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Voicing residents' perception of (commercial) food cues in outdoor public spaces: a photovoice study

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Abstract

Background (Commercial) food cues in outdoor public spaces are environmental drivers of unhealthy diets. This study aimed to explore residents' perceptions of food cues in outdoor public spaces in relation to their perceived food environment, eating behaviour, and their opinion on governmental outdoor food cue regulations.

Methods A photovoice study, consisting of a photography assignment followed by semi-structured interviews, was conducted among 15 adult residents of the municipality of Wageningen, the Netherlands. Participants had one week to take photographs of outdoor food cues they encountered in their municipality, using a mobile app "myfood-environment", that were central to the interview afterwards.

Results Participants mainly noticed unhealthy food cues, which they viewed as constant 'reminders' that unhealthy food was easily accessible and affordable. Their views varied on the extent to which food cues affected their own eating behaviour, but generally believed that food cues affected that of others. Participants identified several factors that amplify outdoor food cues' influence on eating behaviour, including hunger, fatigue and attractiveness of the cues. The findings revealed support for government regulation of food cues, while acknowledging the complexity of this issue and the diverse perspectives on how such regulations should be designed (e.g., where, for whom), with one notable counterargument being concerns about feeling patronized by such policies.

Conclusions Current findings may inform health professionals and (local) policy makers about the unhealthy food cues encountered by residents in outdoor public spaces, which unconsciously influence their eating behaviour, while also providing insights into designing food cue regulations that attract policy support by balancing public health goals with considerations of consumer autonomy and citizen preferences.

Keywords Neighbourhood, Food cues, Food environment, Public space, Eating behaviour, Perceptions, Photovoice

Background

Overweight, obesity, and diet-related chronic diseases pose a major public health challenge globally and predominantly result from unhealthy dietary patterns [1]. Eating behaviour arises from many factors and is strongly influenced by the food environment [2, 3]. Contemporary food environments tend to promote unhealthy eating behaviour due to the ubiquitous availability, accessibility, attractiveness, affordability, and promotion of unhealthy foods over healthy foods [3]. Food environments are characterized by an overrepresentation of unhealthy food outlets [4] and outdoor marketing for unhealthy foods, for instance on billboards, or bus shelters [5–7]. As a result, people are continuously exposed to predominantly unhealthy, tempting foods, creating visual food cues

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in outdoor public spaces [6, 8]. Visual food cues can be defined as any visible cues or situations linked to food-related memories [9]. Examples of food cues encountered outdoors are food advertisements, food displays, and logos of food stores.

People's eating behaviour is unconsciously influenced by the ubiquitous food cues they encounter in their environment [9, 10]. Dual-process theories of health behaviour posit that eating behaviour is driven by two distinct cognitive processes: automatic processes (also referred to as impulsive or implicit processes, operating with high speed and requiring low cognitive efforts) and reflective processes (also referred to as controlled or explicit processes, requiring conscious, cognitive processing) [11]. Visual food cues primarily engage automatic processes, which lead to rapid, emotional and physiological responses that encourage eating in an unconscious way [12].

The effect of visual food cues on eating behaviour and food temptations has largely been studied in laboratory settings, including neuroimaging studies to unravel the brain reactions to visual food cues [13, 14]. Findings indicate that particularly palatable, high-caloric visual food cues trigger people's immediate desire for food, so called 'food cravings' [15, 16]. Besides, food cues can increase people's motivation to obtain and consume food, even when participants are satiated and not actively looking for food anymore [17]. Systematic literature reviews have shown that food-cue induced cravings can predict subsequent eating behaviour and weight gain in children and adults [18, 19].

Even if people were made aware of all the hidden ways in which food cues influence their behaviours, few people would be able to resist these cues on a daily basis given that they affect behaviour through automatic processes [10, 20]. Moreover, settings where people acquire food are often designed to promote impulsive purchases [10, 21, 22]. To illustrate, in the Netherlands, 80% of foods and 80% of promotions in supermarkets contribute to unhealthy diets and these figures are even larger for out-of-home food chains [23]. Also, individuals see more frequently unhealthy food cues in public spaces than healthy cues [24]. This stimulates people to make automatic, and largely unhealthy food choices [10, 21–23]. This may explain why studies that developed cognitive trainings targeted at individuals to reduce the effect of visual food cues on individuals' eating behaviour and weight gain were not effective in 'real-world' settings [14]. Besides, evidence shows that interventions targeting individual behaviour are much less effective in reducing obesity prevalence than structural interventions changing the food environment [25]. Unhealthy food cues in the food environment affect all individuals, regardless of their weight, which makes it a promising target for structural interventions [19, 26]. Therefore, public health experts urge for governmental measures to reduce the amount of unhealthy outdoor food cues residents are exposed to, as a strategy to limit the intake of low-nutrient energy-dense foods [5, 10, 27, 28].

To the best of our knowledge, there is a lack of studies on the diversity of food cues that residents encounter in outdoor public spaces. Most research about visual food cues focuses on laboratory settings and evaluates immediate to short term effects of visual food cues on food cravings or eating behaviour [14]. Besides, the majority of studies about residents' perception of their food environment ignore the presence of visual food cues in outdoor public spaces as part of the measurements [29]. Most studies so far have particularly focused on exposure to outdoor food marketing in real-world settings [5, 6]. Yet, no study has focused explicitly on how residents perceive food cues in relation to their food environment, eating behaviour, or governmental restrictions.

Lived experience research (e.g. using the photovoice method) is one way of including citizens in the generation of solutions to improve food environments [30]. It generates insights into the ways people navigate and perceive their food environment, which is useful to better understand the role of food environments in eating behaviour. Lived experience research is also valuable for the design, implementation and evaluation of food environment policies [30–32]. Local municipalities might benefit from incorporating citizens' insights in the policy process because designing public policies with its users enables the latter to contribute their knowledge and experiences, resulting in more suitable policies, and possibly increased public support [32]. Besides, this knowledge is paramount to develop effective governmental regulations addressing unhealthy outdoor visual food cues, as public opinion may be a barrier to policy development and implementation [33, 34]. This study will focus on visual food cues, hereafter the term 'food cues' will be used to refer to visual food cues only.

By applying the photovoice method, this study aimed to evaluate how residents relate observed food cues to their perceived food environment and eating behaviour. Also, this study sought to understand their perspectives on policies to regulate unhealthy food cues in outdoor public spaces.

Methods

Study design and setting

A photovoice project with interviews was conducted in April 2023 in the municipality of Wageningen, the Netherlands. In 2022, Wageningen had a total population of about 40.000 residents [35]. This study is part of larger research project investigating ways to move towards

healthy and sustainable food environments in the Foodvalley region, which includes Wageningen [36]. All participants provided their written informed consent for this study. In addition, participants agreed to the privacy statement regarding the collection, use, and processing of personal data through the mobile application. Approval for the study was granted by the Social Sciences Ethics Committee of Wageningen University.

Participants and sample

A purposive sampling strategy was used to recruit participants. Eligible participants were adults speaking Dutch and living in Wageningen for at least one year. They had to own a smartphone with mobile data, a camera, and a GPS function (although the GPS data was not used for the present study [24]).

To recruit participants, a researcher (KR) approached people in outdoor public spaces at different times (four weekdays during and after working hours spread over two weeks) and various locations (e.g., the bus station, park, shopping centre, and supermarkets). The researcher explained the aim of the study and the research activities (i.e. the photography assignment and interview) to eligible participants. If they agreed to participate and provided their written informed consent, the contact details and demographic information of participants were written down and the date and location for the interview were set. Participants also received an information flyer and an e-mail, which had a referral to the project's website and contact details of the researcher for further information [37]. They received a €10 gift card for their participation in the study.

Data collection

Data was collected through photovoice, consisting of a photography assignment and semi-structured interviews in the period March–April 2023. The photovoice method consists of participants taking photographs to document and reflect on what they perceive to be related to a particular community issue. These photographs are subsequently discussed in focus groups [38] or, more recently, through interviews [39–41] to comprehend real-life experiences, expertise, and knowledge associated with the photographs.

Consistent with previous photovoice studies assessing the food environment [41–43], we requested participants in the current study to take five photographs of food cues they encountered in their municipality over a one-week period. However, we did not treat this number as a fixed requirement, and we did not exclude participants with fewer photos or ask participants to delete pictures if they took more. If participants had taken zero pictures, they would have been excluded; however, this was not the case.

Participants received an e-mail with instructions and personal login credentials to download a mobile application (app) ('myfoodenvironment') to photograph food cues in Wageningen. This app was adapted from a previous app [44] and tailored to the specific objectives of this research project. Food cues were defined as anything they noticed in outdoor public spaces, reminding them of food. It was emphasized that they had to take the photographs in outdoor public spaces in Wageningen. Outdoor public spaces were defined as places open and accessible to the public, not in buildings. When opening the app, participants saw the button "I'd like to add a food cue" on which they could click to photograph a food cue. After taking a photograph, participants were asked to provide a short description of what they had photographed in the app. This was followed by a few questions regarding the photograph (additional file 1). These questions were asked as a pilot test for another study of this research project [24].

In the week following the photography assignment, semi-structured interviews with each participant were conducted. Interviews allow for an in-depth exploration of individual perceptions of the photographs [45] and enable participants to feel comfortable, safe, and open for self-expression [46]. Participants' photographs were used during the interviews to facilitate dialogue and guide the discussion on food cues in outdoor public spaces. The interviews took place at the Wageningen University ($N=9$) or online via Microsoft Teams ($N=6$), depending on participants' preferences. The researcher provided the photographs on paper (at the university) or on slides (online) for the interviews. When participants took more than five photographs, all photographs were provided and discussed. The interviews lasted 18 to 37 min and were audio-recorded.

Interview guide

A semistructured interview guide was developed by the research team for the purpose of this study based on the Model of Community Nutrition Environments (additional file 2) [47]. First, it was verified if the photographs were taken by the participant, and inquired how the participant experienced the photovoice assignment. Subsequently, participants were asked to explain why they considered these to be food cues and how often they encountered them. Also, participants were asked about their perceptions of the connection between food cues and eating behaviour, as well as how these cues shaped their perception of their local food environment. Finally, the interview delved into participants' perception of

government regulation of these food cues in outdoor public spaces. Intentionally no specific description of 'food cue regulation' was provided, to leave room for participants to express their views on various types of regulation.

Data analysis

Photographed food cues

To gain insight into the food cues photographed by the participants, we determined the following characteristics (based on the INFORMAS protocol for outdoor advertising (79) and own fieldwork in the Netherlands): the type of food cue (e.g. free-standing sign, poster), the originator of the food cue (e.g. food outlets: supermarket, full-service restaurant, quick-service restaurant; food manufacturer), and the representation of the food cue (e.g. text, illustrations, logos). The visibility of foods products (yes/no) on the food cues was also determined.

Additional steps were taken to code visible food products on the photographed food cues. Visible food products were categorized by food group based on the Dutch Nutrient File (NEVO table), which contains data on more than 2,300 foods that are regularly eaten in the Netherlands [48]. Visible food products were also coded based on healthiness using a consumer guide for healthy and sustainable diets based on the Dutch national nutrition guidelines (entitled 'the Wheel of Five'). The 'Wheel of Five' gives an overview of the products that contribute to a healthy diet. A product was considered healthy if it was included in the 'Wheel of Five' and unhealthy if it was not included in the 'Wheel of Five' [49]. Food products that were assembled dishes, which were not listed in the 'Wheel of Five', were coded for healthiness using the 'Healthy Meal Index'. This is a tool used to obtain an indication of the healthiness of assembled dishes (i.e. meals), inspired by the work of Kasper and colleagues (2016) and based on the 'Wheel of Five' [23, 50]. Last, for each food cue, it was determined whether visible food products were all unhealthy, all healthy, or some healthy and some unhealthy. Food cues that did not depict food products (e.g. brand marketing) were not coded for healthiness. The setting of the food cue (e.g. outside, near a shop; outside, near a food service outlet; outside, at the market; outside, near a train station) was determined by the participants, through a question in the app (see question 1 and corresponding response options in additional file 1).

Interviews

All interviews were transcribed verbatim (in Dutch), and relevant quotes were translated in English. The interview transcripts were imported and analysed in the ATLAS.ti Analysis Software (2023). Participants' names were replaced by ID-codes. One researcher (KR) coded and analysed the data using a thematic content approach [51]. All interviews were coded inductively to generate initial codes for every sub-question of the interview separately. This was an iterative process of going back and forth through the data. These codes were then analysed and sorted into potential overarching themes that helped to answer each sub-question. The themes were constructed iteratively by three researchers (KR, TW, MP). The authors combined codes across the data to form a theme, in a way that captured important dynamics in the data. Initial themes were discussed within the team, refined to include more complexity, and subsequently written down. After the final themes were defined, the coded data extracts within each theme were checked to fit the theme. A codebook of themes and codes was made to ensure transparency and consistency in the analyses. The definitions of the codes and their frequency were documented to ensure their occurrence in the data aligned with their significance in the analyses.

The researcher MP (PhD) has a background in public health nutrition, TW (MSc) has a background in public health nutrition and law, SD (PhD) has a background in sociology, KR (MSc) has a background in nutrition. All researchers are female and MP and SD had sufficient prior experience and training in conducting qualitative research, while KR and TW had some prior training in conducting qualitative research.

Results

Participant Characteristics

Fifteen participants (seven women, eight men, age range 21–73, different education levels) participated in the study (Table 1).

Photographed food cues

A total of 85 photographs were taken (ranging from 4 to 10 photographs per participant), but one photograph was excluded because it was taken indoors, resulting in 84 photographs included in the current study (Table 1). The majority of the photographed food cues were located in front of a food store ($N=31$; 36.9%) or a food service outlet (e.g. restaurant) ($N=24$; 28.6%). Most food cues were posters/banners/stickers ($N=42$; 50%) or free-standing signs ($N=14$; 17.6%). The food cues mainly originated from specialty food stores ($N=23$; 27.1%), supermarkets ($N=18$; 21.2%) and quick-service restaurants ($N=16$; 18.8%).

No food product was visible on 24 (28.6%) food cues (e.g., only a brand, logo, or vague text such as 'breakfast' was visible), while the majority of the food cues ($N=60$ (71.4%)) featured visible food products. Most ($N=43$ (71.7%) of the food cues showing (a) food product(s) featured one or more unhealthy foods, while 28.3% ($N=17$)

Table 1 Participants' demographics and number of photographs taken

Participant (p)	Gender	Age (years)	Education level (completed)	Number of photographs
1	Woman	23	Upper secondary education[2]	5
2	Man	73	Vocational training[2]	6
3	Man	21	University degree[3]	4
4	Man	22	Higher professional education[3]	5
5	Man	29	University degree[3]	10
6	Man	64	University degree[3]	6
7	Man	39	Higher professional education[3]	5
8	Woman	25	University degree[3]	6
9	Woman	57	Higher professional education[3]	5
10	Woman	54	Vocational training[2]	5
11	Man	49	Higher professional education[3]	7
12	Woman	58	Vocational training[2]	5
13	Man	27	Upper secondary education[2]	5
14	Woman	47	Higher professional education[3]	5
15	Woman	63	Higher professional education[3]	5

Footnotes indicate: (1) a lower education level; (2) a medium education level; (3) a higher education level, based on the Dutch Central Bureau for Statistics (CBS) [52]

featured only healthy foods. Most food groups visible on the food cues showing (a) food product(s) were: 'fast-food meals and snacks' ($N=13$; 14.9%); 'candy, chocolate and ice cream' ($N=13$;14.9%); and vegetables ($N=10$; 11.5%). More details on the content of the photographs can be found in additional files 3 and 4.

Food cues that residents noticed in outdoor public spaces

Most participants shared that the photography assignment raised their awareness of the presence of food cues in outdoor public spaces; "*I was not aware of this before, but now that I had to look for them, it suddenly is a lot*" (woman, 23-y (participant (p1)). Another participant said: *"I have walked past there a hundred times, but now that I looked so critically, I thought,'Gosh, what a big thing that is, such a big ice cream stand!"* (woman, 57-y (p9)). Participants declared that the majority of food cues in outdoor public spaces were for unhealthy food, as illustrated by the following quote: "*You notice way less healthy than unhealthy food. Actually, I didn't see any healthy food at all*" (woman, 54-y (p10)). They also noticed that most food cues were located near their homes and therefore would be faced on a daily basis.

Residents' perception of food cues in relation to their perceived food environment

Participants expressed their belief that a few food cues in outdoor public spaces contributed to an environment that stimulated healthy eating while most food cues did not. They expressed that food cues contributing to a healthy food environment signalled the availability and accessibility of healthy food, such as the market, advertisements for fruit and vegetables, and fruit and vegetables stalled in front of a food outlet (Figs. 1 and 2). Although most food cues did not show any prices, participants perceived them to be unaffordable, because of their assumption that healthy food is in general (more) expensive, as illustrated by the following quote: *"It is available, but way less affordable than unhealthy food, because the greengrocer* [Fig. 1] *is super expensive*" (woman, 23-y (p1)).

Participants mentioned that food cues not contributing to a healthy food environment functioned as a reminder that unhealthy food is easily accessible, available and affordable. These cues included advertisements for unhealthy food outlets (e.g. fast-food restaurants) or unhealthy food (e.g., ice cream, pizza, alcohol) (Fig. 3). One participant (woman, 47-y (p14)) explained that seeing 'snack bars' (local Dutch fast food outlet) and pizza takeaways at every corner of the street, which are open until late at night and sell unhealthy foods that are affordable, made it easy to eat whatever and whenever you want; "*they make it very easy to get that pizza; they have lots of discounts*". Unhealthy food was also perceived to be more affordable, as explained by one participant: "*generally unhealthy food is cheap food*" (man, 21-y (p3)). Participants thought that the food cues reinforced this assumption by showing "good" prices and discounts more prominently for unhealthy food than for healthy food. In addition, they noticed that unhealthy food cues aligned with norms for the promotion of food. For example, participants mentioned ice cream advertisements

Fig. 1 Poster of fruit and vegetables on the window of a specialty store ("Vegetables") (Titles of photographs between brackets correspond to participants' description of the photograph as entered in the app)

Fig. 2 Fruits and vegetables on display in front of a specialty store ("Vegetable stalls in front of a shop")

at the public swimming pool, because ice cream "*is normal if you go swimming with children during the holiday*" (man, 49-y (p11)) and beer advertising at the soccer field (Fig. 4), because "*beer and sports belong together*" (woman, 54-y (p10)).

Residents' perception of food cues in relation to their eating behaviour

Most participants acknowledged that some of the food cues they photographed may influence their eating behaviour, with some participants noting this could occur unconsciously. Several participants expressed that certain food cues did not affect them personally, but acknowledged the influence that those food cues could have on others. One participant said: "*Of course, there are people who are vulnerable and can't resist the temptation, but that is not the case for me*" (woman, 49-y (p11)). Participants who acknowledged the potential influence of certain food cues on their eating behaviour provided two main explanations for this. First, participants mentioned that food cues could function as a reminder of what

Fig. 3 Poster showing a pizza advertisement for a quick-service restaurant ("Advertisement")

food they had at home; needed to buy; or was available. A participant explained: *"You see Bakker Bart [a bakery chain] and you think 'Do I still have enough bread in the house?'"* (woman, 57-y (p9)). Second, food cues could create a craving for the depicted food (outlet), similar food, or food in general, as highlighted in the following quote:

Fig. 4 Poster showing an advertisement for a beer brand along the soccer field ("Advertisement")

Fig. 5 Sticker on supermarket window showing fruits ("Fruit assortment at the Lidl")

"The Magnum on the bus shelter. I think that is a food cue that makes me want to try this new Magnum ice cream" (man, 27-y (p13)). They could act upon this craving either directly or in the near future.

Participants also explained that the influence of a food cue on their eating behaviour depended on various factors. Many participants mentioned that food cues had a larger influence on them when they felt tired and/or hungry. This was especially true for food cues depicting convenience food, as explained by a participant: "*If I just ate and come across a pizza place, it's all fine. But if I am hungry, especially after a long day of work and I had a busy week, I could easily walk into that store*" (woman, 47-y (p14)). Participants explained that a food cue that was in line with their personal goals or eating habits could have a larger effect: "*I aim to eat healthy, so when I see that [salad advertisement], I think 'oh yes, I want to eat that'*" (woman, 23-y (p1)).

Participants also mentioned that the perceived attractiveness of a food cue influenced the effect it could have on their eating behaviour. For example, two participants mentioned how a nice photograph of fruit and vegetables (Fig. 5, participants photographed the same food cue) looked attractive to them, because of the variety of colours (man, 21-y (p3) and man, 29-y (p5)). This contrasts with Fig. 6, which was described as "*simply a big hump of bread. That is not really attractive*" (man, 29-y (p5)). Besides, unattractive food cues were mentioned to decrease appetite; "*at the snack bar, there is such a disgusting, filthy French fry bag on the outside, that is actually a reversed food cue*" (man, 39-y (p7)).

Participants explained that the influence of a food cue could depend on the perceived accessibility and

Fig. 6 Poster showing an advertisement for bread from a specialty store ("Variety of breads")

affordability of food. For example, an advertisement showing a pizza delivery or a food outlet within walking distance from home increased perceived accessibility, which encouraged eating behaviour. However, even if the displayed food was not directly accessible (e.g. the food outlet was not nearby or closed), the food cue could still have an effect because some participants would be triggered to buy it at a later moment or find a substitute. As explained by a participant: "*When I pass by there, they are not open […], but it is because you have had a moment of'hey, oh a nice sandwich and something else that later when you arrive at the station, that might be in your head, and then you get something"* (man, 39-y (p7)).

Next, participants stated that food cues depicting foods that were perceived to be inexpensive (e.g., food cues showing discount) often influenced them to acquire (an increased amount of) a particular food. One participant (man, 27-y (p13)) explained that "*as this indicates a special offer, which is for a limited time, it motivates me to go to the supermarket to take advantage of the offer*". On the other hand, food cues that were perceived as unaffordable did not have an effect on people, or had a delayed effect, as some would seek a more affordable substitute. One participant (woman, 23-y (p1)) stated: "*If I see these vegetables, I think… Yeah, I want to eat healthy, with a lot of vegetables! However, I will not go to that store, as the greengrocer is very expensive*".

Participants mentioned several other factors that influenced the extent to which food cues affected their eating behaviour. They mentioned that the weekend was the moment to spend time on social interaction and tasty food, which influenced the effect of a food cue. Participants were more tempted to acquire tasty food (e.g., ice cream, snacks, or a drink) when in the company of others, because "*eating together is always more pleasant*" (woman, 58-y (p12)). The weather also impacted the effect of food cues. Food cues related to ice cream and terraces were often mentioned to have a larger effect in case of good weather. One participant (man, 39-y (p7)) explained that "*when it is good weather and you come across a pleasant restaurant or pleasant café, that is tempting, because that is the right moment for it*". A few participants mentioned being less affected by food cues in case they had a task to perform (e.g. on their way to an appointment), and vice versa; "*when I have the time, I look around… It is a combination of time and focus whether I am susceptible to food cues*" (woman, 57-y (p9)).

Residents' perception of government food cue regulation

Most participants believed that the government should regulate food cues but observed this as a complex issue with varied perspectives on the design of such regulations. They explained how food cues steer many people towards unhealthy eating behaviour, increasing the public health issue of overweight and obesity. One participant (woman, 57-y (p9)) explained "*clearly, we are incapable to resist the amount of temptation, and I think it would be good for the government to intervene in this […] because people are unable to oversee the effects of a candy bar in the long run*". Participants mentioned that the government should promote the presence of healthy food cues and decrease the presence of unhealthy food cues in outdoor public spaces. They specified the importance of considering the setting of food cues when regulating them, for example by focusing on areas often used by children or waiting places (e.g. bus/train stations). On the contrary, some participants mentioned advertising in front of a store to be acceptable, especially if it is in the shopping district. One participant declared: *"All these examples are at the store itself, which I am ok with. But don't put a lot of those advertisements at a bus station."* He explained: *"I just think you can do some advertising for yourself at your own store. You're already at the store anyway. But then if it is further away, where many more people pass by, that might be going too far"* (man, 22-y (p4)). While some participants mentioned that the amount of food cues might be a bit exaggerated, they understood their presence as companies need to advertise their products to make profit. One participant (man, 27-y (p13)) supported governmental action to create a healthy food environment, but emphasized he did not want the fries-sculpture at the snack bar to disappear, as "*it belongs there*" and brightens up the street scenery.

A few participants firmly stated the government should not intervene in food cues in outdoor public spaces, among which two participants (man, 73-y (p2); man 64-y (p6)) who thought that none of the food cues influenced their eating behaviour. Participants who were opposed to food cue regulation argued that eating unhealthy food every once in a while, is pleasant and not that harmful. One participant (man, 39-y (p7)) explained that "*you should be able to enjoy life. For me, that includes a pizza every once in a while*". This quote also reflects the idea that individuals want to be responsible for their own choices; "*People want to make their own decisions, even if they are not able to do so, or do so unconsciously*" (woman, 25-y (p8)). Participants mentioned that the government should improve the accessibility, availability, and affordability (e.g., removing the tax on fruit and vegetables) of healthy food to stimulate a healthy eating behaviour instead of-, or in addition to food cue regulations. One participant explained: *"food advertising does not affect me, but if I walk into the supermarket and pay 80 cents for only one apple! And I pay 80 cents for a bag of candy… Then I get that people choose unhealthy food*" (woman, 54-y (p10)). They also suggested that the government

could empower residents to be less tempted by unhealthy food cues through information campaigns on healthy eating. Last, some suggested it would be more efficient to invest in interventions to change social norms, rather than banning food cues. One participant (woman, 63-y (p15)) explained that the current food environment is a "*social environment in which this [unhealthy food] is accepted and convenient and pleasant. And it is pleasant. So, that is something you cannot break through easily*".

Discussion

This qualitative study provides insight into residents' perceptions of food cues in outdoor public spaces in relation to their perceived food environment, eating behaviour, and their opinion on governmental outdoor food cue regulations. Participants predominantly photographed unhealthy food cues in their outdoor living environment, which contributed to their perception of an unhealthy food environment. Participants differed in their views on the extent to which these food cues affected their own eating behaviour, but there was a general consensus that the food cues affected that of others. Participants identified several factors influencing the extent to which food cues impacted eating behaviour, suggesting that the perceived effect of food cues is dynamic rather than static. Governmental food cue regulation was found to be a complex issue, with participants having various opinions about the degree to which governments should regulate the number of food cues in outdoor public spaces. Arguments in favour of regulations were linked to the understanding that food cues have often negative and unconscious effects on people's eating behaviour and contributed to the increased prevalence of overweight and obesity. Arguments in opposition to regulations were linked to the fear of paternalization, doubts regarding the degree to which people are negatively affected by these food cues, and the idea that food cues are necessary for businesses and are a normal part of the street scenery.

Participants perceived most food cues to relate to unhealthy food, which is in line with findings from prior quantitative work in the Netherlands where we found that unhealthy food cues in outdoor public spaces were more frequently noticed by participants, as well as more often perceived as encouraging others to eat, compared to healthy food cues [24]. Also, it aligns with research specifically on outdoor food marketing. A scoping review of the literature on outdoor food marketing concluded that nearly a quarter of advertisements across all studies were for food and on average 63% of advertised foods were considered unhealthy [6]. Besides, in prior photovoice studies, participants also noticed and discussed the negative impacts of overall fast-food or supermarket marketing strategies on their eating behaviour (i.e. food cues) [40, 43]. Next, healthy food cues were perceived to be less affordable, even when they did not depict a price. Participants generally assumed that healthy food was more expensive than unhealthy food. This is a common phenomenon, which has a powerful influence on food choices [53, 54]. According to Haws et al. (2017) this 'healthy is expensive intuition' might be accurate in some cases but is overgeneralized to products and contexts where it is not objectively true and can act as a bias when consumers are processing information about health and price heuristically. On the other hand, in the Netherlands healthy diets have been found to be more expensive than unhealthy diets [55], and price is an important factor determining food choices [56].

Participants perceived the influence of food cues on eating behaviour as dynamic rather than static. They explained that food cues could influence eating behaviour differently depending on a diversity of factors. Identified factors were related to physical state, perceived attractiveness, accessibility and affordability, and the context (e.g. weather, company, day of the week) in which an individual encountered a food cue. These findings are in line with laboratory studies, which indicate that while food cues engage automatic processes [15, 16], factors such as hunger, stress, a person's affective state, and personal habits such as exercise and sleep can influence these automatic processes and thus the impact of food cues on eating behaviour [13]. Besides, perceived attractiveness, accessibility and affordability are components of the perceived food environment, which have widely been recognized as factors impacting eating behaviour [57–59]. Prior photovoice studies have also found that participants named other factors, such as the presence of company or a celebration, as potential influencers of eating behaviour [40, 42].

Participants generally believed other people were more susceptible to food cues than they were themselves. This tendency to perceive exposure to a persuasive message (such as advertising) as more influential on others than on oneself is a common phenomenon observed in mass media communication and advertising called the third-person effect [60–62]. People tend to acknowledge that the behaviour of others can be influenced by external elements (such as food cues), while they deny their own susceptibility to these environmental influences [60–63]. As such, they lack insight into the extent to which their food choices are made automatically and unconsciously [10]. In 'real-world' settings, people are exposed to a myriad of palatable food cues. Food outlets, with their accompanying food cues have been designed to encourage impulsive eating behaviour, in an unconscious way [10, 22]. This makes it very hard to resist the temptations, even when one

is made aware of them. As an alternative approach to individual cognitive trainings to support healthy eating [14], modifying the food environment itself by reducing or banning environmental factors could be more successful [10, 20]. Public health experts have recommended the implementation of structural governmental policies to reduce environmental factors influencing unhealthy eating behaviour [5, 6, 10, 64, 65]. A food cue regulation could for instance restrict the amount of unhealthy food cues in outdoor public spaces to create healthier food environments. For instance, the city of London has successfully banned unhealthy food marketing from its public transport, which led to reductions of unhealthy food purchases [66].

Most participants seemed in favour of regulations to reduce the number of unhealthy food cues in outdoor public spaces, albeit under certain conditions (e.g., in certain areas, addressing children). This finding is in contrast with prior research, where participants more frequently tend to be opposed to structural, restrictive policies targeting the food environment, while being more in favour of food policies that provide incentives or information [24, 67, 68]. The study's location – a politically progressive municipality – may explain these results. Progressive political parties tend to be more in favour of structural, restrictive policies to advance public health, compared to conservative parties [69, 70]. To illustrate, 67% of Amsterdam residents (another progressive area) supported a policy banning fast food outlets from public spaces to contribute to public health [71]. Another explanation may be that the participants from this study were given the opportunity to discuss the content, scope, and conditions of the food cue regulation, whereas prior survey studies left no space for elaboration [24, 67, 68].

On the other hand, food cue regulation was perceived by some participants to limit individuals' autonomy over their food choices, which was the main reason why some participants were against it. Some participants tended to insist on the importance of being able to make their own choices regarding their eating behaviour, without being influenced by governmental policies. An explanation for this could be that people have a psychological need for autonomy [72]. This was also observed in a study of Haynes and colleagues (2017), which showed that the extent of policy support was associated with the perceived impact on autonomy [68]. For example, public support was higher for a policy that would distribute free fruits at school, than for a policy aiming to remove unhealthy foods from shops. Another explanation for participants' reluctance to governmental regulations of unhealthy food cues might be associated with the idea of 'paternalism' or interference with individual liberty, referred to as 'nanny-state' interventions [73]. Future research may deepen our understanding of the way these factors may shape individual perceptions towards regulating food cues in outdoor public spaces.

Strengths and Limitations

Current findings should be interpreted in light of several limitations. A first limitation relates to the study sample. A relatively small sample size was included in the study, although this is an acceptable number in photovoice research, it may have resulted in limited diversity of the sample [40, 42, 43, 46]. Second, the photographic assignment was to identify visual food cues in outdoor public spaces of the participant's municipality. However, because food cues largely influence behaviour in an unconscious way [9, 10], and given the third-person effect [60], participants may have missed more subtle food cues in their environment. Third, the extent to which these perceived effects identified by participants match the actual reality is debatable, given the largely unconscious workings of food cues and people's tendency to underestimate their susceptibility to food cues. Still, the participants' perceptions of food cues' effects (regardless of their actual effect) give valuable insight into their understanding and perception of food cues and underpinnings for support of- or opposition to governmental food cue regulations.

In addition to these limitations, the current study has several strengths. This study produced a rich qualitative dataset by the use of photovoice to reveal residents' perception of food cues. Photovoice enabled the collection of visual food cue data, providing context to the participants' experiences of their living environment that would otherwise not be available to the researchers. The photographs enriched the data by revealing personal experiences, emotions and opinions, and gave the opportunity to directly reflect on the effect of seeing a food cue. This allowed for insights that revealed not only the importance of what is depicted by a food cue, but also the associations and meanings that participants attached to it.

Recommendations for future research and practice

Future research should assess the actual effect of food cues in outdoor public spaces on the eating behaviour of residents. In the case of governmental regulations restricting unhealthy food cues in outdoor public spaces, natural experiments can be used for quantitative evaluations. For example, a recent study evaluated the effects of banning marketing of high fat, sugar, and salt food and beverages across all public transport in London and showed that this led to a decrease in advertisements for

these products [74] and to a relative reduction in the consumption thereof [66]. Moreover, given that an increasing number of consumers do their food groceries online, future research could also examine the impact of food cues in the digital food environment, and possibilities to counterweight unhealthy digital food cues [75].

Future research should also seek to better understand public opinion on- and support for governmental policies for healthy food environments in general and seek ways to implement such regulations while maintaining public support, as public opinion has a strong impact on public policy [33]. In this regard, it is important to better understand, consider and counteract growing ideas of 'paternalism' and 'nanny-state', which are also fueled by commercial parties and contribute to the general public's reluctance to governmental restrictions [76–78].

Experts argue that it is the duty of governments to take measures to limit potential public health harm caused by the food industry, that urges and manipulates people towards unhealthy eating behaviours [76, 78]. The government could implement food cue regulations, to create a food environment where individuals are (unconsciously) encouraged to make healthy choices. Current findings may inform (local) policy makers by revealing the (perceived) impact of unhealthy food cues in outdoor public spaces on eating behaviour and public health. Our results support the idea that banning outdoor unhealthy food cues could contribute to promoting healthier food choices, as it would limit reminders and temptations for unhealthy eating, thereby contributing to public health. The results also suggest that policy makers should not only rely on surveys to gain insights into citizens' opinion for structural, restrictive measures, rather they should initiate a conversation with them. Besides, these findings could inform the development of guidelines for the design and implementation of a food cue regulation (i.e. what type of food cues to restrict, which locations to regulate, to what extent should the target group be considered).

Conclusions

Residents noticed mainly unhealthy food cues in outdoor public spaces, which contributed to their perception of a generally unhealthy food environment. They had different opinions on the extent to which food cues impact their eating behaviour but mostly agreed that it impacted that of others. Besides, most participants were in favour of governmental food cue regulation, albeit they often had ideas about the scope and content of the regulation. Current findings may inform (local) policy makers about the unhealthy food cues encountered by residents in outdoor public spaces, which unconsciously influence their eating behaviour. Last, these findings can be used to design and implement food cue regulations (i.e. which type of food cues or areas to target) that attract policy support by balancing public health goals with considerations of consumer autonomy and citizen preferences that are more likely to receive public support.

Supplementary Information

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Additional file 1. Questions and response options in the 'myfoodenvironment' app. This file contains table S1 with data about the questions and response options in the'myfoodenvironment' app, which was used by participants to take photographs of outdoor food cues.

Additional file 2. Interview Guide*. This file contains the guide used for the semi-structured interviews, which followed the photography assignment.

Additional file 3. Characteristics of photographed food cues, based on the INFORMAS protocol for outdoor advertising [79] and own fieldwork in the Netherlands. This file contains table S2 with data about the characteristics of outdoor food cues photographed by participants, such as setting of food cue, type of food cue, food cue originator, representation of food cues, visibility of food product on food cue, healthiness of food products on food cues where (a) food product(s) was/were visible.

Additional file 4. Overview food groups visible on photographed food cues, based on the Dutch Nutrient File (NEVO table). This file contains table S3 with data about the food groups that were visible on the photographed food cues, classified based on the Dutch Nutrient File (NEVO table).

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Authors' contributions

T.W., K.R. and M.P. conceptualised and designed the study. K.R. collected the data. T.W. and K.R. analysed and interpreted the data. T.W. and K.R wrote the original draft. T.W, S.D, M.P made substantial revisions to the drafts. All authors reviewed and approved the submitted version of the manuscript. All authors have agreed both to be personally accountable for their own contribution and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

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Data availability

Data is provided within the manuscript or supplementary information files. Additional data will be made available upon request by emailing the corresponding author: Tamika.wopereis@wur.nl.

Declarations

Ethics approval and consent to participate

Approval for the study was granted by the Social Sciences Ethics Committee of Wageningen University. All participants provided their written informed consent for this study. In addition, participants agreed to the privacy statement regarding the collection, use, and processing of personal data through the mobile application.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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