrition transition. Nestle Nutr Workshop Ser Pediatr Program. 2009;63:1-10; discussion -4, 259-68. doi:10.1159/000209967.

2. Malik VS, Popkin BM, Bray GA, Despres JP, Willett WC, Hu FB. Sugar-Sweetened Beverages and Risk of Metabolic Syndrome and Type 2 Diabetes. Diabetes Care. 2010;33(11):2477-83. doi:10.2337/dc10-1079.

3. Monteiro CA, Moubarac JC, Cannon G, Ng SW, Popkin B. Ultra-processed products are becoming dominant in the global food system. Obes Rev. 2013;14:21-8. doi:10.1111/obr.12107.

4. Smith LP, Ng SW, Popkin BM. Trends in US home food preparation and consumption: analysis of national nutrition surveys and time use studies from 1965-1966 to 2007-2008. Nutr J. 2013;12. doi:Artn 45

10.1186/1475-2891-12-45.

5. Brug J. Determinants of healthy eating: motivation, abilities and environmental opportunities. Fam Pract. 2008;25 Suppl 1:i50-5. doi:10.1093/fampra/cmn063.

6. Story M, Kaphingst KM, Robinson-O'Brien R, Glanz K. Creating healthy food and eating environments: policy and environmental approaches. Annu Rev Public Health. 2008;29:253-72. doi:10.1146/annurev.publhealth.29.020907.090926.

7. Giskes K, van Lenthe F, Avendano-Pabon M, Brug J. A systematic review of environmental factors and obesogenic dietary intakes among adults: are we getting closer to understanding obesogenic environments? Obes Rev. 2011;12(501):e95-e106. doi:10.1111/j.1467-789X.2010.00769.x.

8. Lake AA. Neighbourhood food environments: food choice, foodscapes and planning for health. Proc Nutr Soc. 2018;77(3):239-46. doi:10.1017/S0029665118000022.

9. Filomena S, Scanlin K, Morland KB. Brooklyn, New York foodscape 2007-2011: a five-year analysis of stability in food retail environments. Int J Behav Nutr Phys Act. 2013;10:46. doi:10.1186/1479-5868-10-46.

10. James P, Seward MW, James O'Malley A, Subramanian SV, Block JP. Changes in the food environment over time: examining 40 years of data in the Framingham Heart Study. Int J Behav Nutr Phys Act. 2017;14(1):84. doi:10.1186/s12966-017-0537-4.

11. Maguire ER, Burgoine T, Monsivais P. Area deprivation and the food environment over time: A repeated cross-sectional study on takeaway outlet density and supermarket presence in Norfolk, UK, 1990-2008. Health Place. 2015;33:142-7. doi:10.1016/j.healthplace.2015.02.012.

12. Richardson AS, Meyer KA, Howard AG, Boone-Heinonen J, Popkin BM, Evenson KR et al. Neighborhood socioeconomic status and food environment: a 20-year longitudinal latent class analysis among CARDIA participants. Health Place. 2014;30:145-53. doi:10.1016/j.healthplace.2014.08.011.

13. Statistiek C-CBvd. Obesity rate in the Netherlands lower than in other OECD countries. CBS, Netherlands. 2011. https://www.cbs.nl/en-gb/artikelen/nieuws/2011/47/obesity-rate-in-the-netherlands-lower-than-in-other-oecd-countries. 2019.

14. Dekker LH, Rijnks RH, Strijker D, Navis GJ. A spatial analysis of dietary patterns in a large representative population in the north of The Netherlands - the Lifelines cohort study. Int J Behav Nutr Phys Act. 2017;14(1):166. doi:10.1186/s12966-017-0622-8.

15. Poelman M, Strak M, Schmitz O, Hoek G, Karssenberg D, Helbich M et al. Relations between the residential fast-food environment and the individual risk of cardiovascular diseases in The Netherlands: A nationwide follow-up study. Eur J Prev Cardiol. 2018;25(13):1397-405. doi:10.1177/2047487318769458.

16. Moudon AV, Cook AJ, Ulmer J, Hurvitz PM, Drewnowski A. A neighborhood wealth metric for use in health studies. Am J Prev Med. 2011;41(1):88-97. doi:10.1016/j.amepre.2011.03.009.

17. Lachat C, Nago E, Verstraeten R, Roberfroid D, Van Camp J, Kolsteren P. Eating out of home and its association with dietary intake: a systematic review of the evidence. Obes Rev. 2012;13(4):329-46. doi:10.1111/j.1467-789X.2011.00953.x.

18. Mills S, Brown H, Wrieden W, White M, Adams J. Frequency of eating home cooked meals and potential benefits for diet and health: cross-sectional analysis of

a population-based cohort study. Int J Behav Nutr Phys Act. 2017;14(1):109. doi:10.1186/s12966-017-0567-y.

19. Nago ES, Lachat CK, Dossa RA, Kolsteren PW. Association of out-of-home eating with anthropometric changes: a systematic review of prospective studies. Crit Rev Food Sci Nutr. 2014;54(9):1103-16. doi:10.1080/10408398.2011.627095.

20. Ball K, Lamb KE, Costa C, Cutumisu N, Ellaway A, Kamphuis CB et al. Neighbourhood socioeconomic disadvantage and fruit and vegetable consumption: a seven countries comparison. Int J Behav Nutr Phys Act. 2015;12:68. doi:10.1186/s12966-015-0229-x.

21. Black C, Moon G, Baird J. Dietary inequalities: what is the evidence for the effect of the neighbourhood food environment? Health Place. 2014;27:229-42. doi:10.1016/j.healthplace.2013.09.015.

22. Woodruff RC, Raskind IG, Harris DM, Gazmararian JA, Kramer M, Haardorfer R et al. The dietary impact of introducing new retailers of fruits and vegetables into a community: results from a systematic review. Public Health Nutr. 2018;21(5):981-91. doi:10.1017/S1368980017003226.

23. Glanz K, Sallis JF, Saelens BE, Frank LD. Healthy nutrition environments: concepts and measures. Am J Health Promot. 2005;19(5):330-3, ii. doi:10.4278/0890-1171-19.5.330.