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Where do Dutch adults obtain their snack foods? Cross-sectional exploration of individuals' interactions with the food environment

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ABSTRACT

We investigated frequency of consumption and location of obtaining snack foods and sociodemographic differences therein. Data: cross-sectional survey data (N = 1784 Dutch adults 18–65 years) on the frequency of consumption of 10 snack foods and where they obtained them. Adjusted logistic regression analyses revealed notable differences in the frequency of snack food consumption between younger and older adults and between those with low vs. high socioeconomic position (SEP). The location of obtaining snack foods also differed between sociodemographic groups with supermarkets forming an important point-of-purchase for snack foods, especially for those with low SEP and with children in their household.

1. Introduction

Living in an 'obesogenic' food environment with an overabundant availability of and advertisement for energy-dense and nutrient-poor foods and beverages is likely to contribute to unhealthy diets and higher risk of obesity (Swinburn et al., 1999). Many studies have therefore investigated whether geographic exposure to unhealthy food environments is associated with these behavioural and health outcomes, but the evidence is largely inconsistent (Cobb et al., 2015; Mackenbach et al., 2013; Chennakesavalu and Gangemi, 2018; Caspi et al., 2012; Wilkins et al., 2019; Williams et al., 2014; Engler-Stringer et al., 2014; van der Horst et al., 2007; Gamba et al., 2015; Gustafson et al., 2012; Sacks et al., 2019; Larson and Story, 2009; Bivoltsis et al., 2018). This may be due to researchers often having to rely on assumptions about when, where, and how individuals are 'exposed' to the food environment. For example, the assumption that closer proximity to fast food restaurants is related to fast food consumption is not often explicitly tested. Even studies that use personalised exposure measures such as mobility patterns – allowing for more precise insights into the locations in which individuals spend their time – have to rely on assumptions such as that passing by certain food locations reflects exposure and subsequent use (Hobbs and Atlas, 2019; Liu et al., 2020).

Two mechanisms may explain how 'exposure' to food retailers can lead to food intake – a direct mechanism in which the presence of a food outlet results in an individual being aware of the food outlet, leading to usage of that food outlet, and consumption of the food obtained in that food outlet (e.g. (Mackenbach et al., 2019)). Another mechanism is an indirect one in which the presence of food outlets results in increased awareness or liking of such outlets in general, which leads to their increased use elsewhere or at a different time (e.g. (van Rongen et al., 2020),), a mechanism somewhat similar to advertisement effects. While there is some emerging evidence on such pathways (Mackenbach et al., 2019; van Rongen et al., 2020; Penney et al., 2017; Ziauddeen et al., 2018) a better insight into both mechanisms is needed to understand how individuals interact with their food environment and how this interaction is associated with food consumption. Such insights are essential to strengthen the conceptual foundation of food environment-food consumption studies. A key piece of missing information for these mechanisms include the types and locations of food outlets that are actually used for the purchase and consumption of foods (Thornton et al., 2017; Hillier, Cannuscio, Karpyn, McLaughlin, Chilton, Glanz; Kerr, Frank, Sallis, Saelens, Glanz, Chapman; Ver Ploeg et al.,

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2015). Given the ubiquity of food outlets, a better insight in what subgroups use what food outlets for what purposes is essential to understand the influence of the food environment on health.

Identifying the types of food outlets used may be especially important for the consumption of snack foods, which can be purchased from a range of food and non-food outlets. While snack foods can be healthy (e.g., an apple), there is an excessive availability of unhealthy options such as chocolate bars and fried snacks, and evidence suggests that the consumption of unhealthy snacks has increased over time (Piernas and Popkin, 2009; Zizza et al., 2001). While the occasional consumption of snack foods is not problematic and sometimes even recommended in nutritional guidelines, habitual unhealthy snacking may contribute to the development of overweight and associated health risks through decreased satiety and increased energy intake (Skoczek-Rubinska and Bajerska, 2021). In the Netherlands, adults consume an average of 41 g of cookies and pies per day, 30 g of sugar and sweets per day, and 21 g of savoury snacks per day (van Rossum et al., 2020) while the Netherlands Nutrition Centre recommends to consume energy-dense snacks only sparingly (Netherlands Nutrition Centr, 2018).

Therefore, in the present study, we investigated i) how often Dutch adults consumed unhealthy snacks, ii) at what types of outlets they obtain these snacks. As these patterns are likely to depend on socio-demographic characteristics, such as age (Vatanparast et al., 2020), gender (Manippa et al., 2017), socioeconomic position (SEP (Pechey and Monsivais, 2016)) and the presence of children in the household (Damen et al., 2019), we also iii) investigated socioeconomic differences in the frequency and location of unhealthy snack consumption.

2. Methods

2.1. Setting and target population

This study is part of the 'Healthy Food Environments' project funded by an NWO (Netherlands Organization for Scientific Research) Veni grant. In this three-year project, a multidisciplinary perspective was applied to study the links between exposure to several aspects of the food environment, food choices and health outcomes (e.g., see (Pinho et al., 2020; Mackenbach et al., 2019a; Mackenbach et al., 2019b; Hobbs et al., 2021; Hoenink et al., 2020)). The current study is a cross-sectional survey (Eet & Leef onderzoek) especially designed to investigate the interactions between individuals and their food environment among the adult general population (aged 18–65 years) living in urban areas in the Netherlands. The study was conducted according to the declaration of Helsinki and was approved by the Medical Ethical Committee of VU University Medical Center (no. 2019.307).

Participants were recruited from the general Dutch population. The inclusion criterion was being 18–65 years of age. Exclusion criteria were: not being able to understand the Dutch language and not having access to a computer with Internet and e-mail address.

2.2. Recruitment approach

Participants were recruited through a stepwise recruitment approach. First, postal invitations were sent to ~21,500 randomly selected home addresses in the twenty largest cities (in terms of total population, based on data from Statistics Netherlands) of the Netherlands: Amsterdam, Rotterdam, Den Haag, Utrecht, Eindhoven, Tilburg, Almere, Groningen, Breda, Nijmegen, Apeldoorn, Haarlem, Enschede, Arnhem, Amersfoort, Zaanstad, Den Bosch, Haarlemmermeer, Zwolle and Zoetermeer. Based on the socio-demographic characteristics of the responders, a targeted Facebook and Instagram campaign was launched to include more men (lower and higher educated) and lower educated women. In addition, 54 lower educated men who participated in previous studies conducted at the same department received an invitation to participate in the current study via e-mail.

Potentially eligible participants were directed to the project website. The website displayed the study information letter and asked participants for their informed consent for participation in the study. Participants could also indicate that they were interested in being invited for follow-up studies. After providing informed consent, participants had to fill in their current age (which should be between 18 and 65 years) and their e-mail address. Eligible participants received login details for the first part of the web-based questionnaire via e-mail. This questionnaire covered socio-demographics, psychosocial resources, questions regarding lifestyle and health, snacking behaviours and perceptions of the food environment. After completing the first part, participants were invited to complete part two, which consisted of choice-based conjoint tasks assessing supermarket preferences. Finally, participants were invited to complete the third part assessing diet quality based on adherence to 15 Dutch dietary guidelines. Participants received reminders after 7 and 14 days if they did not complete a questionnaire. Participants who completed all three questionnaires received a gift voucher of 7,50€. The study flow chart is shown in Fig. 1. For the present study, only data from the first part of the questionnaire was used.

3. Data

3.1. Frequency of consumption of snacks

Participants answered 10 (non-validated) questions on the frequency of consumption of: sweets, chocolate, cookies, cakes and pies, ice-cream, crisps and salty snacks (e.g., cheese crunchies, seasalt crisps or pretzel sticks, nuts (e.g., peanuts, coated peanuts or almonds), pizza, fried snacks (e.g., fries, croquette or bamihap (typical Dutch fried snack)) and sausage rolls (e.g., hotdog or sausage roll). Answering options were: never, 1–2 times per year, 5–6 times per year, once a month, twice per month, once a week, twice a week, three times per week, four times per week, five times per week, six times per week and every day. Answering options were recoded into: never, 1–5 times per year, once a month, twice a month, 1–2 times per week and 3–7 times per week. High frequency of consumption was defined as at least once a week based on the distribution of the data.

3.2. Location for obtaining snacks

Participants were asked to indicate at what type of location they obtained each of the 10 snack foods, with a 'not applicable' option if they did not consume these snacks. Participants could tick one or more of the following answering options: purchased at a supermarket during regular shopping; purchased at a supermarket during an unplanned shop; purchased at work; received at work (e.g., treat from colleague); purchased at the station; received at my friends/family's place; purchased at the bakery/snackbar/pizzeria/ice-cream parlor; purchased or received at the (sports)club; somewhere else. The distinction between regular and unplanned supermarket visits was based on anecdotal information that unhealthy snacks are sometimes deliberately not purchased during a regular supermarket trip, but during a supermarket visit specifically used to obtain snacks foods. The open-ended answers to the 'somewhere else' option were further classified into: gas station; specialty store; purchased online; restaurant/café. Remaining individual 'other' locations were not analysed.

3.3. Sociodemographic characteristics

Participants answered questions on their age, gender and number of children in the household. Age was classified into 18–30 years, 31–50 years and 51–65 years. The number of children in the household was dichotomized into yes or no. In addition, participants reported about their education level, occupation, and net household income. Answering categories for education level were 'no education', 'primary school', 'low vocational education' and 'general secondary education' (coded as

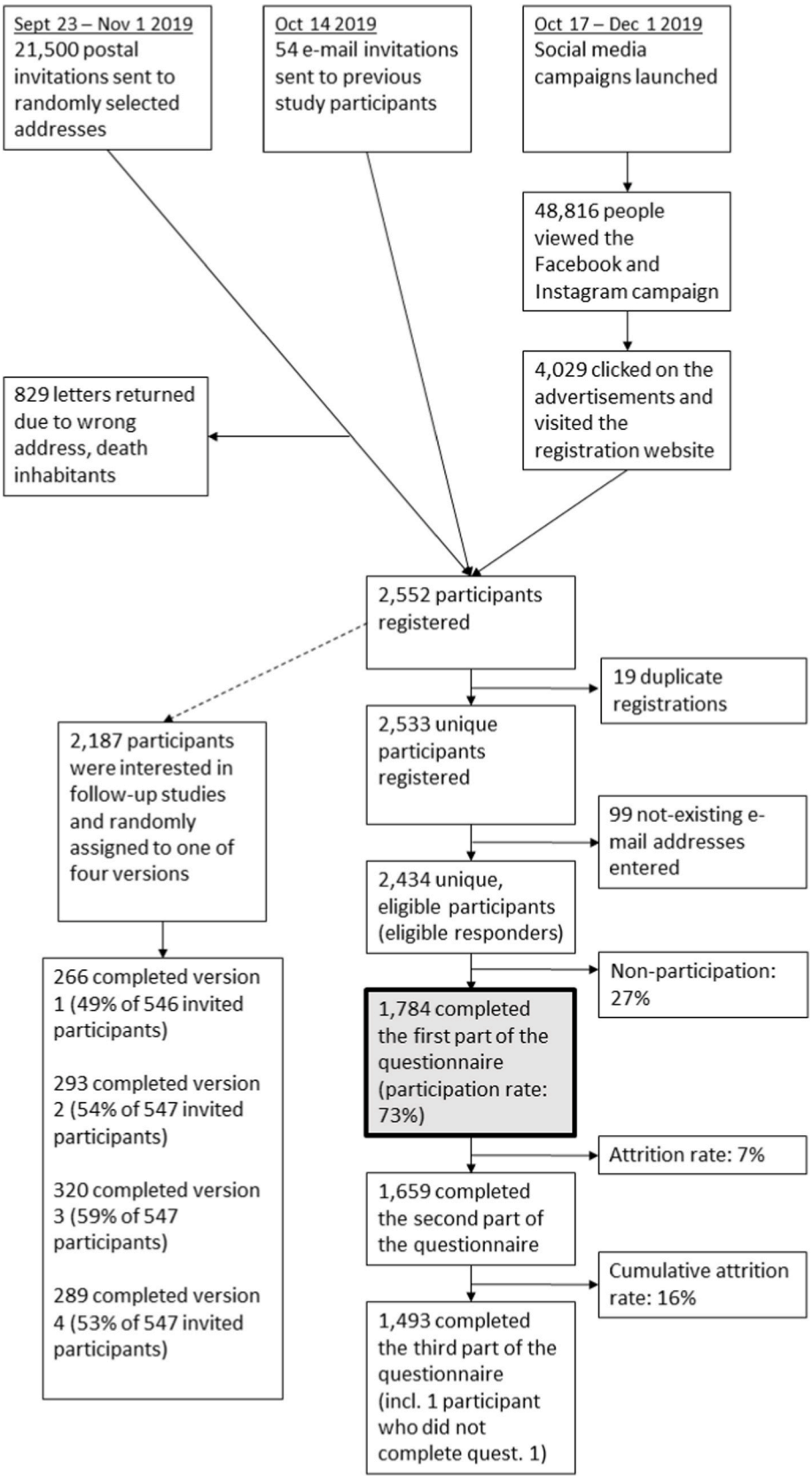

Fig. 1. Flow chart of the Eet & Leef study – data from grey box used for the current study.

lower educated; maximum 12 years of education); 'secondary vocational education' and 'higher general secondary education' (coded as middle educated; 12–16 years of education); and 'higher professional education' (coded as high educated; minimum of 17 years of education) and 'don't know' (coded as missing). Participants were asked to report their current occupation, or when currently not employed, their past main occupation. Occupations were classified according to the Dutch classification of occupations 2014 (BRC, 2014) and translated to four levels of the International Standard Classification of Occupations (ISCO) 2008: skill level 1 (low), skill level 2 (medium) and skill levels 3 and 4 (high). Answers that could not be classified into these skills levels (e.g., 'housewife', 'retail' (without further detail about job)) were coded as missing for this variable. The answering options for household income were: €0–1200/month, €1200–1800/month, €1800–2600/month, €2600–4000/month, >€4000/month and 'don't want to share' (coded as missing). Household equivalent income was calculated as the mean income per category divided by the number of adults and children in the household, with a value of 1 for the first adult, a value of 0,5 for the second adult and each subsequent adult, and a value of 0,3 for each child (OECD (Organization for Economic Co-operation and Development)-modified equivalence scale (Hagenaars et al., 1994)). Household equivalent income was subsequently divided into low (0–1300€ per month), medium (1301–2600€ per month) and high (2601->4000€ per month) household equivalent income.

An SEP-index was created by summing the levels of education (low/1, middle/2, high/3), occupation (low/1, middle/2, high/3) and household income (low/1, middle/2, high/3) so that the total index ranged from 3 to 9, with higher scores representing a higher SEP. The scores were then divided into low SEP (3–5), medium SEP (6–7) and high SEP (8–9). In order to use all information available and use also those participants that had missing values on a single SEP variable, we created a SEP-index on which participants that had missing values on one (N = 240) or two (N = 20) of the SEP indicators, had their SEP-index score based on the available information (e.g., in case of two indicators available: low SEP = 2–3, medium SEP = 4, high SEP = 5–6).

4. Statistical analyses

A total of 1784 participants completed the first part of the questionnaire. Apart from the individual variables on education, occupation or income, none of the other variables had missing data due to the design of the online questionnaire (and the constructed SEP-index has no missing values). Therefore, the analytical sample for the main analyses consisted of 1784 participants who all had complete data.

Descriptive statistics were used to report on the frequency of consumption of each of the 10 snack foods, and on the location where snack foods were obtained. As exploration, we also report the location of obtaining snack foods separately for participants with low and high frequency of snack consumption. As intraclass correlation coefficients showed negligible clustering of participants within 4-digit postal codes (e.g., ICC = 0.00027 for frequency of sweets consumption) we conducted simple logistic regression analyses to identify sociodemographic differences in high frequency of snack consumption, as compared to low frequency, for each of the 10 snacks, as well as sociodemographic differences in the locations used for obtaining snacks. These models included age groups, gender, children in the household and the SEP-index as covariates. We conducted sensitivity analyses excluding participants with missing data on one of the SEP indicators but do not report results because they were similar to main results. We report adjusted Odds Ratios (aORs) and 95% Confidence Intervals (CIs). Analyses were conducted in SPSS version 26.0.

5. Results

5.1. Sample characteristics

The analytical sample consisted of 1784 individuals of which 63.7% were women and the median age was 43.0 years (Table 1). Most participants (59.1%) lived in a household without children. On the basis of education, income and occupation combined, 17.9% of participants was considered of low SEP, 37.3% of medium SEP and 44.8% of high SEP.

5.2. Frequency of consumption of snacks

Fig. 2 and Supplementary Table 1 display the frequency of consumption of each of the 10 snack foods. Sweets, chocolate, cookies, crisps and salty snacks, and nuts were snacks consumed most frequently. For example, 27.0% reported consuming sweets 3 to 7 times per week and 16.3% reported consuming nuts 3 to 7 times per week. Pies and cake, ice cream, pizza, fried snacks and sausage rolls were consumed less often. For example, 48.2% reported consuming ice cream 1 to 5 times per year. However, while 30.7% reported to consume fried snacks 1 to 5 times per year, another 20.5% reported to consume fried snacks 1 to 2 times per week.

5.3. Location for obtaining snacks

Table 2 displays the locations used to purchase or obtain each of the ten snack foods. In general, the *supermarket* was an important source for obtaining snacks; 54.1% of the participants purchased sweets at the supermarket during regular shopping, 70.3% chocolate, 66.1% cookies, 73.5% crisps and salty snacks and 70.3% purchased nuts. While ice cream was purchased at the supermarket during a regular shop by only 48.2% of the participants, this still was the most important location for purchasing ice cream. The same trends were noted for pizza and sausage rolls. The snacks most frequently purchased at the supermarket during an occasional shop were sweets (20.4%) and chocolate (22.1%).

Several other locations important for obtaining snacks were identified. Participants were less likely to obtain snack foods *at work*. The snacks most frequently purchased at work were fried snacks (5.6% of participants), sweets (5.2%) and chocolate (5.2%). The snacks most frequently received at work, for example from colleagues, were pies or cake (41.8%), sweets (22.5%) and cookies (21.3%). The *train station* was

Table 1
Characteristics of the Eet & Leef study sample (N = 1784).

Sociodemographic characteristic	N (%) or median (IQR)
Gender (female)	1137 (63.7%)
Age (years)	43.0 (31.0–55.0)
18–30 years	*437 (24.5%)*
31–50 years	*721 (40.4%)*
51–65 years	*626 (35.1%)*
Number of children in the household	1.8 (1.0–3.0)
Children in the household (% with no children)	1054 (59.1%)
Education level[a]	
Low (up to general secondary education)	*190 (10.7%)*
Medium (up to higher general secondary education)	*574 (32.5%)*
High (higher professional education)	*1004 (56.8%)*
Net household equivalised income level	
Low (0–1300€/month)	*440 (26.8%)*
Medium (1300–2600€/month)	*949 (57.9%)*
High (2600–4000€/month)	*250 (15.3%)*
Occupation skill level	
Low (ISCO-08 level 1)	*54 (3.2%)*
Medium (ISCO-08 level 2)	*537 (32.3%)*
High (ISCO-08 level 3 or 4)	*1074 (64.5%)*

ISCO | International Standard Classification of Occupations.
[a] Low education level ranges from zero to twelve years of education, medium education level from thirteen to sixteen years of education and high education level start from seventeen years of education onwards.

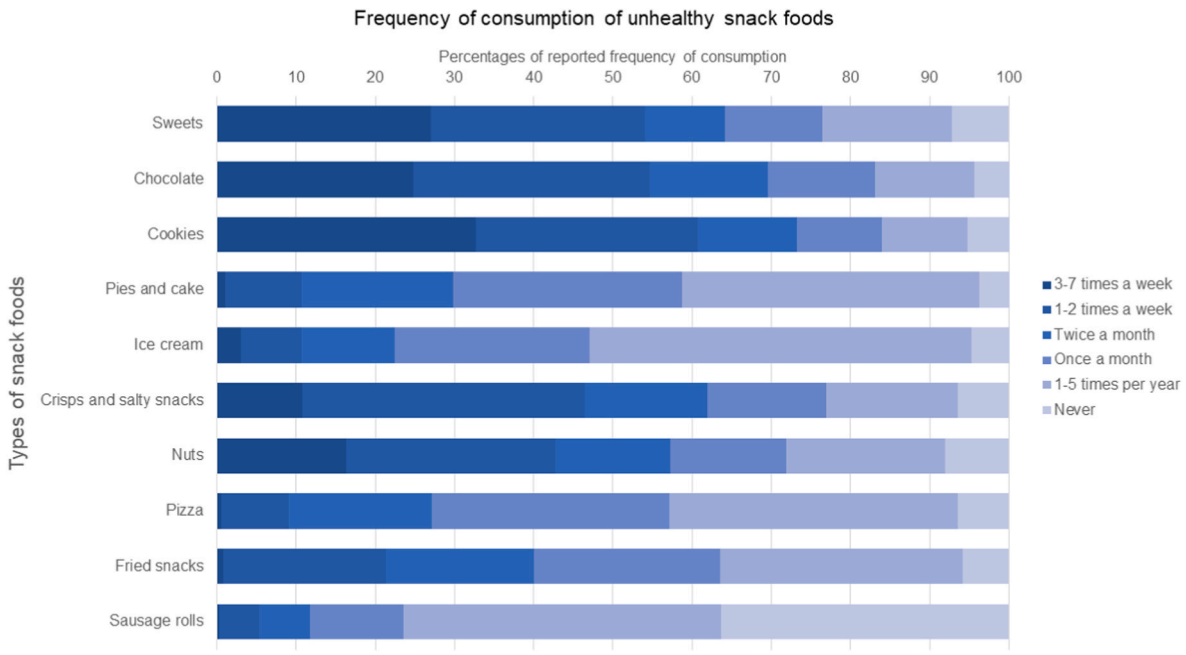

Fig. 2. Frequency of consumption of unhealthy snack foods in the Eet & Leef study (N = 1784).

a location that was not often indicated as a source of obtaining snacks. Overall, 8.1% of participants reported to purchase sausage rolls from the train station, 7.2% to purchase sweets and 5.8% to purchase fried snacks from this location. Another important source of obtaining snacks was *at their friends' or family members' place*. For example, 21.8% reported to obtain sweets, 24.0% chocolate, 31.2% cookies, 46.3% pies or cake, 34.7% crisps and salty snacks and 30.8% nuts from their friends or family's place. *Specialized stores* (i.e., bakery, snack bar, pizzeria and ice cream parlor) were less often reported as a location to obtain snacks in general, but were important locations for obtaining specific snacks, namely fried snacks (57.2%), ice cream (47.3%), pizza (46.7%), pies or cake (18.5%) and sausage rolls (14.3%). Finally, very few participants reported to obtain their snacks from a *(sports) association or club*, but the snack food most frequently obtained there was fried snacks (4.5%). Other reported locations included gas stations (1.2% obtained sweets there), delicatessen stores or street food market (3.0% obtained nuts there), bars or restaurants (1.6% obtained fried snacks there) and home delivery (1.5% ordered pizza). A small number of responses from participants could not be classified into a general category (ranging from 3 responses about the location of pizza consumption to 18 responses about the location of sausage roll consumption), which included 'fair trade shops', 'dollarstores' and 'IKEA'.

In Supplementary Table 2 we report the locations used to purchase or obtain each of the ten snack foods separately for those with low and high levels of frequency of consumption. For all types of snack foods, those with a high frequency of consumption reported to use the supermarket (during a regular shopping trip) more often as location for obtaining snacks than those with a low frequency of consumption. E.g., 36.6% of those with a low frequency of sweets consumption reported to use the supermarket to obtain sweets, compared to 68.9% of those with a high frequency of sweets consumption. This pattern was less pronounced for other locations. Another notable finding was that 46.9% of those with a low frequency of pies and cake consumption reported to obtain this from their friends'/family's place, while this was lower (38.4%) for those with a high frequency of pies and cake consumption.

5.4. Sociodemographic differences in frequency of snack food consumption

Fig. 3 and Supplementary Table 2 describe what sociodemographic subgroups were more likely to consume each of the ten snacks more frequently.

There were some notable differences in the frequency of snack consumption between *younger and older participants*. Compared to adults aged 51–65 years, those aged 18–30 years were less likely to report a high consumption of sweets (aOR = 0.55, 95%CI 0.42, 0.74) and nuts (aOR = 0.67 [0.50, 0.89]), but more likely to report a high consumption of chocolate (aOR = 1.37 [1.03, 1.82]), crisps and salty snacks (aOR = 2.77 [2.07, 3.72]), pizza (aOR = 3.00 [1.82, 4.94]), fried snacks (aOR = 1.47 [1.04, 2.07]) and sausage rolls (aOR = 2.74 [1.44, 5.21]). A similar pattern, but with smaller effect sizes, was seen for the difference between those aged 31–50 years compared to adults aged 51–65 years.

Gender differences were most notable for chocolate (aOR = 1.36 [1.10, 1.68]), which was consumed more often by females than males, and pizza (aOR = 0.51 [0.35, 9,73]), fried snacks (aOR = 0.62 [0.48, 0.80]) and sausage rolls (aOR = 0.26 [0.16, 0.42]), which were consumed more often by males than females.

Differences by *SEP* were observed for all snack foods except sweets and cookies. Compared to those with a high SES, those with a low SES had higher odds of reporting high levels of consumption of pies and cakes (aOR = 1.65 [1.07, 2.55]), crisps and salty snacks (aOR = 1.42 [1.05, 1.91]), pizza (aOR = 1.80 [1.09, 3.00]), fried snacks (aOR = 1.85 [1.30, 2.63]) and sausage rolls (aOR = 3.62 [1.90, 6.89]) and lower odds to report high levels of nuts consumption (aOR = 0.63 [0.46, 0.85]). A similar pattern, but with smaller effect sizes, was seen for the difference between those with a medium SEP compared to adults with a high SEP.

There were few differences in the frequency of snack consumption between *those with and without children*. Those with children had higher odds of reporting high levels of consumption of chocolate (aOR = 1.40 [1.12; 1.75]); cookies (aOR = 1.52 [1.21, 1.91]); and crisps and salty snacks (aOR = 1.35 [1.08, 1.76]).

5.5. Sociodemographic differences in locations for obtaining snack foods

Table 3 displays odds of purchasing each of the ten snack foods at

Table 2
Location of obtaining snacks (participants could tick multiple locations per snack) in the Eet & Leef study (N = 1784).

	N (%) who indicated that they obtained snacks at these locations										
	Supermarket, (regular shopping)	Supermarket, (one-time/ unplanned visit)	Work, purchased from e.g., canteen, vending machine	Work, received (e.g., treat from colleague)	Train station	Friends'/ family's place	Specialized shop (i.e. bakery/snack bar/ pizzeria/ice cream parlor)	Association/ sports club	Other: gas station	Other: speciality store/market	Other: bar or restaurant	Other: ordered online/ delivered at home
Sweets	825 (54.1%)	311 (20.4%)	79 (5.2%)	343 (22.5%)	109 (7.2%)	332 (21.8%)	25 (1.6%)	25 (1.6%)	18 (1.2%)	11 (0.7%)	1 (0.1%)	1 (0.1%)
Chocolate	1071 (70.3%)	337 (22.1%)	80 (5.2%)	250 (16.4%)	73 (4.8%)	365 (24.0%)	35 (2.3%)	11 (0.7%)	9 (0.6%)	13 (0.9%)	1 (0.1%)	2 (0.1%)
Cookies	1008 (66.1%)	264 (17.3%)	44 (2.9%)	324 (21.3%)	48 (3.1%)	475 (31.2%)	54 (3.5%)	22 (1.4%)	1 (0.1%)	0 (0%)	6 (0.4%)	0 (0%)
Pies/cake	404 (26.5%)	158 (10.4%)	12 (0.8%)	637 (41.8%)	16 (1.0%)	705 (46.3%)	282 (18.5%)	13 (0.9%)	0 (0%)	3 (0.2%)	17 (1.1%)	0 (0%)
Ice cream	735 (48.2%)	222 (14.6%)	17 (1.1%)	69 (4.5%)	45 (3.0%)	258 (16.9%)	721 (47.3%)	20 (1.3%)	1 (0.1%)	0 (0%)	19 (1.2%)	1 (0.1%)
Crisps and salty snacks	1120 (73.5%)	268 (17.6%)	29 (1.9%)	72 (4.7%)	27 (1.8%)	529 (34.7%)	10 (0.7%)	27 (1.8%)	1 (0.1%)	2 (0.1%)	2 (0.1%)	0 (0%)
Nuts	1071 (70.3%)	201 (13.2%)	13 (0.9%)	60 (3.9%)	15 (1.0%)	470 (30.8%)	6 (0.4%)	15 (1.0%)	0 (0%)	45 (3.0%)	2 (0.1%)	2 (0.2%)
Pizza	765 (50.2%)	192 (12.6%)	12 (0.8%)	19 (1.2%)	11 (0.7%)	149 (9.8%)	712 (46.7%)	4 (0.3%)	0 (0%)	2 (0.1%)	15 (1.0%)	23 (1.5%)
Fried snacks	469 (30.8%)	104 (6.8%)	86 (5.6%)	48 (3.1%)	88 (5.8%)	209 (13.7%)	872 (57.2%)	68 (4.5%)	3 (0.2%)	2 (0.1%)	25 (1.6%)	5 (0.3%)
Sausage rolls	344 (22.6%)	178 (11.7%)	59 (3.9%)	90 (5.9%)	124 (8.1%)	131 (8.6%)	218 (14.3%)	11 (0.7%)	5 (0.3%)	4 (0.3%)	4 (0.3%)	0 (0%)
0–5%	5–10%	10–20%	20–40%	>40%								

each location for subgroups based on age, gender, SEP and children in the household. We observed sociodemographic differences for all locations. Across all snack foods obtained from all locations, differences by age group were most notable, while there were only very few differences between those with and without children in the household.

Effects suggested that the *differences by age* were most consistent for supermarket, at work (received from colleagues) and at the place of friends or family. Younger adults had lower odds than older adults to purchase their snack foods from the supermarket during a regular shop but higher odds than older adults to purchase their snack foods from the supermarket during an occasional shop. For example, adults aged 18–30 years and 31–50 years had 0.37 [0.29, 0.49] and 0.75 [0.60, 0.94] times the odds of purchasing sweets from the supermarket during regular shopping than those aged 51–65 years. Younger adults also had higher odds than older adults to purchase or receive their snack foods at work than older adults, and higher odds than older adults to obtain their snack foods from their friends' or family's places.

The *differences by gender* were most consistent for the supermarket during an occasional shop and purchase at work. Women had lower odds than men to obtain their snack foods from the supermarket during an occasional shop, with the exception of sweets, chocolate and cookies where we observed no gender differences in the likelihood of obtaining them at the supermarket during an occasional shop. Women also had lower odds than men to purchase their snack foods at work, e.g., 0.34 (95%CI: 0.19; 0.60) the odds to purchase cookies at work compared to men. There were no consistent gender differences in friends/family's places and specialized shops as location for obtaining snack foods; men and women had similar odds of obtaining their snacks from these places.

Differences by SEP were not observed for (sports) clubs or associations as location for obtaining snack foods. The most consistent differences by SEP were for the supermarket, mostly for the supermarket during an occasional visit but also for the supermarket during a regular shop. For some snack foods, those with lower SEP consistently had higher likelihood of obtaining these snacks from the supermarket during a regular shop and during an occasional visit than those with higher SEP. For example, those with a low SEP had a 1.77 [1.34, 2.34] higher odds of purchasing sweets from the supermarket during a regular visit and a 1.36 [1.04, 1.77] higher odds of purchasing sweets from the supermarket during an occasional shop than those with a high SEP. However, the odds to obtain nuts from the supermarket during a regular visit was lower for those with low SEP vs. high SEP (aOR = 0.70 [0.53, 0.93], but the odds to be obtained from the supermarket during an occasional shop was higher among those with low SEP vs. high SEP (aOR = 1.80 [1.23, 2.61]).

Finally, the only consistent differences in locations for obtaining snack foods between *those with and without children* in the household were for the supermarket during a regular visit and at friends/family's places. Those with children had consistently higher odds to purchase their snack foods from the supermarket during a regular visit than those without children, while they had lower odds to obtain their snack foods at the place of their friends or family members than those without children.

6. Discussion

This study investigated how often Dutch adults consume unhealthy snacks and at what types of (food and non-food) outlets they obtain their snacks. We also sought to investigate what sociodemographic characteristics were associated with higher unhealthy snack consumption and obtaining snacks at specific types of outlets. Key results were 1) that the supermarket was the most important source for obtaining snacks, and 2) that those with lower SEP and those with children had higher odds of purchasing their snacks from the supermarket than those with higher SEP and without children. These findings are concerning given the unequal burden of diet-related chronic diseases across socioeconomic groups (M é jean et al., 2013) and concerns around the role of unhealthy

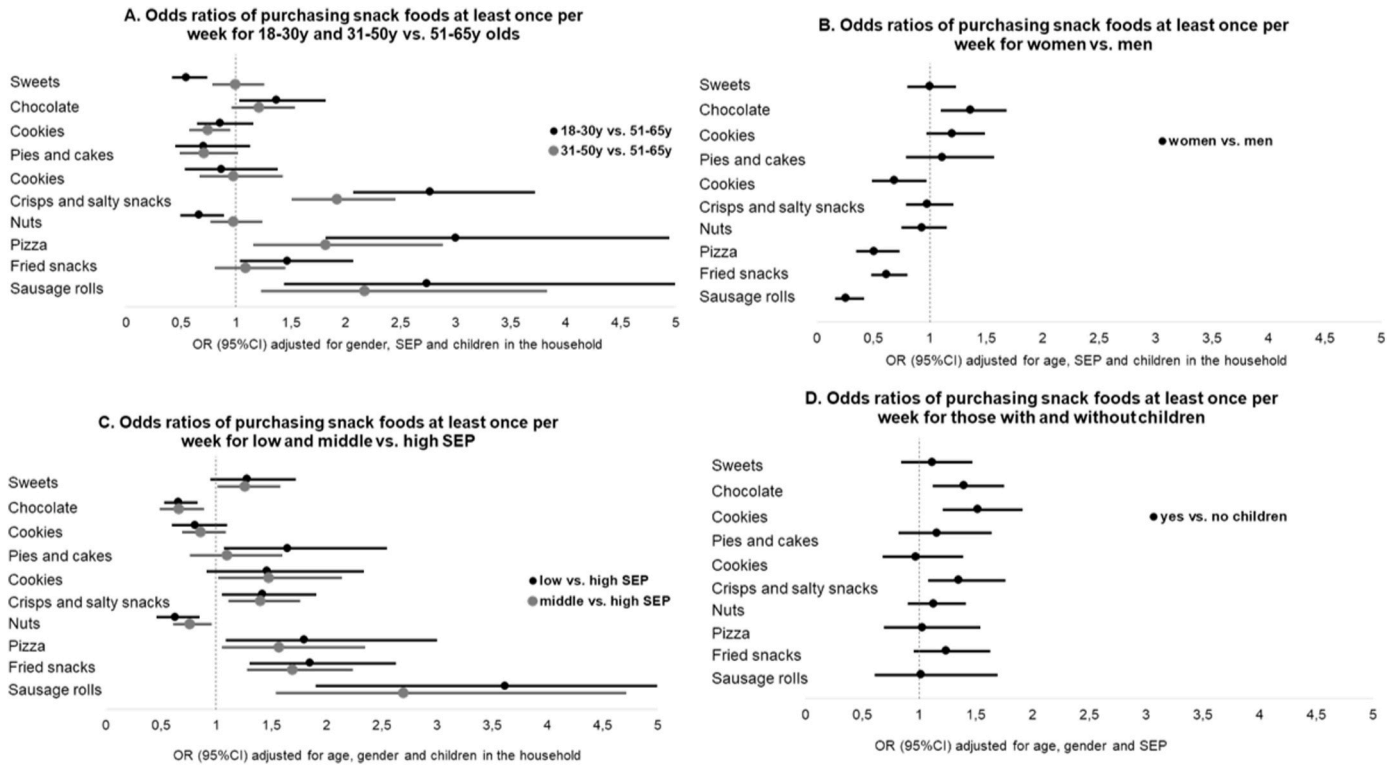

Fig. 3. Differences in odds ratios of high snack consumption by sociodemographics in the Eet & Leef study (N = 1784).

food environments for the next generation (United Nations Children' s Fund and United Nations Special Rapporteur on the Right to Food, 2019).

While occasional healthy snacking may not be problematic for health, we observed a fairly high consumption of snacks high in fat, sugar or salt. Sweets, chocolate, cookies, crisps and salty snacks and nuts were the most frequently consumed snacks, while pies and cake, ice cream, pizza, fried snacks and sausage rolls were consumed less often. Whereas the Netherlands Nutrition Centre recommend sparse consumption of energy-dense snacks (Netherlands Nutrition Centr, 2018), more than 50% of the participants reported to consume sweets, chocolate and cookies on a weekly or even daily basis. Some of the observed sociodemographic differences in frequency of snack consumption were comparable to the latest Dutch National Food Consumption Survey (DNFC, 2012–2016). This included the higher consumption of chocolate, crisps and salty snacks, pizza, fried snacks and sausage rolls of younger compared to older adults, the lower consumption of pizza, fried snacks and sausage rolls by women compared to men, and the lower nuts consumption among those with low vs. high SEP (van Rossum et al., 2020). However, the DNFC also reports that the consumption of all snack foods other than nuts is approximately equal across socioeconomic groups and that the consumption of chocolate is equal among men and women, which is in contrast with our findings. The differences may be explained by the timing of the measurement (2019 in our study, 2012–2016 in the DNFC), the sociodemographic distribution of the participants (lower than true proportion of low SEP participants in our study) and the measure of intake (frequency in our study, frequency and portion size in the DNFC) (van Rossum et al., 2020). The consumption of snack foods is likely to be country-specific. For example, a Brazilian study reported that sweetened coffee and tea, sweets and desserts, fruit, sugar-sweetened beverages, and high-calorie salgados (fried dough with meat, cheese or vegetables) were the most commonly consumed snacks (Duffey et al., 2013), while in Greece, chocolates, cakes, ice-cream, savoury pies and coffee were most commonly consumed (Fotiadou and Babajimopoulos, 2006), in Norway cakes, fruit, sugar and sweets, bread, and alcohol beverages (Myhre et al., 2015), and fruit, grains and beverages in China (Wang et al., 2012). These differences also highlight the differences in definitions and operationalisations of snack food consumption in different contexts.

A notable finding of the study was that the supermarket was the most important location for the purchase of unhealthy snack foods. Supermarkets provide for all mentioned snack foods and potentially at lower prices than at specialized stores (e.g., ice cream parlors). In addition, promotion strategies in supermarkets are mostly focused on unhealthy discretionary foods (Bennett et al., 2019; Charlton and K??hk??nen LA Sacks G Cameron AJ, 2015; Riesenberg et al., 2019; Kaur et al., 2020). For example, price promotions in supermarkets are mostly for unhealthy foods (Bennett et al., 2019; Kaur et al., 2020; Ravensbergen et al., 2015; Hendriksen et al., 2021) and check-outs mostly offer unhealthy impulse-buy products, such as single serve crisps and chocolate bars (Thornton et al., 2012; Lam et al., 2018). As such, these findings warrant caution in the dichotomization of food retailers into healthy and unhealthy, whereby supermarkets often reflect access to healthy food (Thornton and Kavanagh, 2012). As supermarkets are the most important source of healthy foods and beverages in most upper mid-to high-income countries, including the Netherlands (Geurts et al., 2017; Reardon and Hopkins, 2006), they potentially form the most important setting to promote healthier dietary choices (Lakerveld et al., 2018). However, a Dutch study showed that there is much room for improvement, with most supermarkets having unhealthy check-outs, marketing for unhealthy products targeting children and price promotions being mainly for unhealthy products (Questionmark. Superlijst gezondheid 2020, 2020). Such improvements are especially important since those with a lower SEP and those with children in the household on average had 1.5 times the odds of obtaining unhealthy snack foods from the supermarket. Healthier supermarket environments may therefore contribute to a reduction in socioeconomic inequalities in diet and diet-related diseases and a healthier future generation.

In addition to formal food retailers, participants also reported to obtain their unhealthy snack foods from non-food locations such as the

Table 3
Sociodemographic differences in use of different locations for obtaining snack foods in the Eet & Leef study (N = 1784).

Supermarket, during regular shopping											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
Age	18–30 years	**0.37 (0.29; 0.49)**	**0.50 (0.38; 0.66)**	**0.53 (0.40; 0.68)**	**0.38 (0.28; 0.53)**	**0.45 (0.35; 0.59)**	0.78 (0.59; 1.03)	**0.41 (0.31; 0.53)**	1.13 (0.89; 1.47)	0.96 (0.72; 1.27)	1.13 (0.82; 1.54)
	31–50 years	**0.75 (0.60; 0.94)**	0.78 (0.61; 1.00)	**0.65 (0.51; 0.83)**	**0.74 (0.58; 0.93)**	0.83 (0.66; 1.03)	1.07 (0.83; 1.37)	**0.73 (0.57; 0.93)**	**1.27 (1.02; 1.58)**	0.92 (0.72; 1.16)	1.13 (0.87; 1.47)
	51–65 years	1	1	1	1	1	1	1	1	1	1
Gender	Female	0.88 (0.72; 1.08)	1.14 (0.92; 1.42)	1.17 (0.95; 1.44)	**0.79 (0.63; 0.98)**	0.83 (0.68; 1.02)	1.15 (0.92; 1.43)	0.87 (0.70; 1.08)	**0.79 (0.65; 0.96)**	0.99 (0.79; 1.22)	**0.67 (0.53; 0.84)**
	Male	1	1	1	1	1	1	1	1	1	1
SEP	Low	**1.77 (1.34; 2.34)**	0.76 (0.57; 1.02)	1.13 (0.85; 1.50)	**1.86 (1.39; 2.49)**	1.24 (0.95; 1.62)	1.03 (0.76; 1.38)	**0.70 (0.53; 0.93)**	1.23 (0.94; 1.60)	**2.26 (1.71; 2.98)**	**2.37 (1.76; 3.20)**
	Medium	**1.26 (1.02; 1.56)**	**0.71 (0.57; 0.90)**	0.98 (0.78; 1.22)	**1.38 (1.08; 1.76)**	1.13 (0.91; 1.40)	1.03 (0.81; 1.30)	0.91 (0.72; 1.15)	0.98 (0.79; 1.20)	**1.44 (1.14; 1.82)**	1.20 (0.92; 1.56)
	High	1	1	1	1	1	1	1	1	1	1
Children in the household	Yes	**1.58 (1.28; 1.96)**	**1.43 (1.13; 1.79)**	**1.99 (1.59; 2.49)**	**1.29 (1.02; 1.62)**	**1.32 (1.07; 1.62)**	**1.67 (1.32; 2.12)**	1.11 (0.88; 1.39)	**1.36 (1.11; 1.67)**	**1.54 (1.23; 1.92)**	**1.39 (1.08; 1.56)**
	No	1	1	1	1	1	1	1	1	1	1
At the supermarket during an occasional shop											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
Age	18–30 years	**5.67 (4.00; 8.03)**	**5.10 (3.51; 7.42)**	**5.10 (3.51; 7.42)**	**2.83 (1.85; 4.34)**	**5.20 (3.55; 7.60)**	**4.26 (2.96; 6.14)**	**2.96 (2.00; 4.37)**	**4.90 (3.25; 7.39)**	**4.36 (2.48; 7.65)**	**4.70 (3.08; 7.18)**
	31–50 years	**2.65 (1.90; 3.68)**	**3.14 (2.20; 4.48)**	**3.14 (2.20; 4.48)**	**1.89 (1.27; 2.82)**	**1.89 (1.30; 2.73)**	**2.60 (1.84; 3.67)**	**2.13 (1.48; 3.05)**	**2.03 (1.36; 3.04)**	**2.62 (1.53; 4.49)**	**2.22 (1.47; 3.36)**
	51–65 years	1	1	1	1	1	1	1	1	1	1
Gender	Female	0.98 (0.76; 1.27)	0.83 (0.64; 1.08)	0.83 (0.64; 1.08)	**0.69 (0.50; 0.95)**	**0.68 (0.51; 0.90)**	**0.67 (0.52; 0.87)**	**0.68 (0.51; 0.90)**	**0.70 (0.52; 0.94)**	**0.64 (0.43; 0.94)**	**0.60 (0,44; 0.81)**
	Male	1	1	1	1	1	1	1	1	1	1
SEP	Low	**1.36 (1.04; 1.77)**	**1.47 (1.03; 2.09)**	**1.47 (1.03; 2.09)**	**2.26 (1.51; 3.39)**	**1.74 (1.20; 2.52)**	**1.71 (1.21; 2.42)**	**1.80 (1.23; 2.61)**	1.34 (0.91; 1.96)	**3.03 (1.85; 5.00)**	1.16 (0.76; 1.76)
	Medium	1.33 (0.95; 1.86)	**1.46 (1.10; 1.94)**	**1.46 (1.10; 1.94)**	1.39 (0.97; 1.99)	**1.41 (1.04; 1.92)**	1.26 (0.95; 1.68)	**1.42 (1.04; 1.94)**	0.82 (0.59; 1.14)	**1.63 (1.04; 2.58)**	1.21 (0.88; 1.68)
	High	1	1	1	1	1	1	1	1	1	1
Children in the household	Yes	1.10 (0.84; 1.44)	0.78 (0.58; 1.04)	0.78 (0.58; 1.04)	1.01 (0.71; 1.42)	1.17 (0.86; 1.59)	0.83 (0.62; 1.11)	1.08 (0.80; 1.48)	0.94 (0.71; 1.38)	1.09 (0.71; 2.58)	0.82 (0.58; 1.16)
	No	1	1	1	1	1	1	1	1	1	1
Purchased at work											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
Age	18–30 years	**5.23 (2.72; 10.06)**	**7.36 (3.57; 15.20)**	**5.32 (2.44; 11.62)**	**18.12 (2.14; 153.41)**	**3.72 (1.05; 13.10)**	**33.82 (4.40; 259.91)**	**13.47 (1.58; 114.75)**	**15.40 (1.74; 136.65)**	**1.88 (1.05; 3.36)**	**3.09 (1.48; 6.46)**
	31–50 years	**2.84 (1.23; 4.63)**	**4.03 (1.99; 8.19)**	1.44 (0.64; 3.27)	7.05 (0.87; 57.05)	2.18 (0.64; 7.35)	**17.50 (2.32; 132.07)**	7.64 (0.93; 62.83)	6.90 (0.84; 56.82)	**1.73 (1.02; 2.94)**	**2.31 (1.16; 4.59)**
	51–65 years	1	1	1	1	1	1	1	1	1	1
Gender	Female	0.66 (0.42; 1.03)	0.72 (0.46; 1.12)	**0.34 (0.19; 0.60)**	0.62 (0.23; 1.66)	**0.21 (0.08; 0.57)**	**0.43 (0.22; 0.84)**	**0.17 (0.05; 0.56)**	**0.07 (0.02; 0.33)**	**0.53 (0.35; 0.81)**	**0.56 (0.34; 0.93)**

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Table 3 (*continued*)

Supermarket, during regular shopping											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
	Male	1	1	1	1	1	1	1	1	1	1
SEP	Low	1.56 (0.96; 2.54)	**2.16 (1.21; 3.84)**	1.39 (0.63; 3.10)	1.74 (0.48; 6.32)	3.33 (0.99; 11.21)	1.64 (0.67; 4.03)	2.88 (0.70; 11.88)	0.85 (0.17; 4.39)	0.92 (0.48; 1.77)	0.85 (0.39; 1.83)
	Medium	1.50 (0.81; 2.78)	**1.72 (1.05; 2.83)**	1.52 (0.81; 2.87)	1.36 (0.45; 4.14)	2.19 (0.72; 6.67)	1.35 (0.64; 2.86)	2.20 (0.63; 7.68)	1.15 (0.36; 3.69)	1.36 (0.86; 2.14)	1.17 (0.68; 2.01)
	High	1	1	1	1	1	1	1	1	1	1
Children in the household	Yes	0.74 (0.43; 1.25)	1.10 (0.67; 1.80)	1.35 (0.70; 2.56)	2.67 (0.88; 8.05)	1.06 (0.38; 2.92)	1.33 (0.62; 2.86)	1.09 (0.33; 3.63)	2.06 (0.62; 6.86)	0.75 (0.46; 1.21)	1.02 (0.58; 1.79)
	No	1	1	1	1	1	1	1	1	1	1
Received at work											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
Age	18–30 years	**1.83 (1.32; 2.54)**	**2.74 (1.90; 3.96)**	**1.84 (1.32; 2.55)**	**1.90 (1.45; 2.49)**	**2.41 (1.27; 4.58)**	**3.58 (1.81; 7.09)**	**5.55 (2.32; 13.33)**	**17.52 (2.15; 142.94)**	**2.69 (1.25; 5.81)**	1.44 (0.78; 2.67)
	31–50 years	**1.93 (1.44; 2.57)**	**1.85 (1.32; 2.59)**	**1.80 (1.35; 2.41)**	**1.52 (1.20; 1.92)**	**1.95 (1.07; 3.54)**	**2.69 (1.41; 5.14)**	**4.77 (2.10; 10.86)**	**12.75 (1.65; 98.45)**	1.69 (0.82; 3.49)	**1.70 (1.03; 2.80)**
	51–65 years	1	1	1	1	1	1	1	1	1	1
Gender	Female	1.03 (0.81; 1.32)	1.13 (0.85; 1.49)	1.08 (0.84; 1.38)	1.06 (0.86; 1.31)	**0.47 (0.29; 0.74)**	**0.60 (0.38; 0.95)**	**0.44 (0.27; 0.73)**	**0.17 (0.06; 0.43)**	**0.27 (0.15; 0.49)**	**0.31 (0.20; 0.48)**
	Male	1	1	1	1	1	1	1	1	1	1
SEP	Low	**0.34 (0.23; 0.51)**	**0.40 (0.26; 0.63)**	**0.29 (0.19; 0.44)**	**0.27 (0.20; 0.37)**	0.72 (0.35; 1.49)	**0.41 (0.17; 0.98)**	**0.36 (0.14; 0.93)**	1.07 (0.33; 3.46)	0.70 (0.28; 1.75)	0.60 (0.31; 1.19)
	Medium	0.79 (0.61; 1.01)	0.89 (0.67; 1.18)	0.76 (0.59; 0.98)	**0.58 (0.46; 0.71)**	1.03 (0.63; 1.69)	1.16 (0.72; 1.86)	0.79 (0.46; 1.34)	0.93 (0.36; 2.56)	1.23 (0.67; 2.24)	0.91 (0.58; 1.44)
	High	1	1	1	1	1	1	1	1	1	1
Children in the household	Yes	0.82 (0.63; 1.06)	1.08 (0.81; 1.45)	0.82 (0.63; 1.07)	0.84 (0.68; 1.05)	0.74 (0.44; 1.26)	0.81 (0.48; 1.36)	0.92 (0.52; 1.62)	1.14 (0.44; 2.98)	0.86 (0.45; 1.65)	1.21 (0.76; 1.90)
	No	1	1	1	1	1	1	1	1	1	1
At the train station											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
Age	18–30 years	**1.75 (1.04; 2.94)**	**2.62 (1.42; 4.82)**	**4.76 (2.17; 10.46)**	**14.91 (1.87; 118.82)**	1.39 (0.68; 2.84)	**11.20 (2.51; 49.93)**	**4.03 (1.03; 15.86)**	5.87 (0.64; 54.20)	**3.94 (2.27; 6.86)**	**2.09 (1.26; 3.45)**
	31–50 years	**1.83 (1.15; 2.91)**	**2.32 (1.29; 4.17)**	**2.65 (1.21; 5.81)**	6.70 (0.82; 55.15)	1.32 (0.67; 2.57)	**8.37 (1.90; 36.84)**	3.15 (0.84; 11.85)	**8.89 (1.08; 73.54)**	**1.88 (1.07; 3.30)**	**2.03 (1.30; 3.16)**
	51–65 years	1	1	1	1	1	1	1	1	1	1
Gender	Female	**0.63 (0.43; 0.93)**	0.94 (0.60; 1.47)	**0.58 (0.34; 0.99)**	0.69 (0.27; 1.74)	0.58 (0.34; 1.01)	0.74 (0.37; 1.50)	0.52 (0.21; 1.28)	**0.27 (0.08; 0.93)**	**0.49 (0.33; 0.73)**	**0.45 (0.31; 0.64)**
	Male	1	1	1	1	1	1	1	1	1	1
SEP	Low	1.31 (0.77; 2.22)	1.29 (0.72; 2.30)	1.97 (0.95; 4.09)	1.29 (0.39; 4.29)	1.28 (0.59; 2.77)	2.34 (0.96; 5.70)	**2.96 (1.01; 8.66)**	**8.80 (1.65; 46.81)**	1.37 (0.82; 2.29)	1.12 (0.70; 1.79)
	Medium	1.40 (0.92; 2.11)	1.03 (0.64; 1.66)	**1.91 (1.05; 3.48)**	0.85 (0.30; 2.42)	1.30 (0.71; 2.39)	1.46 (0.66; 3.25)	1.11 (0.37; 3.35)	3.61 (0.69; 18.89)	0.75 (0.47; 1.19)	0.73 (0.49; 1.10)
	High	1	1	1	1	1	1	1	1	1	1
Children in the household	Yes	0.72 (0.47; 1.10)	**0.53 (0.32; 0.89)**	0.73 (0.39; 1.36)	0.58 (0.17; 1.97)	**0.48 (0.24; 0.93)**	0.60 (0.26; 1.41)	0.72 (0.25; 2.06)	0.45 (0.11; 1.85)	**0.58 (0.35; 0.96)**	0.97 (0.65; 1.43)

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Table 3 (*continued*)

Supermarket, during regular shopping											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
	No	1	1	1	1	1	1	1	1	1	1
At friends'/family's place											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
Age	18–30 years	**3.00 (2.21; 4.09)**	**2.92 (2.16; 3.94)**	**2.25 (1.71; 2.96)**	**2.67 (2.06; 3.48)**	**3.57 (2.54; 5.02)**	**2.95 (2.24; 3.88)**	**2.64 (1.20; 3.50)**	**4.45 (2.87; 6.88)**	**3.70 (2.52; 5.45)**	**2.85 (1.75; 4.66)**
	31–50 years	**1.70 (1.28; 2.28)**	**1.47 (1.11; 1.95)**	**1.37 (1.06; 1.76)**	**1.48 (1.18; 1.86)**	**1.67 (1.19; 2.34)**	**1.78 (1.39; 2.27)**	**1.70 (1.32; 2.19)**	**1.78 (1.13; 2.80)**	**2.07 (1.41; 3.03**	**2.09 (1.32; 3.30)**
	51–65 years	1	1	1	1	1	1	1	1	1	1
Gender	Female	1.26 (0.99; 1.61)	1.23 (0.96; 1.56)	**1.41 (1.13; 1.76)**	**1.47 (1.20; 1.80)**	0.83 (0.64; 1.08)	1.15 (0.93; 1.42)	1.18 (0.94; 1.47)	0.76 (0.54; 1.05)	0.91 (0.68; 1.22)	0.75 (0.53; 1.06)
	Male	1	1	1	1	1	1	1	1	1	1
SEP	Low	1.22 (0.88; 1.69)	0.79 (0.58; 1.10)	**0.59 (0.43; 0.79)**	**0.75 (0.57; 0.99)**	0.82 (0.56; 1.20)	**0.68 (0.50; 0.91)**	**0.71 (0.53; 0.96)**	1.08 (0.68; 1.70)	1.33 (0.89; 1.98)	0.80 (0.48; 1.34)
	Medium	**1.40 (1.09; 1.80)**	0.92 (0.72; 1.17)	0.82 (0.65; 1.03)	0.92 (0.75; 1.14)	1.11 (0.84; 1.47)	0.97 (0.77; 1.21)	0.90 (0.72; 1.13)	1.15 (0.81; 1.63)	**1.50 (1.10; 2.05)**	1.00 (0.69; 1.45)
	High	1	1	1	1	1	1	1	1	1	1
Children in the household	Yes	0.84 (0.65; 1.09)	0.89 (0.70; 1.15)	**0.76 (0.61; 0.96)**	0.83 (0.68; 1.03)	**0.52 (0.39; 0.71)**	0.83 (0.66; 1.03)	**0.75 (0.60; 0.95)**	**0.49 (0.33; 0.73)**	**0.59 (0.43; 0.83)**	0.98 (0.67; 1.44)
	No	1	1	1	1	1	1	1	1	1	1
At specialized shops (i.e. bakery, ice-cream parlor)											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
Age	18–30 years	**2.59 (1.36; 4.91)**	1.73 (0.80; 3.74)	1.01 (0.50; 2.08)	**0.52 (0.36; 0.73)**	1.24 (0.96; 1.61)	2.17 (0.60; 7.82)	–	**2.07 (1.60; 2.68)**	**1.69 (1.30; 2.19)**	**0.56 (0.36; 0.86)**
	31–50 years	1.00 (0.53; 1.88)	0.98 (0.45; 2.15)	1.08 (0.59; 1.97)	**0.60 (0.46; 0.80)**	1.11 (0.89; 1.38)	0.55 (0.10; 3.05)	–	**1.27 (1.02; 1.59)**	**1.26 (1.01; 1.58)**	**1.45 (1.06; 1.96)**
	51–65 years	1	1	1	1	1	1	1	1	1	1
Gender	Female	1.13 (0.66; 1.92)	0.90 (0.47; 1.71)	0.79 (0.46; 1.34)	**1.42 (1.09; 1.86)**	**1.40 (1.14; 1.70)**	0.65 (0.21; 1.96)	–	0.92 (0.75; 1.12)	0.88 (0.72; 1.07)	0.96 (0.72; 1.28)
	Male	1	1	1	1	1	1	1	1	1	1
SEP	Low	1.73 (0.91; 3.29)	2.06 (0.91; 4.63)	1.04 (0.47; 2.30)	0.79 (0.55; 1.13)	**0.65 (0.50; 0.85)**	2.56 (0.51; 12.92)	–	**0.63 (0.48; 0.82)**	**0.65 (0.50; 0.85)**	1.34 (0.92; 1.95)
	Medium	1.27 (0.72; 2.25)	1.48 (0.72; 3.04)	1.61 (0.91; 2.85)	0.97 (0.74; 1.28)	**0.78 (0.63; 0.96)**	2.81 (0.72; 11.01)	–	**0.77 (0.63; 0.96)**	**0.75 (0.61; 0.93)**	1.18 (0.87; 1.61)
	High	1	1	1	1	1	1	1	1	1	1
Children in the household	Yes	**1.73 (1.00; 3.00)**	0.74 (0.36; 1.51)	1.09 (0.62; 1.91)	1.23 (0.95; 1.61)	**1.30 (1.06; 1.60)**	0.37 (0.08; 1.81)	–	1.07 (0.87; 1.32)	**1.32 (1.07; 1.62)**	0.88 (0.66; 1.18)
	No	1	1	1	1	1	1	1	1	1	1
Sports association/club											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
Age	18–30 years	**5.35 (1.42; 20.18)**	**1.16 (1.22; 101.84)**	0.93 (0.36; 2.41)	1.13 (0.32; 4.04)	**8.55 (2.17; 33.70)**	**9.37 (3.08; 28.46)**	**3.93 (1.31; 11.79)**	– –	**3.39 (1.83; 6.27)**	**5.02 (1.23; 20.44)**

(*continued on next page*)

Table 3 (*continued*)

Supermarket, during regular shopping											
		Sweets (aOR (95%CI)	Chocolate (aOR (95% CI)	Cookies (aOR (95%CI)	Pies/cake (aOR (95% CI)	Ice cream (aOR (95%CI)	Crisps and salty snacks (aOR (95%CI)	Nuts (aOR (95% CI)	Pizza (aOR (95% CI)	Fried snacks (aOR (95%CI)	Sausage rolls (aOR (95%CI)
	31–50 years	**5.12 (1.47; 17.83)**	5.58 (0.66; 47.21)	0.50 (0.18; 1.38)	1.35 (0.42; 4.33)	2.06 (0.54; 7.93)	2.10 (0.64; 6.91)	1.05 (0.32; 3.51)		1.14 (0.63; 2.09)	1.30 (0.29; 5.93)
	51–65 years	1	1	1	1	1	1	1	1	1	1
Gender	Female	0.55 (0.26; 1.15)	**0.15 (0.04; 0.56)**	1.05 (0.46; 2.43)	0.72 (0.27; 1.90)	0.56 (0.23; 1.35)	0.43 (0.22; 0.86)	**0.26 (0.11; 0.63)**	–	**0.37 (0.23; 0.60)**	**0.32 (0.11; 0.91)**
	Male	1	1	1	1	1	1	1	1	1	1
SEP	Low	1.49 (0.55; 4.05)	1.79 (0.48; 6.62)	1.31 (0.48; 3.63)	0.36 (0.04; 2.92)	0.69 (0.18; 2.55)	1.20 (0.47; 3.02)	0.53 (0.15; 1.88)	–	1.06 (0.56; 2.00)	1.97 (0.52; 7.55)
	Medium	1.21 (0.52; 2.78)	0.39 (0.08; 1.96)	0.85 (0.34; 2.14)	1.34 (0.50; 3.64)	0.83 (0.32; 2.17)	1.00 (0.46; 2.14)	0.48 (0.18; 1.28)	–	0.93 (0.55; 1.56)	1.34 (0.40; 4.47)
	High	1	1	1	1	1	1	1	1	1	1
Children in the household	Yes	0.99 (0.43; 2.28)	1.78 (0.48; 6.62)	0.63 (0.25; 1.60)	0.31 (0.08; 1.13)	**3.88 (1.42; 10.57)**	1.00 (0.43; 2.35)	0.77 (0.26; 2.27)	–	**1.83 (1.09; 3.07)**	1.30 (0.39; 4.32)
	No	1	1	1	1	1	1	1	1	1	1

SEP | Socioeconomic position. All analyses are adjusted for the other sociodemographic variables than the exposure.
Associations highlighted in bold text represent statistically significant associations.
*These associations could not be calculated due to a limited amount of observations.

train station, gas station and (sports) associations/clubs, albeit much less frequently. This suggests that depending on the context under study, non-food locations could also be operationalised as part of the food environment, especially when it concerns unhealthy snack foods that can be obtained from a range of locations. A few studies investigated the role of non-food locations. For example, Wright et al. showed that 16% of non-food stores in a shopping mall displayed food at the check-out, with all of them displaying less healthy foods (Wright et al., 2015). Liu et al. reported that unhealthy snack consumption was more prevalent in non-eating places than in designated eating places (Liu et al., 2015). In addition, two studies demonstrated that snacking behaviours were most likely to occur at home (Vatanparast et al., 2020; Liu et al., 2015). However, this is the first time snack consumption has been directly linked to the location where snacks have been obtained.

The fact that many snacks were obtained at the place of friends or family members, or received at work, for example as a birthday treat from a colleague, suggests that unhealthy snack food also plays an important role during social gatherings. Indeed, previous research among Dutch adults showed that special occasions or celebrating at a party were the most common reasons for consuming unhealthy snacks (Verhoeven et al., 2015). This corresponds with the sociological perspective that eating can be seen as a social practice, and that eating routines cannot be seen as separate from their social context (Delormier et al., 2009; Olstad and Kirkpatrick, 2021). The presence of others eating and perceptions of social norms with regard to snacking may also contribute to this social phenomenon (Schuz et al., 2018; Stok et al., 2018). The fact that older adults were consistently more likely to purchase their unhealthy snack foods from the supermarket during a regular shop, and younger adults from a range of locations, may point towards a role for impulsiveness, which tends to decline with age (Steinberg et al., 2008).

Despite the relatively large and sociodemographically diverse sample size and the unique set of questions around locations for snack food purchases, the presented results should be viewed in the light of some limitations. Information bias may have arisen due to a number of reasons. We only collected data on 10 selected snack foods, focused mostly but not solely on unhealthy items and the interpretation of the categories may differ between participants. For instance, some participants may have reported about their pizza consumption as a meal instead of snack food, and nuts could include healthy unsalted nuts. The information on consumption was limited to frequency, which means that the results cannot be generalized to energy intake, and we did not use a validated measurement instrument. Also, for the combined SEP score, it would have been preferable to use a better indicator of occupational prestige than the ISCO08 skill levels, but this was not possible in the current study. Selection bias due to a lower than true proportion of adults with a low SEP may have reduced the observed socioeconomic differences in frequency of snack food consumption and location for obtaining snack foods. Also, we focused on a primarily urban sample, while both the availability and use of food outlets may be different in more rural areas. Finally, many confidence intervals were wide, potentially due to the categorization of sociodemographic variables and infrequent use of specific food retailers for specific snacks, so future studies are needed to confirm effect sizes observed.

Our findings reinforce the importance of exploring the interactions between individuals and their food environments. We observed clear differences in the way sociodemographic subgroups used their food environment for obtaining snacks foods, and future studies may explore whether the use of food retailers explains the link between exposure to food outlets and snack food intake. In addition, given the increasing availability of online food shopping opportunities, future studies could consider sociodemographic variation in online food shopping behaviours. At the same time, there are increasing concerns around decreasing availability of local food stores such as greengrocers and increasing availability of convenience stores and fast-food outlets (Pinho et al., 2020; Hobbs et al., 2021; Maguire et al., 2015; P é rez-Ferrer et al., 2020). Yet, even increases in access to supermarkets in more deprived areas (Pinho et al., 2020; Hobbs et al., 2021) may not be viewed as favourable given the current study results. Policies targeting availability of and promotions for unhealthy foods within food stores, such as restricting the promotion of unhealthy foods at check-outs, store entrances, aisle ends and online equivalents (Department of Health and Social, 2020), should therefore perhaps be prioritised. Implementation of such policies should then be thoroughly evaluated in terms of effectiveness, equity and systemic changes, e.g., through interrupted time series analyses or Reflexive Monitoring in Action methods.

In conclusion, both the frequency and location of obtaining snack foods differed between sociodemographic groups. Differences in the frequency of snack food consumption were most notable between younger and older adults and between those with low as compared to high SEP. Supermarkets form an important point-of-purchase for unhealthy snack foods, especially for those with a low SEP and those with children in the household. Finally, non-food locations could potentially be considered as relevant food environment context when considering sources of unhealthy snack foods. Our findings reinforce the importance of tackling unhealthy food environments but for one of the first times highlight the important role of supermarkets in snacking behaviour particularly for lower SEP populations.

Declaration of interest

We declare no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.healthplace.2022.102802.

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