

Government policies to improve food environments: A population and equity lens



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Government policies to improve food environments: A population and equity lens

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1

General introduction

1. General introduction

Food environments have a major impact on population diet and as a result on population levels of overweight, obesity, and non-communicable diseases (NCDs). Food environments can be defined as the physical, economic, policy, and sociocultural surroundings, opportunities, and conditions that influence people's food and beverage choices and nutritional status (1). Contemporary food environments stimulate unhealthy food choices (2) and further exacerbate socioeconomic health inequalities (3). Therefore, government policies are essential to create environments where foods that contribute to a healthy diet are most available, affordably priced, widely promoted, and easily accessible (1). These governmental food environment policies have the potential to improve population diet and reduce socioeconomic inequalities in diet (4). Although many high-income countries face a severe epidemic of overweight and obesity, the extent to which governmental food environment policies have been implemented at European Union (EU) level and in European countries (such as the Netherlands) is largely unknown. Furthermore, little is known about how and via what underlying mechanisms different food environment policies may impact on socioeconomic inequalities in diet.

This introduction starts with an outline of major developments in population health outcomes, population diet, and the need for governmental food environment policies (part 1) and underlines the potential impact of governmental food environment policies on socioeconomic inequalities in diet (part 2). In the first part, the global and European trends in the prevalence of overweight and obesity, the risks of overweight and obesity, and the importance of prevention strategies to halt the rise in overweight and obesity are described. Moreover, the contribution of contemporary diets to these public health problems and the influence of food environments on population diet are discussed. Finally, the importance of government policies to create healthy food environments that support healthy diets among the entire population and of evaluating these policies to improve food environments in the EU and the Netherlands is addressed. In the second part, socioeconomic inequalities in overweight, obesity, and diet and the underlying causes of these inequalities are described. Furthermore, the importance of relating these underlying causes to the impact of governmental food environment policies on socioeconomic inequalities in diet and health is addressed. As part of this, the implementation of a specific food environment policy (i.e., a sugar-sweetened beverages (SSBs) tax) that may contribute to a reduction in socioeconomic inequalities in diet and health is discussed. In the final section, the research aims and the thesis outline are presented.

1.1 Population health, population diet, and the need for governmental food environment policies

1.1.1 Increasing prevalence of overweight and obesity globally and in Europe

Worldwide trends show that the prevalence of overweight and obesity has been increasing in the past decades. The World Health Organization (WHO) uses the Body Mass Index (BMI) – defined as a person's weight in kilograms divided by the square of that person's height in meters (kg/m^2) – to classify overweight (having a BMI of $\geq 25 \text{ kg}/\text{m}^2$) and obesity (having a BMI of $\geq 30 \text{ kg}/\text{m}^2$) in adults (5). Among adults, the prevalence of overweight has risen over the 1975–2016 period from nearly 21% in men and 24% in women to approximately 40% in both men and women (6, 7). Moreover, the prevalence of obesity rose from 3% in 1975 to 12% in 2016 for men, and from 7% in 1975 to 16% in 2016 for women (6, 7). For children (aged 5–19 years), overweight is defined as greater than one standard deviation and obesity as greater than two standard deviations above the WHO Growth Reference median (5). In 2016, 18% of children (aged 5–19 years) were overweight or obese, compared with 4% in 1975 (5, 6). In the WHO European Region, which comprises 53 countries and covers a vast geographical region from the Atlantic to the Pacific oceans, overweight and obesity affect almost 60% of adults; and nearly one in three children was living with overweight or obesity in 2022 (8). More than 50% of the adult population in the EU were overweight, of whom 16.5% were obese in 2019 (9). In the Netherlands, 50% of the adult population had overweight and 14.3% had obesity in 2021 (10). Of the Dutch children aged 2 to 12 years old, 12% had overweight and 3% had obesity (2018–2021) (11).

1.1.2 Risks of overweight and obesity

Being overweight or obese is an important risk factor for developing NCDs such as type 2 diabetes, cardiovascular diseases, and some types of cancer, thereby increasing the risk of death (8, 12, 13). High BMI (greater than $25 \text{ kg}/\text{m}^2$ for adults) was among the top five risk factors in terms of attributable deaths and disability-adjusted life-years (DALYs) of the 84 risk factors evaluated by the Global Burden of Disease Study in 2017 (14, 15). The number of global deaths and DALYs attributable to high BMI more than doubled between 1990 and 2017 (12). That the relative risk of death increases with a higher BMI was also shown by two meta-analyses (13, 16, 17), which showed that the lowest risk of death was observed among people (healthy never-smokers) with a low BMI and that the relative risk of death significantly increased in the BMI range above 25 (16, 17). In EU countries, on average 73 people per 100 000 population will die prematurely each year as a result of overweight, with lower premature mortality rates in countries where the overweight prevalence is low and life expectancy is high (18). Children with obesity are more likely to stay obese into adulthood and more likely to develop NCDs at a younger age (19). In addition, obesity may lead to a greater risk of various psychological and

mental health problems, as adults and children living with obesity may struggle with issues related to their mood, self-esteem, quality of life, and body image (8, 19, 20).

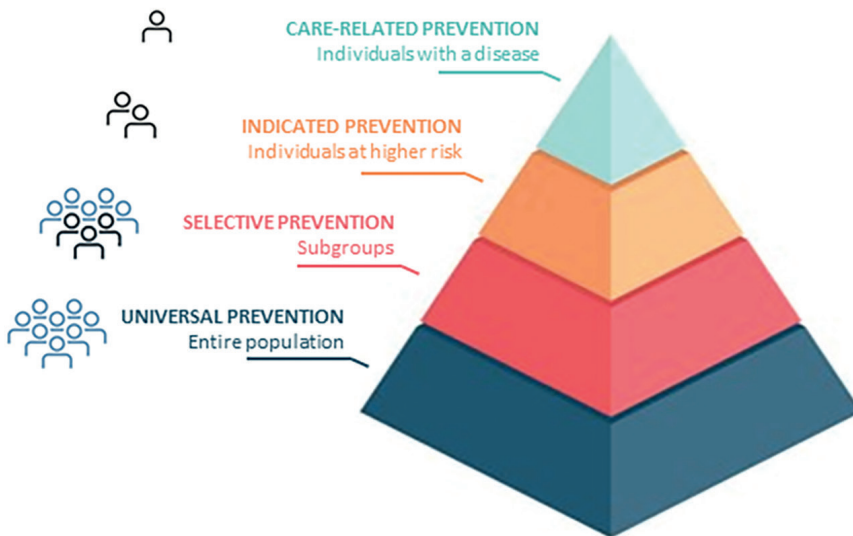
Besides the impact on population health, overweight and obesity have economic impacts on health systems and society (18, 21). The treatment of obesity and related NCDs increases health expenditures, with countries (including EU countries) spending around 8% of their healthcare budget on treating overweight, obesity, and related conditions (18). Furthermore, overweight and obesity reduce employment rates and increase early retirement, absenteeism, and presenteeism, resulting in a reduced workforce (18). EU countries witness a decrease in labor market output of 0.05% on average as a result of overweight-related early retirement, 0.38% as a result of overweight-related absenteeism, 0.43% as a result of overweight-related unemployment, and 0.69% as a result of overweight-related presenteeism (18).

1.1.3 Prevention strategies: the prevention paradox and the importance of structural universal preventive measures

Because overweight and obesity are important risk factors for developing chronic diseases and are associated with higher risks of death worldwide, strategies to prevent and reduce current high levels of overweight and obesity effectively are extremely important (13, 17). Prevention strategies can be classified into different categories. On the one hand, these strategies can be based on the stage of disease, using the concepts of primary, secondary, and tertiary prevention (22). In this classification, the aim of primary prevention is to prevent the development of overweight and obesity in the general population (22, 23). Secondary prevention (screening) is the early detection and subsequent treatment of individuals with (a high risk for developing) overweight and obesity, to prevent the further development of overweight, obesity, and related chronic diseases (22, 23). The aim of tertiary prevention is to prevent complications and exacerbations for patients with obesity and related chronic diseases (22, 23). On the other hand, prevention strategies can be classified in terms of the target groups at which the prevention strategy is aimed, using the concepts of universal, selective, indicated, and care-related prevention (22, 24). The prevention strategies and their target groups are described in Box 1 and visualized in Figure 1.

Box 1: Prevention strategies and their target groups (22, 24, 25).

- **Universal prevention:** includes strategies offered to the full population to actively stimulate and protect the population's health. Prevention measures such as food reformulation at macro level, regulation on the density of fast-food restaurants, and mass health education campaigns fall into this category.
- **Selective prevention:** refers to strategies targeted at subpopulations, distinguished by age, sex, occupation, socioeconomic position, or other obvious characteristics, whose risk of becoming ill is above average. Examples include increasing public breastfeeding possibilities for mothers or providing food vouchers for free vegetables and fruit to people under a certain income threshold.
- **Indicated prevention:** includes strategies targeted at individuals with incipient disease symptoms and prevents these symptoms further developing into a disease or disorder. A preventive intervention in this category includes, for example, lifestyle advice for people with overweight.
- **Care-related prevention:** includes strategies targeted at patients who have already developed a disease or disorder. These strategies seek to prevent a disease leading to complications, disability, a lower quality of life, or death; for example, lifestyle intervention programs for patients with obesity and/or type 2 diabetes.

**Figure 1. The categories of prevention strategies and target groups (26).**

In the past, policymakers and professionals tended to implement selective, indicative, and care-related prevention measures targeting high-risk groups and individuals (27). However, according to Rose, universal prevention strategies targeting the entire population are more beneficial for population health, when health problems, such as overweight where many individuals are at a moderately increased risk, are involved (28) (Figure 2). These universal prevention strategies encourage the whole population to change behavior, shifting the entire risk distribution in populations to somewhat lower risk categories (the bell-curve shift), instead of shifting only a smaller group of high-risk individuals into a lower risk category (Figure 2). Universal measures lead to a small decrease in disease risk and have relatively small health benefits at individual level, but they lead to a larger risk reduction and offer large health benefits at population level (the prevention paradox) (28). This is because many individuals in the population have slightly elevated risks of diseases (e.g., overweight), and preventing even a small proportion of disease or achieving a small reduction in risk in many people leads to a higher absolute number of diseases prevented than a larger reduction of risk in a small group of high-risk individuals (28). Furthermore, universal preventive measures can lead to additional healthy life-years for the entire population at relatively minimal cost (24, 29).

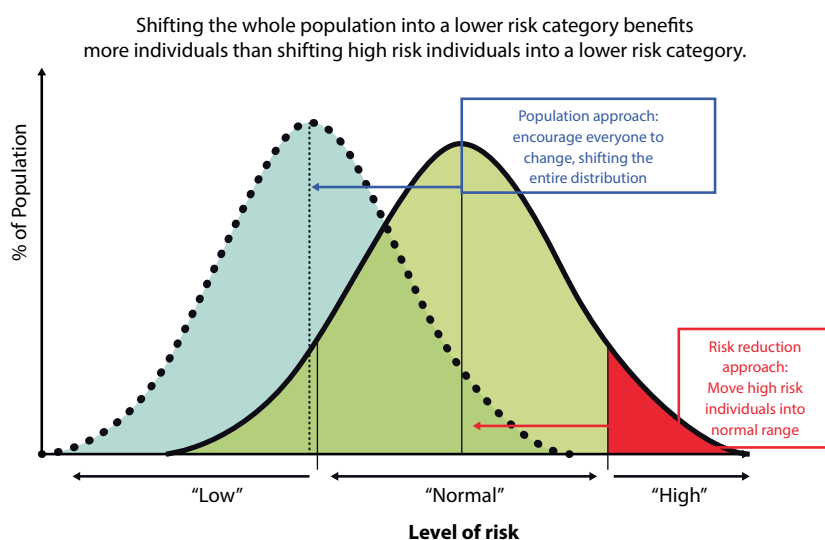


Figure 2. The bell-curve shift of risks in populations (28, 30).

Universal prevention strategies can be more agentic (targeting behavior change among individuals) or more structural (targeting the social, economic, political, and material contexts in which behavior occurs) (25). Traditionally, the prevention of overweight, obesity, and NCDs has been linked primarily to individual responsibility, for which universal prevention strategies are mostly agentic, based on providing health education or

information about the risks of unhealthy behaviors or the benefits of healthy lifestyle choices (14, 25, 31). However, efforts to generate changes in health behavior using these strategies have had limited success, as lifestyle choices are influenced by environmental conditions that may render healthy behavioral choices either easier or more difficult (31). Therefore, it is important to implement more structural universal prevention strategies that change the context in which behavioral choices are made, thus making the healthy choice the easiest choice (31).

1.1.4 Prevention strategies at EU level and in the Netherlands

As overweight and obesity rates have reached epidemic proportions across European countries (8, 9), there is an urgent need for the EU and European countries to apply effective prevention strategies. Although European countries are currently implementing prevention strategies to halt the rise in overweight and obesity, no country is currently on track to meet the WHO Global NCD target of halting the rise of obesity by 2025 (8).

At EU level, the European Commission established a community strategy to address the issues of overweight and obesity, by adopting the White Paper *A Strategy on Nutrition, Overweight and Obesity-related Health Issues* in 2007 (32). Moreover, at EU level, member states developed the *EU Action Plan on Childhood Obesity 2014-2020*, an implementation plan to contribute to halting the rise in overweight and obesity in children and young people (0–18 years) by 2020 (33). The European Commission is currently aiming to tackle obesity through several programs and initiatives (34), such as Europe's Beating Cancer Plan (35), the EU4Health program (34), the Farm to Fork Strategy (36), and the EU Healthier Together NCD Initiative (37). In the Netherlands, the Dutch government signed the National Prevention Agreement (NPA) with more than 70 public and private organizations in 2018 (38). The NPA specifies goals to reduce overweight among adults from 48.7% in 2017 to 38% in 2040, and among children and adolescents from 13.5% in 2017 to 9.1% in 2040. In addition, the NPA aims to reduce obesity among adults from 14.5% in 2017 to 7.1% in 2040, and among children and adolescents from 2.8% in 2017 to 2.3% in 2040 (38). However, to achieve these goals, mainly voluntary and self-regulated prevention measures are included in the NPA. Furthermore, the proportion of the national healthcare budget that is spent on prevention measures remains relatively low (2.2% in 2019) (29). The Dutch National Institute for Public Health and the Environment, which evaluated the progress of the NPA in 2021, concluded that additional measures will be needed to meet all the ambitions by 2040 (39).

1.1.5 The impact of the food environment on population diet and its crucial role in the prevention of overweight and obesity

An unhealthy diet is a major risk factor for developing overweight and obesity as well as NCDs such as type 2 diabetes and cardiovascular diseases (8, 40). Unhealthy

diets are characterized by a high caloric intake, including foods high in added/free sugar, saturated fat and/or salt, and a low intake of fresh, nutritious foods, like fruits, vegetables, legumes, nuts, and whole grains (41). Healthy diets are characterized by an optimal caloric intake and consist largely of a diversity of plant-based foods, small amounts of animal-source foods, unsaturated rather than saturated fats, and limited amounts of refined grains, ultra-processed foods, and added sugars (42).

Multiple factors influence population diet, which in turn contributes to developing overweight and obesity and NCDs. Individuals' dietary intake is multifactorial, driven by a complex interplay of individual (biological, demographic, psychological, and situational), social, cultural, physical, environmental, and economic determinants (43, 44). At population level, food environments, i.e., the collective physical (availability, quality, promotion), economic (costs), policy (rules), and sociocultural (norms, beliefs) surroundings, opportunities, and conditions, are of great influence on population-level diet and nutritional status (1, 45) (Figure 3).

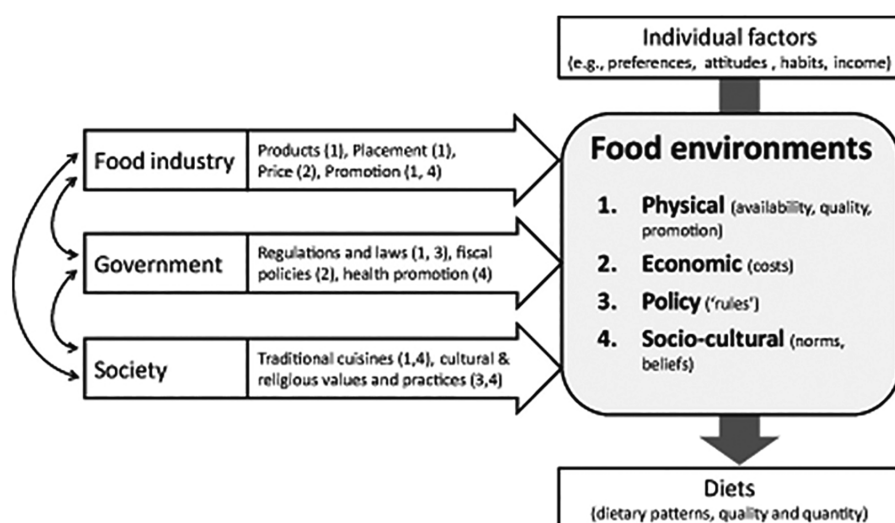


Figure 3. Food environments and their four main components; the major influences of the food industry, governments, and society on food environments (and their interactions); and individual factors–food environments interaction to shape diet (1).

People make around 200 food choices per day (46). Although it is often thought that these choices are made consciously, the majority of food choices are made automatically and unconsciously, and largely influenced by the food environment, e.g., food that is available, accessible, promoted, and the prices of food products (1, 46). Evolutionarily, people's preference for foods high in energy and sugars was advantageous throughout history when food was often scarce (47). In current times, however, people's preference

for such foods is innate, and, compared with the past, these palatable and pleasurable foods are now abundantly available and promoted, stimulating unhealthy food choices (47). Thus, the rising levels of overweight and obesity in the past decades are not the result of changes in individuals' genetic make-up, but largely of dramatically changed food environments globally, e.g., obesogenic environments, in which attractive, cheap, energy-dense, and nutrient-poor foods are abundantly available and heavily promoted (2, 6, 48). This change has also been observed in the Netherlands, where, for example, the foodscape changed towards a 35% higher availability of food delivery outlets and restaurants offering convenience and ready-to-eat foods and a 24% decrease in the number of local food shops over a period of 14 years (2004–2018) (49). Furthermore, food availability and promotions in Dutch supermarkets relate mainly to unhealthy foods, with around 80% of the food available and promoted in supermarkets not aligning with national dietary guidelines (50). This percentage is even higher for food products with marketing aimed at children, of which 97% do not align with national dietary guidelines (50, 51). In addition, the often higher price of healthy foods compared with that of unhealthy foods can be an important barrier to adopting healthy diets (52). These failures of food environments to deliver a healthy diet undermine population nutrition in several ways, and in particular for vulnerable populations (40).

1.1.6 The role of government policies in creating healthy food environments to improve population diet

To improve population diet and reduce overweight, obesity, and NCDs, government-implemented universal preventive strategies that create healthy food environments are greatly needed (4, 8, 40). These universal policies to improve food environments include, amongst others, reducing the price of healthy foods, healthy food provision in schools and other public organizations, and restricting the marketing of unhealthy foods to children (40). An advantage of government policies that create healthy food environments is not only that they target the entire population, but also that they are structural: they tackle the determinants of the incidence of obesity (e.g., food prices, availability) and require little individual effort (agency) to actually change dietary behavior (8). This makes these structural, universal, preventive measures more effective in improving population diet than measures that require a high level of individual agency, such as health-education mass media campaigns, which presume that, if people know what is healthy, they will change their behavior accordingly (2). Providing individuals with information or education to change their behaviors while exposed to a food environment where unhealthy foods are abundantly available, cheap, and heavily marketed (2, 25, 45) has proved largely ineffective over the past decades (53). Rather, it is via the structural, universal, preventive measures that create healthy food environments that we can expect people to change their diet sustainably (even if only a little) (2, 25) and facilitate a global shift in population diet and prevent NCDs (42).

Data published by the WHO and the World Cancer Research Fund indicate that, globally, most countries have implemented measures that require a high level of individual agency to change behavior, such as the communication of dietary guidelines, media campaigns promoting fruit and vegetable consumption, or individual nutrition counselling by dietitians, whereas structural and universal government policies to create healthy food environments are less present (40, 54, 55). An important reason for the ongoing domination of preventive measures that require high levels of agency may be various interested parties' (e.g., politicians, the public, food companies) reticence about accepting structural government policies, as they might be considered as limiting freedom of choice and thus of being paternalistic (53). However, currently, the tendency of many food companies to create unhealthy food environments operating on market principles also influences people's food choices and thus population diet (4). The food industry uses various strategies to successfully pursue its business – also called the commercial determinants of dietary behavior – such as production, processing, and design (e.g., reformulation, increasing product appeal with low-cost ingredients) and marketing and preference shaping (e.g., advertising, sponsorships) (56). This market failure to deliver optimal health benefits for the population increases the urgency for governments to take action and implement food environment policies (4). However, in the past decades, the implementation of structural government policies has been made difficult and stymied by the influence of commercial interests (including food and drink industries) (4) that have large budgets to use different tactics (e.g., lobbying decision makers, stirring up public resistance) to undermine the implementation of policies to reduce overweight, obesity, and NCDs (4, 40, 56).

These influences reinforce the need for comprehensive monitoring and evaluation of governmental food environment policies to support evidence-based policymaking and to hold decision makers accountable for reducing overweight, obesity, and NCDs (1, 4, 57). Monitoring can give insights into current practices, track progress, and facilitate benchmarking across geographies and over time (57). However, in Europe, comprehensive evaluations of the food environment policy landscape have not yet been conducted. Therefore, the extent to which the EU and European countries like the Netherlands have implemented food environment policies, and how these policies could be improved to create healthy food environments and with that improve population diet, is largely unknown. The Healthy Food Environment Policy Index (Food-EPI) is a tool and process developed by the International Network for Food and Obesity/Non-communicable Diseases (NCDs) Research, Monitoring and Action Support (INFORMAS) that can be used to conduct these comprehensive evaluations, as it specifies important policy domains and good practice indicators via which governments can improve the healthfulness of food environments, e.g., by regulating the availability, accessibility, and quality of foods in shops, schools, workplaces; or by price reductions for healthy foods

(4). Although globally, the Food-EPI had already been applied in more than 20 countries, this tool to assess and benchmark government policies and to identify and prioritize policy actions for creating healthy food environments has not yet been applied at EU level or in European countries such as the Netherlands.

1.2 The impact of governmental food environment policies on socioeconomic inequalities in diet

1.2.1 Socioeconomic inequalities in overweight, obesity, and diet

Across and within countries, large socioeconomic inequalities in diet and health are observed (14). In most (European) high-income countries, people with a lower socioeconomic position (e.g., having a lower educational level, lower income, and/or lower occupational level) are at higher risk of developing overweight and obesity than people with a higher socioeconomic position (2, 8, 14). In the EU, women and men in the lowest income group have, respectively, 90% and 50% more chance of having obesity compared with those in the highest income groups (18). Inequalities in obesity among children also exist in Europe, with parental education as a strong driver of unhealthy body weight in children, especially in high-income countries (8).

The consumption of whole grains, fish, fruit, and vegetables is on average higher among people with a higher compared with a lower socioeconomic position, whereas a larger proportion of individuals in lower socioeconomic groups report a higher intake of energy-dense foods (58, 59). Inequalities in dietary behavior are also observed among children and adolescents in the WHO European Region, with poorer dietary trends (e.g., low fruit and vegetable intake, high sugary drink consumption) among young people from lower socioeconomic backgrounds (8).

1.2.2 Universal prevention strategies to reduce socioeconomic inequalities in health

Given the large socioeconomic inequalities in overweight, obesity, and diet, prevention efforts apparently have not been effective in reducing these inequalities over the last decades (8, 60). Until recently, prevention efforts have often fallen into the indicated or care-related prevention categories (see Box 1), such as individual lifestyle interventions (60). Reported effects of these types of interventions among persons in lower socioeconomic groups are relatively small and short term (27). Moreover, most government-implemented universal prevention strategies, such as health education campaigns (61), which focus on advice, guidance, and encouraging people to adopt healthier lifestyles, require a high level of agency and reach mainly people in higher socioeconomic groups (53). Thus, although universal preventive measures can have a large impact on the prevention of overweight and obesity at population level (28),

the impact depends on where the intervention falls on a continuum from agency to structure (62).

Importantly, this matters specifically for persons in lower socioeconomic groups, whose behavior is generally more constrained by socioeconomic and physical structural influences (25). Differences in material and psychosocial circumstances in which people are born, grow up, work, and age, i.e., their daily living conditions (e.g., income, housing, social support) (63), may lead to inequalities in diet and health. Unfavorable daily living conditions (e.g., financial debts, poor housing conditions, social problems) are more prevalent in lower socioeconomic groups, potentially leading to a greater experience of financial constraints and/or perceived stress among persons in lower than in higher socioeconomic groups (64-66). Furthermore, people in lower socioeconomic groups are often more exposed to unhealthy food environments than people in higher socioeconomic groups (67-69). For instance, previous studies have shown a higher number of fast-food restaurants in lower socioeconomic neighborhoods (69, 70), as well as a higher prevalence of unhealthy food marketing aimed at lower socioeconomic groups (67, 71). Moreover, individuals in lower socioeconomic economic groups may be more vulnerable to exposure to these unhealthy food environments (8), for instance when experiencing financial constraints or perceived stress, leading to prioritization of short-term concerns (e.g., solving financial problems) over longer-term goals such as optimal health (72-74).

These differential daily living conditions may influence how agentic or structural universal preventive measures impact on socioeconomic inequalities in diet and health. To understand this impact and to ensure that the most disadvantaged groups in society are not left behind, Backholer et al. developed a theoretical framework (25) (Figure 4).

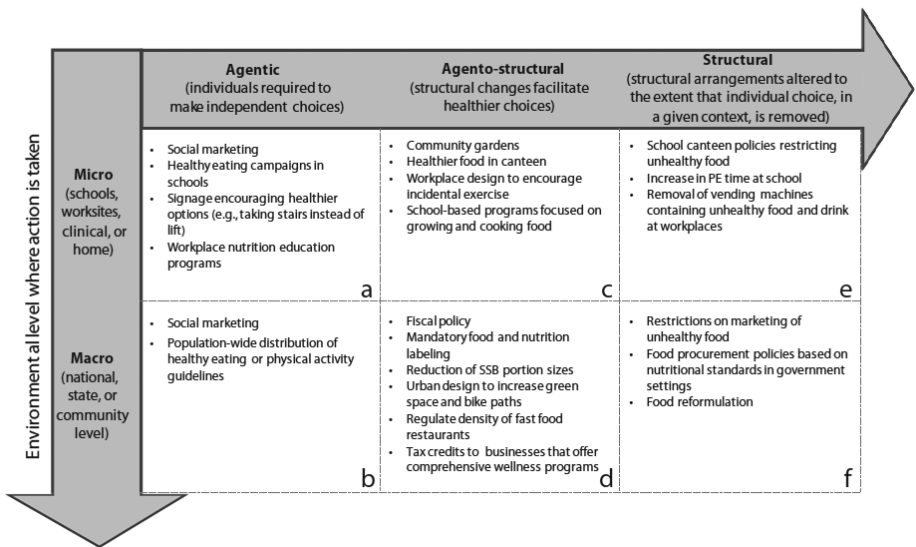


Figure 4. Framework for the likely impact of obesity prevention strategies on socioeconomic inequalities in population weight (25).

Note. PE - physical education; SSB - sugar-sweetened beverage. Parts a and b show interventions more likely to increase the socioeconomic gradient in weight. Parts c and d show interventions in which the impact on the socioeconomic gradient in weight is uncertain. Parts e and f show interventions unlikely to increase the socioeconomic gradient in weight.

According to this framework, universal preventive measures that rely more on individual agency are more likely to increase socioeconomic inequalities in health, whereas structural policies that change the environment in which behavior occurs have generally been shown to have an equal or greater effect among lower socioeconomic groups (25, 62). For the more intermediate (agento–structural) interventions, Backholer et al. hypothesized that the agento–structural interventions that influenced the macro-environmental context were more likely to have an equitable impact because of their greater reach than the interventions influencing micro environments (25).

1.2.3 The impact of governmental food environment policies on socioeconomic inequalities in diet

Governmental food environment policies that make healthy foods more available, affordable, and promoted (25) may especially help to improve the diet of individuals in lower socioeconomic groups, as disadvantages in many life domains are more prevalent in these groups. For instance, having a smaller (food) budget may make individuals in lower socioeconomic groups more susceptible to food pricing policies increasing the price of unhealthy foods and/or decreasing the price of healthy foods. However, evidence on the impact of other food environment policies on the diet of different socioeconomic groups is relatively scarce (75, 76). Furthermore, insights into the underlying causes of socioeconomic inequalities in diet, and how this might influence the impact of food environment policies, remain largely unexplored. Theories explaining

socioeconomic inequalities in health, which specify the role of specific elements in daily living conditions, may help to increase our understanding of the underlying mechanisms by which food environment policies differentially affect individuals in lower and higher socioeconomic groups. Moreover, the mechanisms underlying the potential impact of food environment policies on different subgroups in the population can also be investigated in empirical studies – an aspect hardly investigated so far. Important governmental food environment policies, such as food-related taxes, have been proved to have beneficial effects on diet quality and health (77-79). However, little is known about whether unfavorable conditions that occur more often in the daily lives of individuals/households in lower socioeconomic groups (e.g., experiencing financial constraints or perceived stress) might result in a differential impact of food-related taxes on the dietary behavior of people in lower and higher socioeconomic groups (80). Empirical studies that include these underlying mechanisms could be used to strengthen the evidence base and inform policymakers on how to implement food-related taxes effectively, aiming to improve population diet in general but also specifically targeting lower socioeconomic groups.

1.2.4 The implementation of governmental food environment policies to reduce socioeconomic inequalities in dietary intake and health

That governmental food environment policies, such as food-related taxes, can have beneficial effects on dietary intake and health (77-79) does not automatically imply that governments will also implement these policies (81). As already mentioned, structural low-agency population interventions may be less implemented than measures that address individual behavior (40), because of their acceptability to various parties (e.g., politicians, the public, food companies) (53, 81). Food industries seek to influence policy implementation through, for example, advocating for deregulation and proposing voluntary and self-regulatory measures (82). Also, discursive power and terms such as ‘nanny state’ and ‘paternalistic’ are used to frame arguments to promote individual responsibility and self-regulation over government regulation (82). An important food environment policy that governments could implement, and that in fact has already been implemented in more than 45 countries worldwide and in 12 European countries (83), is a tax on SSBs. Evidence suggests that an SSBs tax has, besides overall beneficial effects on diet quality and health (77-79), the potential to reduce socioeconomic inequalities in diet (76). However, evidence regarding the beneficial pro-equity effects of an SSBs tax does not imply that stakeholders involved in the debate on whether or not to implement an SSBs tax are sensitive to this argument. In the Netherlands, the government has acknowledged the potential of an SSBs tax to be pro-equity but has decided not to introduce an SSBs tax (yet) (38). Insights into the perspectives of various stakeholder groups (e.g., health organizations, policymakers, trade associations) may provide a better understanding of the different equity-related arguments that influence

the decision-making process of an SSBs tax and how the pro-equity effect of an SSBs tax could be increased.

1.3 Aims and research questions

Given the specified knowledge gaps, this thesis addresses two aims and five related research questions:

1. *To assess the extent to which food environment policies have been implemented by the European Union and the Dutch national government and to identify policy actions to create healthy food environments.*
2. *To gain insight into how governmental food environment policies may differentially impact socioeconomic inequalities in diet.*

Related to the first aim, the following research questions are addressed in this thesis:

1. What is the strength of EU-level policies to create healthy food environments in EU member states and how can these policies be improved?
2. To what extent has the Dutch national government implemented policies to create healthy food environments in the Netherlands and how can these policies be improved?

Related to the second aim, the following research questions are addressed:

3. How can theories explaining socioeconomic inequalities in health elucidate the underlying mechanisms by which food environment policies may differentially impact the diet of higher and lower socioeconomic groups?
4. To what extent are the effects of an SSBs tax and nutrient profiling tax on the healthfulness of food purchases modified by experiencing financial constraints or perceived stress?
5. What are the perspectives of stakeholders in the Netherlands on the potential differential impact of an SSBs tax on lower and higher socioeconomic groups?

1.4 Thesis outline

To answer these research questions, five chapters of original research are included in this thesis. Related to the first aim of this thesis, Chapter 2 aims to get insight into the strength of food environment policies at EU level, and Chapter 3 addresses the

implementation of food environment policies by the national government in the Netherlands. For this evaluation, the Healthy Food-Environment Policy Index (Food-EPI) – an international standardized tool and process to evaluate the implementation of governmental food policies – was used (7). The Food-EPI specifies important policy and infrastructure support domains and good practice indicators via which governments can improve the healthfulness of food environments, e.g., by regulating the composition, price, and promotion of foods or by providing funding for food environment policies (5, 7). Chapters 2 and 3 also identify important policy recommendations for the EU and the national government in the Netherlands to create healthy food environments and thereby prevent and halt the rise in obesity, overweight, and NCDs. More specifically, the most important, achievable recommendations and those with the greatest potential to reduce socioeconomic inequalities in diet are presented.

Chapters 4, 5, and 6 provide further insight into how policies to improve healthy food environments may impact on socioeconomic inequalities in diet; this is related to the second aim of this thesis. Chapter 4 uses two contemporary theories, Bourdieu's capital theory and the scarcity theory, to reason how policies influencing food environments may differentially impact on lower and higher socioeconomic groups. Chapter 5 investigates whether material and psychosocial circumstances – such as financial constraints and perceived stress that cause health inequalities – modified the effects of both an SSBs tax and a nutrient profiling tax on food purchases in a virtual supermarket. Chapter 6 aims to investigate various stakeholders' views on the impact of a specific policy measure, namely an SSBs tax, on socioeconomic inequalities. Finally, Chapter 7 includes the discussion and conclusion and addresses the two aims of this thesis.

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2

Strength of EU-level food environment policies and priority recommendations to create healthy food environments

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ABSTRACT

Background: Food environments impact on diets, obesity and non-communicable diseases (NCDs). Government policies are essential to create healthy food environments. This study aimed to assess the strength of European Union (EU)-level policies, and identify and prioritize actions for the EU to create healthy food environments.

Methods: The Healthy Food Environment Policy Index (Food-EPI) was applied. The Food-EPI included 26 policy and 24 infrastructure support indicators. Independent experts (n=31) rated the strength of EU-level policies and infrastructure support for each of these indicators (on a 5-point scale, from very weak to very strong) and identified and prioritized actions to improve food environments.

Results: For 65% of the 26 policy indicators, EU-level policies were rated as weak and for 23% as very weak. For 63% of the 24 infrastructure support indicators, EU-level policies were rated as moderate and for 33% as weak. The experts recommended 18 policy and 19 infrastructure support actions to the EU. The Top 5 prioritized policy actions included three actions in the food composition domain (e.g. setting mandatory food composition targets), one action in the food prices domain and one action in the food promotion domain. The Top 5 prioritized infrastructure support actions included three actions in the leadership domain (e.g. developing a high-level NCDs Prevention Strategy) and two actions in the monitoring domain.

Conclusions: There is large potential for the EU to strengthen its policies and infrastructure support in order to improve food environments. This study specifies priority actions for the EU to create healthy food environments.

INTRODUCTION

Overweight, obesity and diet-related non-communicable diseases (NCDs) pose a major public health problem in Europe. In 2017, more than 50% of the adult population in the European Union (EU) were overweight of which 15% were obese (1). Unhealthy diets with excess foods containing too much sugar, saturated fat and salt (e.g. ultra-processed foods), and low in nutritious foods like fruits and vegetables, increase the risk of developing overweight, obesity and NCDs (2,3). According to The Global Burden of Disease Study (2019), dietary risks are among the Top 5 risks for attributable deaths in females and males (4).

Food environments can be defined as the physical, economic, policy and sociocultural surroundings, opportunities and conditions that influence people's food and beverage choices and nutritional status (5). Commercial interests have been allowed to prevail over public health in the past decades. This has resulted in 'obesogenic' food environments in which ultra-processed, high-fat and sugar-rich products are abundantly available and heavily marketed, much more than healthy foods (6–8). In European Member States, food environments often do not ensure that the healthy option is the easiest option to choose (9). Governments play a crucial role in reversing the obesogenic nature of food environments (6,7,10). Structural, 'upstream' government policies (e.g. marketing regulations for unhealthy foods) have the potential to support healthy diets among the entire population (10–12) and are more likely to result in sustainable improvements in population nutrition than 'downstream' approaches (e.g. health mass media campaigns) (7,13).

Article 168 (1) of the Treaty on the Functioning of the EU states that a high level of human health protection shall be ensured in the definition and implementation of all Union policies and activities (14). Until now, predominantly food environment policies across EU Member States have been analyzed and compared (15). A robust analysis at the supranational level is lacking. It is largely unknown to what extent the EU has implemented policies and infrastructure support that facilitate policy development and implementation to create healthy food environments. Moreover, little is known on how these policies and infrastructure support could be improved. Therefore, this study applied the Healthy Food Environment Policy Index (Food-EPI) developed by the International Network for Food and Obesity/NCDs Research, Monitoring and Action Support (INFORMAS) (10). Globally, the Food-EPI has already been applied in more than 30 countries, mainly to evaluate national level policies (16). This is the first study that has adapted the Food-EPI to evaluate supranational level policies.

In applying the Food-EPI tool, this study aims:

(1) to assess the strength of EU-level policies and infrastructure support and identify implementation gaps.

(2) to identify and prioritize policy and infrastructure support actions to improve food environments in EU Member States.

METHODS

Study design

This mixed-methods study is conducted as part of the Policy Evaluation Network (PEN) (<https://www.jpi-pen.eu/>) and under the umbrella of INFORMAS (informas.org). In 2019–20, we applied the Food-EPI at EU level (10). All procedures performed were in accordance with the ethical standards of the institutional committee [Science-Geosciences Ethics Review Board, Utrecht University, The Netherlands (ERB Review Geo L-19254)] and the Helsinki declaration. All participants signed an informed consent and conflict of interest form before participation.

Study procedure

The Food-EPI is an international standardized tool and process to identify important gaps in policies and infrastructure support, and to identify and prioritize future actions to improve food environments (10). The tool comprises indicators across seven food environment ‘policy’ domains (food composition, labeling, promotion, prices, provision, retail and trade) and six ‘infrastructure support’ domains (leadership, governance, monitoring and intelligence, funding and resources, platforms for interaction and health-in-all-policies) that support policy development and implementation to improve food environments (figure 1) (10). There are indicators contained in each of the domains that encompass actions necessary to improve the healthiness of food environments (Supplementary file S1). This study consisted of six steps (Supplementary file S2), which are further outlined below.

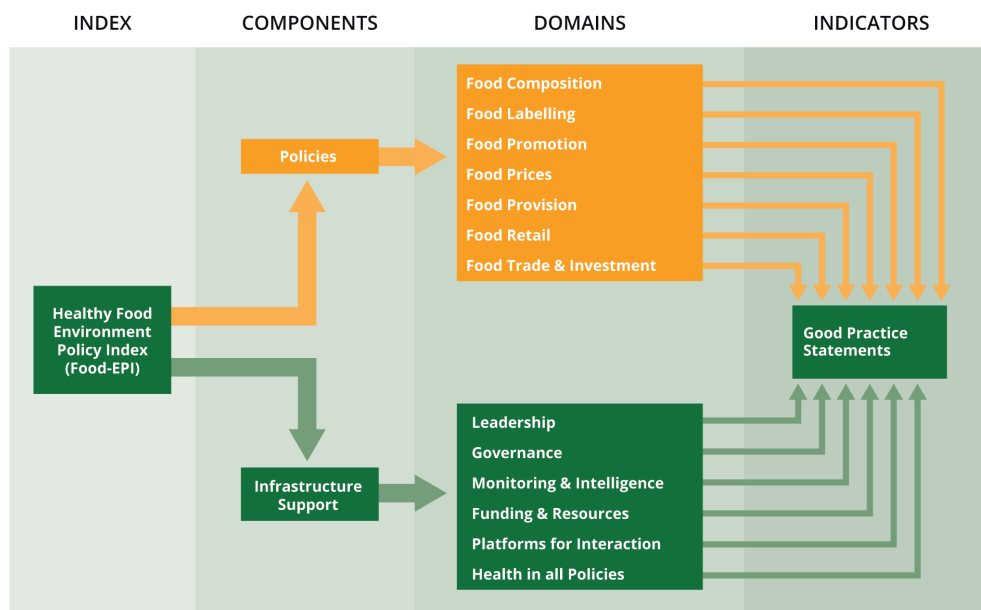


Figure 1. The Food-EPI, as developed by Swinburn B, Vandevijvere S, Kraak V, Sacks G, Snowden W, Hawkes C, et al. (2013). (Food-EPI EU study, 2019–20).

Step 1: tool adaptation

Before applying the Food-EPI to European countries and the EU, PEN researchers reviewed the 47 original Food-EPI indicators (February–May 2019). For each indicator, it was assessed whether the jurisdiction lies with the EU, national governments or both. In addition, as indicators were originally developed for assessing national policies, we adapted the formulation to supranational level. Furthermore, some indicators were disaggregated or added. This resulted in a total of 50 indicators included in this study, i.e. 26 policy and 24 infrastructure support indicators (Supplementary file S1).

Step 2: evidence document

In Step 2, evidence for EU-level policies for each of the 50 Food-EPI indicators was collected and summarized in an 'evidence document' (17) (February–December 2019). The Farm to Fork Strategy (9) was not included in the evidence document, as this strategy was published after finalizing the evidence document. The evidence document was verified for completeness and accuracy by EU governmental officials working at DG SANTE, JRC, Eurostat, the OECD and EFSA.

Step 3: online rating survey

We conducted a workshop (February 2019) with PEN researchers to identify organizations specialized in food, nutrition, public health, obesity and diet-related chronic diseases.

For each organization, we then invited one or two representatives to participate in the EU Food-EPI expert panel (November 2019–January 2020). Where specific representatives were unknown, we sent an invitation to the general e-mail addresses of the organizations. When experts declined, they could put forward a replacement. In total, 61 independent experts were invited. In Step 3, experts were supplied with the evidence document (17) and asked to assess the strength of EU-level policies and infrastructure support during an online survey. A total of 31 experts filled out the survey (February–March 2020), of which 29 experts fully completed and two partly. Participants rated the strength of each of the 26 policy and 24 infrastructure support indicators separately on a five-point Likert scale, indicating whether ‘The EU has put forward ...’, 1 = non-existent/very weak, 2 = weak, 3 = moderate, 4 = strong or 5 = very strong policies. There was also a ‘cannot rate’ option and experts could comment on their rating. Moreover, experts were asked to formulate actions (for each policy and infrastructure domain) for the EU to create healthy food environments.

Steps 4–6: identification and prioritization of actions to improve food environments

Due to the 2020 Covid-19 bans on travel and meetings, face-to-face workshops with the expert panel to discuss the proposed actions, were not possible. Therefore, a different approach than outlined in the Food-EPI protocol (18) was taken, described below in Steps 4–6.

Step 4: online workshops

Two online workshops were held in July 2020 with a selected group of experts, specialized in public health, nutrition or food law/politics ($n=3$), who also had completed the online rating survey. During the workshops, all actions formulated by the entire expert panel in the online rating survey were discussed. The proposed actions were combined, narrowed down and precisely formulated. For each domain, the experts were asked whether the actions aligned with the EU competences to regulate a certain area and whether any important actions were missing.

Step 5a: refining actions

We made final adjustments to the action list according to the input received during the workshops. This adjusted action list was then verified by the three experts who participated in the workshops. Following this verification, the action list was sent to the full expert panel ($n=31$) to ask whether they agreed with the actions formulated and whether any actions were missed. Final adjustments were made to the action list according to the expert panel input.

Step 5b: online survey to investigate which actions to recommend

The expert panel ($n=31$) was invited for a second online survey in September 2020. A total of 16 experts participated in this survey. They were asked to indicate for each action whether they would recommend implementation of the action by the EU, using a five-point Likert scale: 1 = very much disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = very much agree.

Step 6: prioritization of recommended actions

In the final online survey (September–October 2020), the expert panel ($n=31$) was asked to prioritize the recommended actions. A total of 21 experts completed this survey. Experts ranked the policy actions three times on (i) importance, (ii) achievability and (iii) equity, i.e. whether the action would lead to a reduction of socioeconomic inequalities in dietary intake. Experts ranked the infrastructure support actions twice on (i) importance and (ii) achievability. Supplementary file S3 includes a description of the three criteria. When an action was ranked as #1 it was considered to be most important, achievable or equitable.

Data analysis

The mean score on the five-point Likert scale was calculated for each indicator to determine the strength of EU-level policies. The Gwet AC2 inter-rater reliability coefficient and its variance were determined using AgreeStat software (Agreestat 2015.6.1, Advanced Analytics, Gaithersburg, USA). For estimation of the variance, the sample of subjects to rate was set at 100% since all indicators of the Food-EPI were included for rating, while the sample of raters was set at 51% (as per the response rate of experts invited), and the finite population correction was applied (Step 3).

Regarding Step 5b, the mean score was calculated for each action based on the five-point Likert scale. Actions with a mean score of 4.0 or higher were included in Step 6.

In Step 6, we identified the highest prioritized policy and infrastructure actions by summing the ranking scores for each action. First, we calculated the scores for importance and achievability separately. Second, we calculated the total score for each action by summing the scores on importance and achievability. Sum scores could vary from 42 to 798 (policy domains) or from 42 to 756 (infrastructure support domains). A lower sum score indicated a higher perceived priority. We initially identified the Top 10 policy actions based on importance and achievability. Of this Top 10, we identified the five actions, which scored highest on equity. For the infrastructure support actions, the Top 5 was only based on importance and achievability.

RESULTS

Expert panel

The 31 experts that participated in this study were working in academia, international health and food organizations, national governments, and non-governmental, professional health/food organizations and associations. The experts were specialized in food, nutrition, public health, obesity and/or diet-related chronic diseases (Supplementary file S4).

Strength of EU-level policies and infrastructure support

Figures 2 and 3 present the mean implementation score of EU-level policies and infrastructure support for each Food-EPI indicator separately, according to the experts. The Inter-rater reliability (Gwet's AC2) for all Food-EPI indicators was 0.67 (95% CI = 0.61–0.72), which indicates that there was good agreement among experts about the strength of EU-level policies. There was more agreement on the policy indicators (Gwet's AC2 was 0.77; 95% CI = 0.73–0.81) than on the infrastructure support indicators (Gwet's AC2 was 0.62; 95% CI = 0.53–0.72).

Policy domains

The strength of EU-level policies regarding most policy indicators (17 of the 26 indicators; 65%) was rated as weak (figure 2). While the strength of EU-level policies for 6 of the 26 indicators (23%) was evenly rated as non-existent or very weak. The expert panel considered the strength of EU-level policies for 3 of the 26 indicators (12%) to be moderate.

Infrastructure support domains

The strength of EU-level policies regarding most infrastructure support indicators was rated as moderate (15 of the 24 indicators; 63%) (figure 3). In contrast to the policy domains, no EU-level policies with respect to the infrastructure domains were rated as very weak or non-existent. However, the EU was assessed as having weak infrastructure support for 8 of the 24 indicators (33%). Only 1 of the 24 indicators (4%) was rated as strong, namely 'public access to nutrition information' ('Governance').

Identification and prioritization of EU-level policy and infrastructure support actions to improve food environments

Based on Steps 3 (rating survey), 4 (workshops) and 5a (refinements), 30 policy and 32 infrastructure support actions were proposed by the expert panel. In Step 5b (selection survey), 19 policy and 18 infrastructure support actions scored a 4.0 or higher and were thereby recommended to the EU to create healthy food environments in EU Member States.

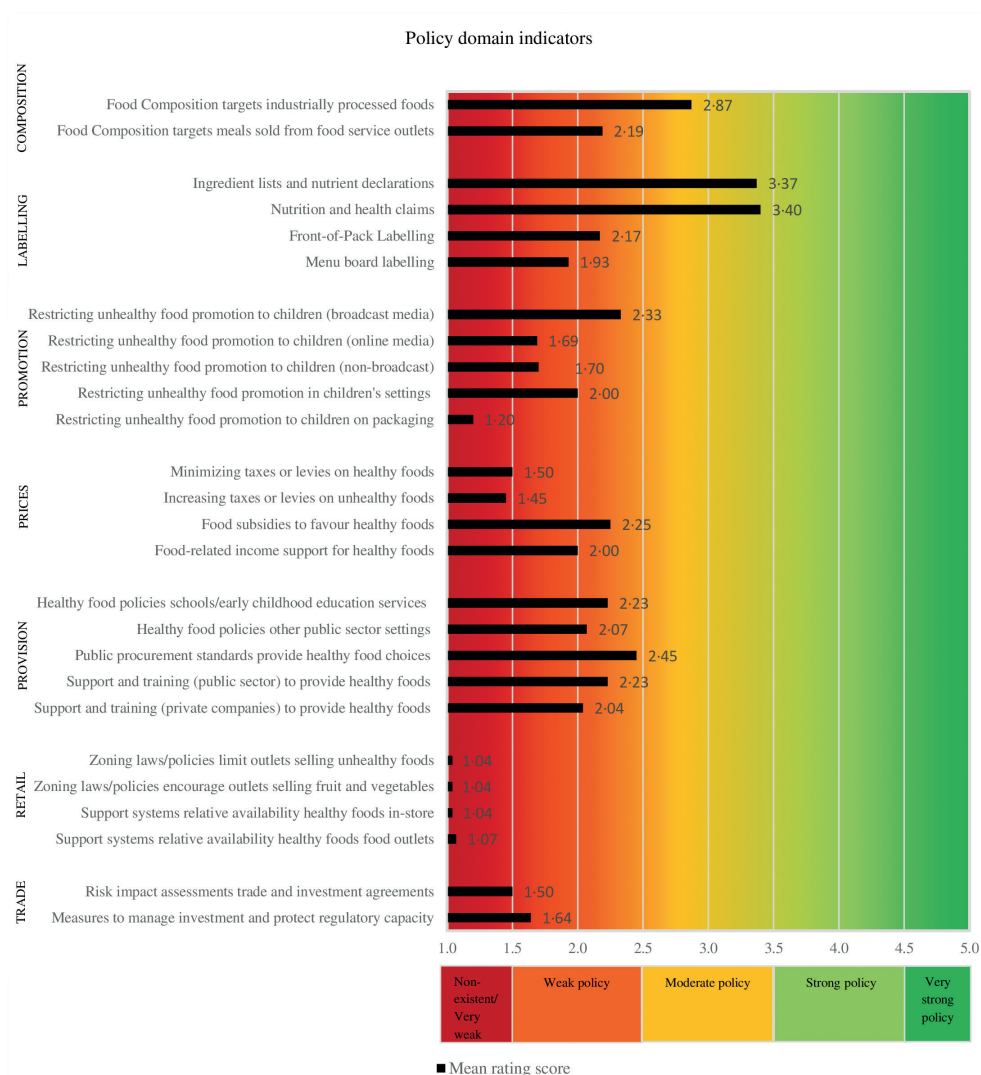


Figure 2. Strength of EU-level policies influencing food environments (Food-EPI EU study, 2019–20).

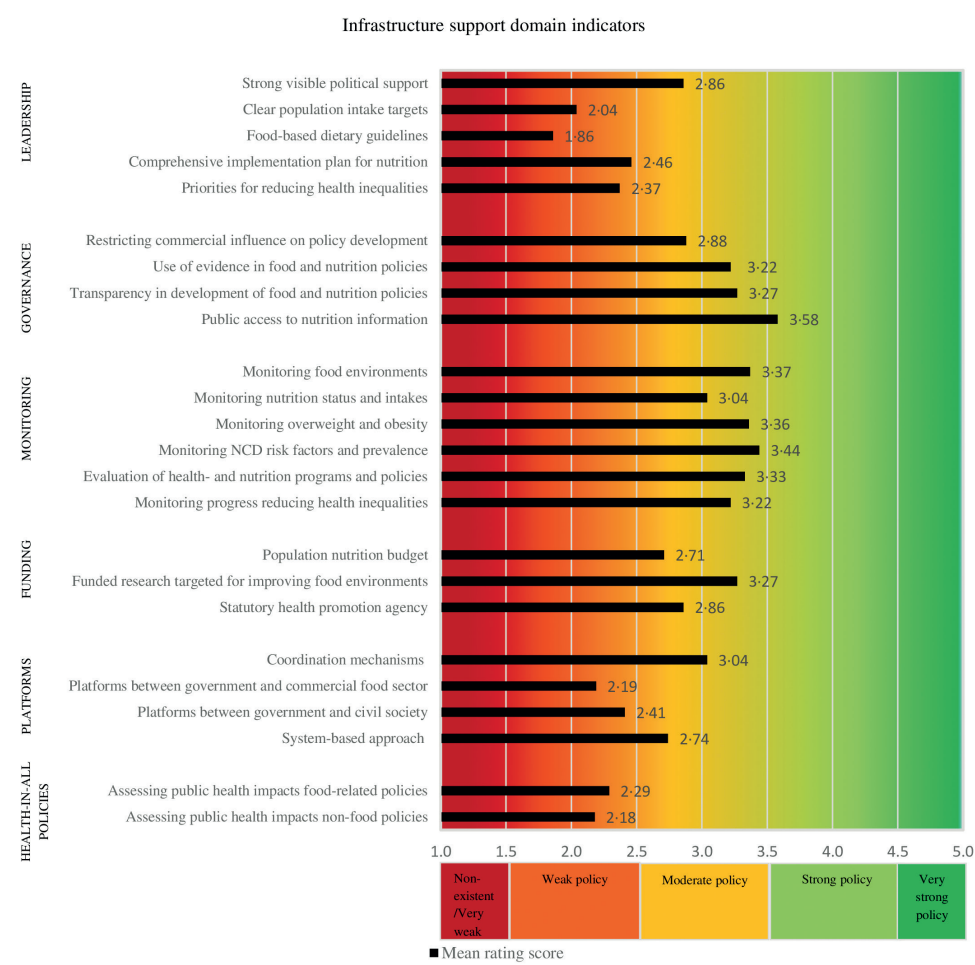


Figure 3. Strength of EU-level infrastructure support influencing food environments (Food-EPI EU study, 2019–20).

Recommended and prioritized policy actions

The 19 policy actions recommended by the experts are detailed in Supplementary file S5. The Top 5 prioritized actions based on importance, achievability and equity (table 1) include: set mandatory, ambitious food composition targets for (i) all food categories and (ii) for processed foods and meals at quick-service restaurants specifically; (iii) adopt a legislated ban for trans-fats instead of the recently introduced (2019) maximum limit of 2 g per 100 g of fat;19 (iv) allow Member States to implement a 0% VAT exemption on fruit and vegetables; and (v) ban marketing of unhealthy foods to children <19 years. In Supplementary file S6, the scores on importance and achievability for each action are plotted in a graph, and the five actions with the greatest potential to reduce socioeconomic inequalities in diet are indicated by a yellow shadow.

Recommended and prioritized infrastructure support actions

The 18 infrastructure support actions recommended by the Food-EPI expert panel are detailed in Supplementary file S7. The Top 5 prioritized actions based on importance and achievability (table 1) were: (i) develop a high-level NCDs prevention strategy; (ii) include clear priorities to reduce health inequalities in EU work programs; (iii) harmonize the promotion of healthy foods with other issues of concern; (iv) benchmark food policies and coordinate good practices among Member States; and (v) support Member States to monitor the status of national food environments. Each infrastructure support action is plotted on importance and achievability in Supplementary file S8.

Table 1. Top 5 EU policy actions based on importance, achievability and equity and Top 5 EU infrastructure support actions based on importance and achievability, recommended and prioritized by the Food-EPI expert panel (Food-EPI EU study, 2019–20).

Food-EPI domain	Policy actions recommended and prioritized by the Food-EPI expert panel
Food prices	Allow Member States to implement a Value-Added Tax (VAT) exemption of 0% for all fresh fruit and vegetables, by adopting the proposal of the Commission ^a and encourage Member States to implement this VAT exemption to encourage healthy food choices.
Food composition	Set mandatory, ambitious, comprehensive, and time-specific food composition targets for added sugars, salt, and saturated fat for all food categories (including processed and ultra-processed foods) sold in EU Member States (e.g. saturated fat reduction for savory snacks of a minimum of 5% in 4 years and a minimum of an additional 5% reduction by 2026 against the individual baseline levels at the end of 2020).
Food composition	Adopt a legislated ban on trans-fats (i.e. no trans-fats are allowed instead of the maximum limit of 2 g per 100 g of fat) in processed and ultra-processed foods sold in EU Member States.
Food composition	Set mandatory, ambitious, and comprehensive reformulation targets for added sugars, salt, and saturated fat for processed and ultra-processed foods and meals sold at quick-service restaurants (including snack food outlets) in EU Member States.
Food promotion	Introduce a new Directive [amending the Audiovisual Media Services Directive (2010/13/EU ^b)], which requires Member States to implement (i) minimum and time-based restrictions or bans on the (online) marketing of foods high in saturated fat, trans fat, salt, or added sugars to children and adolescents up to 19 years old in all digital (including broadcast, online, and social) media and (ii) bans on food packages for marketing foods high in saturated fat, trans fat, salt or added sugars to children and adolescents up to 19 years old.
Food-EPI domain	Infrastructure support actions recommended and prioritized by the Food-EPI expert panel
Leadership	Develop a high-level EU Non-Communicable Diseases (NCDs) Prevention Strategy.
Monitoring	Benchmark food environment policies regarding food reformulation, food labeling (incl. claims and front-of-pack labeling), food marketing, food prices, food provision in public spaces and retail (zoning laws and policies, in-store product placement) and support and coordinate the exchange of good practices between Member States (e.g. via the Open Method of Coordination).
Leadership	Include clear priorities to reduce inequalities or protect vulnerable populations in the multi-annual work programs/annual State of the Union (e.g. by the year X we want to have reduced health inequalities in relation to diet within/between EU Member States).

Leadership	Harmonize the promotion of healthy diets with other issues of concern, such as climate change and environmental protection (e.g. showing leadership via the forthcoming eighth Environmental Action Program and engaging with the European Environmental Agency, with its theme 'environment and health').
Monitoring	Recommend and support Member States to set up a monitoring system to assess the status of food environments and to measure progress on achieving the goals of nutrition and health plans.

a EUR-Lex. Proposal for a COUNCIL DIRECTIVE amending Directive 2006/112/EC as regards rates of value-added tax COM/2018/020 final—2018/05 (CNS). https://ec.europa.eu/taxation_customs/sites/taxation/files/18012018_proposal_vat_rates_en.pdf.

b DIRECTIVE (EU) 2018/1808 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 November 2018 amending Directive 2010/13/EU on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the provision of audiovisual media services (Audiovisual Media Services Directive) in view of changing market realities. EUR-Lex: <https://eur-lex.europa.eu/legal-content/EN/TXT/%20PDF/?uri=CELEX:32018L1808&from=HR>.

DISCUSSION

Overall, the experts’ ratings point to a clear need to strengthen and increase the development and implementation of EU-level food environment policies and infrastructure support. Specifically, experts rated the implementation of most food environment policy indicators as weak and most infrastructure support indicators as moderate. A total of 19 policy and 18 infrastructure support actions for the EU to create healthier food environments have been identified.

The EU performs relatively better with regard to infrastructure support than with policies directly influencing food environments, which is in line with country-level observations. An 11-country Food-EPI comparison study showed that the implementation of infrastructure support was rated higher than the implementation of food environment policies in all countries, except Chile (20). In the Netherlands, Ireland and Norway, implementation of infrastructure support was also rated higher than implementation of policies (21–23).

There are a number of possible explanations for the weakness of EU-level policies directly influencing food environments. Firstly, this might be related to the competences the EU has in developing and implementing healthy food environment policies. Article 5(1) of the Treaty on the European Union (24) states that the EU should act only when the objectives of a proposed action can be better achieved by the EU than by Member States. Article 168 (1) of the TFEU states further that EU action directed towards improving public health and preventing diseases shall complement national policies (14). Legislative harmonization at EU level in the field of public health is excluded by Article 168 (5) of the TFEU, except in narrowly defined areas (25). Therefore, EU action in this field is mostly limited to the adoption of soft law measures such as recommendations and opinions (25).

Secondly, national governments may have a preference to address social issues domestically rather than at EU level (26). Member States may resist EU power as, in most Member States, health spending is one of the largest chunks of the national social welfare budget and citizens may expect public health policies as an expression of solidarity organized by the nation state (27).

Thirdly, the weakness of EU-level policies might be explained by influential and dominant strategies of the food industry on governmental policies, such as lobbying and promoting industry-preferred solutions (28–30). Moreover, much decision-making power has been directly devolved to corporations²⁹, such as the EU Platform on Diet, Physical Activity and Health, which consists of industry, NGO's and the European Commission (29,30). Another example is the EU Pledge, a voluntary initiative by food and beverage companies to change advertising to children (31).

With the Farm to Fork Strategy (2020), the EU has made positive progress in that the strategy integrates all stages of the food system (from production to consumption) (32) and refers to the creation of a favorable food environment that makes it easier to choose healthy and sustainable diets (8). Some actions in the Strategy are similar to actions recommended by the experts in our study, e.g. 'set nutrient profiles to restrict nutrition and health claims of food high in salt, sugars and/or fat', and a 'proposal for a harmonized mandatory front-of-pack nutrition labeling' (9). The Farm to Fork actions address key aspects of the food environment, although not as comprehensive as those suggested by the experts in our Food-EPI EU. Specific actions related to food promotion, retail and trade are lacking in the Farm to Fork strategy, whereas this Food-EPI EU recommends e.g. restrictions or bans on the (online) marketing of unhealthy foods to children, an EU-wide retail sector commitment to remove ultra-processed foods from near checkout counters and mandatory health impact assessments for new trade agreements. Moreover, most actions in the Farm to Fork strategy are self-regulatory, voluntary measures (e.g. expecting food companies to take action on reformulation and adapting marketing strategies), whereas this Food-EPI EU goes further and recommends that the EU develops and implements mandatory structural interventions, such as ambitious, mandatory food composition targets. However, the need for binding legislation in the form of a legislative framework for a sustainable food system has been addressed in the Farm to Fork Strategy (9). A recent paper outlined proposals on the scope and focus of this legislative framework, including the principle to 'Enhance the food environments in which consumer choices are made to encourage healthy, just, affordable and sustainable outcomes' (33). Some EU Member States have already progressed by developing or implementing more mandatory, structural interventions, such as Denmark with a trans-fat ban (15) and Spain with their plans to ban advertising of unhealthy foods aimed at children (34). This suggests that the EU could do more

to commend these pioneering achievements, and encourage other Member States to better them.

Such structural policies are more likely to result in sustainable changes in food consumption (7,35). And as the impact of combined interventions is greater than the impact of individual interventions (36,37), the experts in this study emphasized that measures should be part of a high-level EU Strategy for the prevention of NCDs and recommend harmonization of the promotion of healthy diets with other issues of concern, such as environmental protection. Thus, this Food-EPI EU could be used in addition to the Farm to Fork Strategy, as the actions complement each other well in the ambition to create healthier and more sustainable food environments in EU Member States.

This study has a number of important strengths. It is the first study at EU level that applied a comprehensive mixed-methods approach to generate insight into policy and infrastructure support gaps, as well as actions to improve food environments in the EU. Secondly, policies studied were verified by EU governmental officials and evaluated by independent experts. Thirdly, experts in this study were asked to prioritize the policy actions on equity, in addition to their importance and achievability.

Nevertheless, some limitations should be acknowledged. Firstly, due to the Covid-19 restrictions, the workshop (Step 4) was conducted online with a small group of experts instead of the face-to-face meeting with the entire expert panel. In addition, we experienced a drop-out in participation, as fewer experts participated in the follow-up surveys ($n = 16$, $n = 21$) compared to the first survey ($n = 31$), highlighting the limitations of an online format. Yet, compared to other Food-EPI studies, the number of participants in our prioritization survey ($n = 21$) was in line with other countries (21–23).

We also have recommendations for future research. First, this Food-EPI EU constructed scorecards (figures 2 and 3) on the strength of EU-level policies, which facilitates monitoring over time. In the long-term, this study can contribute to a global database for monitoring and evaluating policies directed at improving food environments. A second recommendation is to identify 'why' recommended policies have or have not been successfully implemented, which can support uptake of policies (38). A third recommendation is to incorporate sustainability indicators in future Food-EPI studies (16). Fourth, it is recommended to monitor policies and practices implemented by the food industry, as a multisector response is needed in the prevention of NCDs (39) and this could inform efforts to hold the private sector accountable (40). A final recommendation is to compare the outcomes of this study, with outcomes of the national Food-EPI studies conducted as part of PEN (Ireland, the Netherlands, Norway, Poland and Germany) and

the H2020 Science and Technology in childhood Obesity Policy (STOP) project (Slovenia, Spain, Portugal, Estonia and Finland).

CONCLUSIONS

Experts considered most EU-level policies directly influencing food environments in EU Member States as weak, while most infrastructure support was rated as moderate. Recommended actions should be implemented by the EU to create healthy food environments in EU Member States.

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SUPPLEMENTARY MATERIAL

Supplementary file 1

2

There are indicators contained in each of the Food-EPI domains that encompass actions necessary to improve the healthiness of food environments and to help prevent obesity and diet-related NCDs (see Table S1). 50 good practice indicators have been included in this Food-EPI EU study.

Table S1 Food-EPI Domains and Indicators [Food-EPI EU study, 2019-2020]

Food-EPI Policy Domains	
Food-EPI Domain	Food-EPI Indicators
DOMAIN 1 – FOOD COMPOSITION Food composition targets/standards/restrictions for processed foods: This domain concerns the extent to which the EU stimulated/proposed/developed/implemented systems to ensure that, where practicable, processed foods minimise the energy density and the nutrients of concern (salt, saturated fat, trans fat, added sugar).	<p>COMP1 Food composition targets/standards/restrictions have been established by the EU for the content of the nutrients of concern (trans fats, added sugars, salt, saturated fat) in industrially processed foods, in particular for those food groups that are major contributors to population intakes of those nutrients of concern.</p> <p>COMP2 Food composition targets/standards/restrictions have been established by the EU for the content of the nutrients of concern (trans fats, added sugars, salt, saturated fat) in meals sold from food service outlets, in particular for those food groups that are major contributors to population intakes of those nutrients of concern.</p>
DOMAIN 2 – FOOD LABELLING This domain concerns the extent to which the EU proposed/developed a regulatory system for consumer-oriented labelling on food packaging and menu boards in restaurants to enable consumers to easily make informed food choices and to prevent misleading claims.	<p>LABEL1 Ingredient lists and nutrient declarations in line with Codex recommendations are present on the labels of all packaged foods.</p> <p>LABEL2 Evidence-based regulations are in place for approving and/or reviewing claims on foods, so that consumers are protected against unsubstantiated and misleading nutrition and health claims.</p> <p>LABEL3 One or more interpretive, evidence-informed front-of-pack supplementary nutrition information system(s) proposed/required by the EU, which readily allow consumers to assess a product's healthiness, is/are applied to all packaged foods (examples are the Nutri-Score and traffic lights).</p> <p>LABEL4 A simple and clearly-visible system of labelling the menu boards of all quick service restaurants (i.e. fast food chains) is set/proposed by the EU to be implemented by the Member States, which allows consumers to interpret the nutrient quality and energy content of foods and meals on sale.</p>

DOMAIN 3 – FOOD PROMOTION

This domain concerns the extent to which the EU has set/proposed policies to reduce the impact (exposure and power) of promotion of unhealthy foods to children including adolescents across all media.

- Exposure of food marketing concerns the reach and frequency of a marketing message. This is dependent upon the media or channels, which are used to market foods.

- The power of food marketing concerns the creative content of the marketing message. For example, using cartoons or celebrities enhances the power (or persuasiveness) of a marketing message because such strategies are attractive to children.

PROMO1 Effective policies are set/proposed by the EU to be implemented by the Member States to restrict exposure and power of promotion of unhealthy foods to children including adolescents through broadcast media (TV, radio).

PROMO2 Effective policies are set/proposed by the EU to be implemented by the Member States to restrict exposure and power of promotion of unhealthy foods to children including adolescents through online and social media.

PROMO3 Effective policies are set/proposed by the EU to be implemented by the Member States to restrict exposure and power of promotion of unhealthy foods to children including adolescents through non-broadcast media other than packaging and online/ social media.

PROMO4 Effective policies are set/proposed by the EU to be implemented by the Member States to ensure that unhealthy foods are not commercially promoted to children including adolescents in settings where children gather (e.g. preschools, schools, sport and cultural events).

PROMO5 Effective policies are set/proposed by the EU to be implemented by the Member States to ensure that unhealthy foods are not commercially promoted to children (including adolescents) on food packages.

DOMAIN 4 – FOOD PRICES

This domain concerns the extent to which food pricing policies (e.g., taxes and subsidies) are aligned with health outcomes by helping to make the healthy eating choices the easier, cheaper choices.

PRICES1 Taxes or levies on healthy foods are minimised to encourage healthy food choices (e.g. low or no sales tax, excise, value-added or import duties on fruit and vegetables).

PRICES2 Taxes or levies on unhealthy foods (e.g. sugar-sweetened beverages, foods high in nutrients of concern) are in place and increase the retail prices of these foods by at least 10% to discourage unhealthy food choices, and these taxes are reinvested to improve population health.

PRICES3 The intent of existing subsidies on foods, including infrastructure funding support (e.g. research and development, supporting markets or transport systems), is to favour healthy rather than unhealthy foods.

PRICES4 The EU ensures that food-related income support programs are for healthy foods within EU countries.

DOMAIN 5 – FOOD PROVISION

This domain concerns the extent to which the EU ensures that there are healthy food service policies to be implemented by Member States in government-funded settings to ensure that food provision encourages healthy food choices, and the extent to which the EU actively encourages and supports private companies to implement similar

PROV1 The EU ensures that there are clear, consistent policies (including nutrition standards) to be implemented by Member States in schools and early childhood education services for food service activities (canteens, food at events, fundraising, promotions, vending machines etc.) to provide and promote healthy food choices.

PROV2 The EU ensures that there are clear, consistent policies to be implemented by Member States in other public sector settings for food service activities (canteens, food at events, fundraising, promotions, vending machines, etc.) to provide and promote healthy food choices.

PROV3 The EU ensures that there are clear, consistent public procurement standards to be implemented by Member States in public sector settings for food service activities to provide and promote healthy food choices.

PROV4 The EU ensures that there are good support and training systems to be implemented by Member States to help schools and other public sector organisations and their caterers meet the healthy food service policies and guidelines.

PROV5 The EU actively encourages and supports private companies to provide and promote healthy foods and meals in their workplaces.

DOMAIN 6 – FOOD IN RETAIL

This domain concerns the extent to which the EU has the power to set/ propose policies and programs to be implemented by Member States to support the availability of healthy foods and limit the availability of unhealthy foods in communities (outlet density and locations) and in-store (product placement).

RETAIL1 Zoning laws and policies are proposed by the EU to be implemented by the Member States to place limits on the density or placement of quick serve restaurants or other outlets selling mainly unhealthy foods in communities and/or access to these outlets (e.g. opening hours).

RETAIL2 Zoning laws and policies are proposed by the EU to be implemented by the Member States to encourage the availability of outlets selling fresh fruit and vegetables and/or access to these outlets (e.g. opening hours, frequency i.e. for markets).

RETAIL3 The EU ensures existing support systems are in place to be implemented by the Member States to encourage food stores to promote the in-store availability of healthy foods and to limit the in-store availability of unhealthy foods.

RETAIL4 The EU ensures existing support systems are in place to be implemented by the Member States to encourage the promotion and availability of healthy foods in food service outlets and to discourage the promotion and availability of unhealthy foods in food service outlets.

DOMAIN 7 – FOOD TRADE AND INVESTMENT

This domain concerns the extent to which the EU ensures that trade and investment agreements protect food sovereignty, favour healthy food environments, are linked with domestic health and agricultural policies in ways that are consistent with health objectives, and do not promote unhealthy food environments.

TRADE1 The EU undertakes risk impact assessments before and during the negotiation of trade and investment agreements, to identify, evaluate and minimize the direct and indirect negative impacts of such agreements on population nutrition and health.

TRADE2 The EU adopts measures to manage investment and protect their regulatory capacity with respect to public health nutrition.

Food-EPI Infrastructure Support Domains

Food-EPI Domain**DOMAIN 8 – LEADERSHIP**

This domain concerns the extent to which political leadership ensures that there is strong support for the vision, planning, communication, implementation and evaluation of policies and actions to create healthy food environments, improve population nutrition, and reduce diet-related inequalities.

Food-EPI Indicators

LEAD1 There is strong, visible, political support (at the head of European Commission/ Parliament level) expressed at European, supra national as well as national level for improving food environments, population nutrition, diet related NCDs and their related inequalities”.

LEAD2 Clear population intake targets have been proposed by the EU for the nutrients of concern and/or relevant food groups to meet WHO and European recommended dietary intake levels.

LEAD3 Clear, interpretive, evidenced-informed food based dietary guidelines have been established and conveyed to EU countries.

LEAD4 There is a comprehensive, transparent, up-to-date implementation plan linked to EU countries’ needs and priorities, to improve food environments, reduce the intake of the nutrients of concern to meet WHO and European recommended dietary intake levels, and reduce diet-related NCDs.

LEAD5 EU priorities have been established to reduce inequalities or protect vulnerable populations in relation to diet, nutrition, obesity and NCDs

DOMAIN 9 – GOVERNANCE

This domain concerns the extent to which the EU has structures in place to ensure

transparency and accountability, and encourage broad community participation and inclusion when formulating and implementing policies and actions to create healthy food environments, improve population nutrition, and reduce diet-related inequalities.

GOVER1 There are procedures in place to restrict commercial influences on the development of policies related to food environments where they have conflicts of interest with improving population nutrition. for example: restricting lobbying influences.

GOVER2 Policies and procedures are implemented for using evidence in the development of food and nutrition policies.

GOVER3 Policies and procedures are implemented for ensuring transparency in the development of food and nutrition policies.

GOVER4 The EU ensures public access to comprehensive nutrition information and key documents (e.g. budget documents, annual performance reviews and health indicators) for the public.

DOMAIN 10 – MONITORING AND INTELLIGENCE

This domain concerns the extent to which the EU’s monitoring and intelligence systems (surveillance, evaluation, research and reporting) are comprehensive and regular enough to assess the status of food environments, population nutrition and diet-related NCDs and their inequalities, and to measure progress on achieving the goals of nutrition and health plans.

MONIT1 Monitoring systems, implemented by the EU, are in place to regularly monitor food environments(especially for food composition for nutrients of concern, food promotion to children, and nutritional quality of food in schools and other public sector settings), against codes/guidelines/standards/targets.

MONIT2 There is regular monitoring of adult and childhood nutrition status and population intakes against specified intake targets or recommended daily intake levels.

MONIT3 There is regular monitoring of adult and childhood overweight and obesity prevalence using anthropometric measurements.

MONIT4 There is regular monitoring of the prevalence of NCD metabolic risk factors and occurrence rates (e.g. prevalence, incidence, mortality) for the main diet-related NCDs.

MONIT5 Major programs and policies are regularly evaluated to assess their effectiveness and contributions to achieving the goals of the nutrition and health plans.

MONIT6 Progress towards reducing health inequalities or health impacts in vulnerable populations and social and economic determinants of health are regularly monitored.

DOMAIN 11 – FUNDING AND RESOURCES

This domain concerns the extent to which the EU has sufficient funding invested in 'Population Nutrition Promotion' (estimated from the investments in population promotion of healthy eating and healthy food environments for the prevention of obesity and diet-related NCDs, excluding all one-on-one promotion (primary-care, antenatal services, maternal and child nursing services etc.), food safety, micronutrient deficiencies (e.g. folate fortification and undernutrition) to create healthy food environments, improved population nutrition, reductions in obesity, diet-related NCDs and their related inequalities.

FUND1 The 'population nutrition' budget, as a proportion of total health spending and/or in relation to the diet-related NCD burden sufficiently contributes to reducing diet-related NCD's.

FUND2 EU funded research is targeted for improving food environments, reducing obesity, NCDs and their related inequalities.

FUND3 There is a statutory health promotion agency in place that includes an objective to improve population nutrition with a secure funding stream.

DOMAIN 12 – PLATFORMS AND INTERACTION

This domain concerns the extent to which there are coordination platforms and opportunities for synergies across EU departments, levels of government, and other sectors (NGOs, private sector, and academia) such that policies and actions in food and nutrition are coherent, efficient and effective in improving food environments, population nutrition, diet-related NCDs and their related inequalities.

PLAT1 There are robust coordination mechanisms across departments and levels of government (European, national, state and local) to ensure policy coherence, alignment, and integration of food, obesity and diet-related NCD prevention policies across governments.

PLAT2 There are formal platforms (with clearly defined mandates, roles and structures) for regular interactions between the EU and the commercial food sector on the implementation of healthy food policies and other related strategies.

PLAT3 There are formal platforms (with clearly defined mandates, roles and structures) for regular interactions between the EU and civil society on the development, implementation and evaluation of healthy food policies and other related strategies.

PLAT4 The governments work with a system-based approach with (local, national and European) organisations/partners/groups to improve the healthiness of food environments in EU countries.

DOMAIN 13 – HEALTH IN ALL POLICIES

This domain concerns the processes that are in place to ensure policy coherence and alignment, and that population health impacts are explicitly considered in the development of EU policies.

HIAP1 There are processes in place to ensure that population nutrition, health outcomes and reducing health inequalities or health impacts in vulnerable populations are considered and prioritised in the development of all EU policies relating to food.

HIAP2 There are processes e.g. Health Impact Assessment's (HIAs) to assess and consider health impacts during the development of other non-food policies.

Figure S1. Steps of the Healthy Food Environment Policy Index 2019–2020 applied in this study (2019–2020) assessing the strength of EU policies and identifying priority actions.

The diagram illustrates the six steps of the EU-LEVEL project, arranged vertically from top to bottom. Each step is represented by an orange box with a green arrow pointing upwards to the next step. The steps are:

- 1. Food-EPI Adaptation**
 • Food-EPI adaptation to EU context: February to May 2019
- 2. Collection of EU-level policies**
 • Collecting information on EU-level policies: Feb-Sep 2019
 • Describing EU-level policies in "evidence document": Oct-Dec 2019
- 3. Online rating**
 • Online survey to rate the strength of EU-level policies and formulate actions: February-May 2020
- 4. Online workshops**
 • Online workshops with selected group of experts to discuss actions formulated in the online rating survey: July 2020
- 5. Refining and selecting actions**
 • a. Reformulating actions: July-August 2020
 • b. Survey to investigate which actions to recommend: Sep 2020
- 6. Prioritisation**
 • Prioritisation: October 2020

[Food-EPI/EU study, 2019-2020]

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Supplementary file 4: Expert panel

[Food-EPI EU study, 2019-2020]

Stakeholder Group	Expertise	Participants approached (n=61)	Participants declined (n=30)	Online rating survey (n=31)	Selection survey (n=16)	Prioritization survey (n=21)
Academia	Academics in the field of obesity prevention, nutrition and health, food and health policies, medical science, political science, behavioural science (n=9)	16	No response=4 No time= 3	9 (of which 1 partly)	5	7
International health and food organizations	Representatives of international non-government health and food organizations in the field of nutrition and health promotion, diet-related chronic diseases, health and food policies (n=5)	11	No response=5 No time= 1	5	3	2
Non-governmental health and nutrition organizations (NGOs)/ associations	Representatives of non-profit organizations and (professional) associations in the field of nutrition, health, diet-related chronic diseases, health and food policies (n=10)	22	No response=9 No time=2 Not sufficient knowledge=1	10	6	8
National governments/ institutes	Representatives of national governments, national/ intergovernmental institutes in Europe in the field of nutrition, health and policies (n=7)	12	No response=3 Not sufficient knowledge=1 Not target group study=1	7 (of which 1 partly)	2	4

Supplementary file 5

Table S2. EU policy actions to improve food environments, recommended by the Food-EPI expert panel (listed in order of importance and achievability). [Food-EPI EU study, 2019-2020]

Ranking (score)	Sum score importance + achievability	Food-EPI Domain	Policy action recommended by the Food-EPI expert panel
1	244	Food Labeling	Develop an EU easy-to-understand front-of-pack label (including a normative health statement) for Member States to implement for all product categories including the display on <u>prepacked foods</u> as well as on-shelf labeling for non-prepacked foods.
2*	294	Food Prices	Allow Member States to implement a Value-Added Tax (VAT) exemption of 0% for all fresh fruit and vegetables, by adopting the proposal of the Commission ¹ and encourage Member States to implement this VAT exemption to encourage healthy food choices.
3*	302	Food Composition	Set mandatory, ambitious, comprehensive and time-specific food composition targets for added sugars, salt, and saturated fat for all food categories (including processed and ultra-processed foods) sold in EU Member States (e.g. saturated fat reduction for savoury snacks of a minimum of 5% in 4 years and a minimum of an additional 5% reduction by 2026 against the individual baseline levels at the end of 2020).
4	305	Food Labeling	Develop and use a clear and evidence-based nutrient profiling system to prevent the use of nutrition and health claims (including function claims) on foods and meals high in saturated fat, trans fat, salt or added sugars.
5*	317	Food Composition	Adopt a legislated ban on trans fats (i.e. no trans-fats are allowed instead of the maximum limit of 2 grams per 100 grams of fat) in processed and ultra-processed foods sold in EU Member States.
6	341	Food Labeling	Adjust existing regulations (e.g. food information to consumers regulation EU No 1169/2011 ² , added sugars annex ³) to make the declaration of added or free sugars on prepacked foods mandatory.
7*	345	Food Composition	Set mandatory, ambitious and comprehensive reformulation targets for added sugars, salt, and saturated fat for processed and ultra-processed foods and meals sold at quick service restaurants (including snack food outlets) in EU Member States.
8*	348	Food Promotion	Introduce a new Directive, (amending the Audiovisual Media Services Directive (2010/13/EU ⁴)), which requires Member States to implement (1) minimum and time-based restrictions or bans on the (online) marketing of foods high in saturated fat, trans fat, salt or added sugars to children and adolescents up to 19 years old in all digital (including broadcast, online and social) media and (2) bans on food packages for marketing foods high in saturated fat, trans fat, salt or added sugars to children and adolescents up to 19 years old.

9	366	Food Promotion	Ensure that the Digital Services Act creates a governance regime that enables Member States to maintain, adopt and enforce national legislation to minimize the exposure of children and adolescents up to 19 years old to foods high in saturated fat, trans fat, salt or added sugars.
10	369	Food Promotion	Develop and use a clear and evidence-based nutrient profiling system (e.g. such as the WHO nutrient profile model) to restrict the marketing (including online marketing) of processed and ultra-processed foods high in saturated fat, trans fat, salt or added sugars.
11	429	Food Promotion	Prohibit the sponsorship of foods high in saturated fat, trans fat, salt or added sugars from EU-wide sporting and other events with a legal or financial connection with the EU (e.g. events organized by the Union of European Football Associations (UEFA)).
12	444	Food Provision	Include minimum mandatory criteria for food procurement supporting healthy diets in schools, hospitals and public institutions, in addition to setting these criteria for sustainable food procurement as announced in the Farm to Fork Strategy.
13	459	Food Prices	Encourage Member States to ensure that consumer food-related income support programs distribute mainly nutritious food products supporting a healthy diet (e.g. fruit and vegetables, dietary fibre), e.g. replacing the current provision about food support in the European Social Fund Plus from “where appropriate the choice of food products to be distributed shall be made having considered their contribution to the balanced diet of the most deprived persons” to “ensure the choice of food products to be distributed is for nutritious food products supporting a healthy diet (e.g. fruit, vegetables, dietary fibre such as whole grains), and is not including foods high in trans fats, saturated fat, added sugars or salt, which contribute to a healthy diet of the most deprived persons”.
14	471	Food Provision	Provide food service and procurement guidelines (e.g. “the European Sustainable and Healthy Public Food Procurement guide”) to support healthy diets which also promote the role of public health dietitians/nutritionists to support public sector organizations and their caterers (e.g. by training staff, supporting the implementation of nutrition standards).
15	474	Food Prices	Require Member States to implement the standard VAT rate of a minimum of 15% to foods high in trans fats, saturated fat, added sugars, by adding those foods to the list of goods and services (Annex IIIa of the current proposal on VAT rates ⁵) to which the standard rate of minimum 15% must always be applied.
16	532	Food Provision	Amend the Public Procurement Directive to include specific clauses that relate to the provision and promotion of nutritious foods supporting healthy diets in public sector settings and support the implementation by Member States via guidelines and toolkits.
17	549	Food in Retail	Elicit an EU-wide retail sector commitment to (1) remove ultra-processed and processed foods high in added sugars, salt, trans fat or saturated fat from near checkout counters and (2) ban (price) promotions of foods high in added sugars, salt, trans fat or saturated fat.

18	597	Food Trade	Make health impact assessments mandatory for new trade agreements between the EU and third countries, including explicit references to the food environment and use this evidence and information when making decisions on trade policy.
19	604	Food Trade	Continuously monitor the impact of trade agreements on the EU food environment, population nutrition and health (e.g. apply the European Precautionary Principle).

- The actions are listed in order of priority considering both importance and achievability.
- The five top 10 actions based on importance and achievability, and with the highest potential to reduce dietary socioeconomic inequalities according to the experts are marked with an asterix (*)
- The top 5 policy actions based on importance, achievability and equity are marked grey.

¹ EUR-Lex. Proposal for a COUNCIL DIRECTIVE amending Directive 2006/112/EC as regards rates of value added tax COM/2018/020 final – 2018/05 (CNS). https://ec.europa.eu/taxation_customs/sites/taxation/files/18012018_proposal_vat_rates_en.pdf

² REGULATION (EU) No 1169/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 of the European Parliament and of the Council, and repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and Commission Regulation (EC) No 608/2004. OJ L 304, 22.11.2011, pp. 18–63. EUR-Lex: <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:304:0018:0063:EN:PDF>

³ European Commission, High Level Group on Nutrition and Physical Activity, 2015. Annex II, Added Sugars. EU FRAMEWORK FOR NATIONAL INITIATIVES ON SELECTED NUTRIENTS. https://ec.europa.eu/health/sites/health/files/nutrition_physical_activity/docs/added_sugars_en.pdf

⁴ DIRECTIVE (EU) 2018/1808 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 November 2018 amending Directive 2010/13/EU on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the provision of audiovisual media services (Audiovisual Media Services Directive) in view of changing market realities. EUR-Lex: <https://eur-lex.europa.eu/legal-content/EN/TXT/%20PDF/?uri=CELEX:32018L1808&from=HR>.

⁵ European Commission. Proposal for a COUNCIL DIRECTIVE amending Directive 2006/112/EC as regards rates of value added tax (2018). https://ec.europa.eu/taxation_customs/sites/taxation/files/18012018_proposal_vat_rates_en.pdf

Supplementary file 6

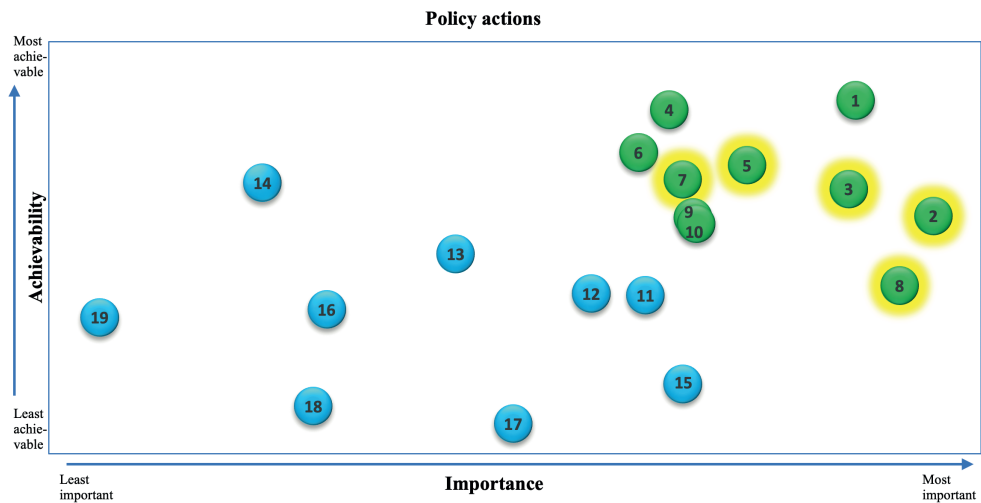


Figure S2. Importance and achievability of the 19 recommended policy actions (top 10 priority actions in green) for the EU and the five ‘green’ actions which have the greatest potential to reduce socioeconomic inequalities in diet (indicated by the yellow shadow).¹

[Food-EPI EU study, 2019-2020]

¹ The numbers of the actions (1-19) align with the numbers of the actions included in Table S2. Number 1 has the highest ranking on a combination of importance and achievability, number 19 has the lowest ranking on a combination of importance and achievability.

Supplementary file 7

Table S3. EU infrastructure support actions, recommended by the Food-EPI expert panel (listed in order of importance and achievability). [Food-EPI EU study, 2019-2020]

Ranking	Sum score importance + achievability	Food-EPI Domain	Infrastructure support action recommended by the Food-EPI expert panel
1	167	Leadership	Develop a high-level EU Non-Communicable Diseases (NCDs) Prevention Strategy.
2	210	Monitoring	Benchmark food environment policies regarding food reformulation, food labeling (incl. claims and front-of-pack labeling), food marketing, food prices, food provision in public spaces and retail (zoning laws and policies, in-store product placement), and support and coordinate the exchange of good practices between Member States (e.g. via the Open Method of Coordination).
3	269	Leadership	Include clear priorities to reduce inequalities or protect vulnerable populations in the multi-annual work programmes/annual State of the Union, (e.g. by the year X we want to have reduced health inequalities in relation to diet within/between EU Member States).
4	287	Leadership	Harmonise the promotion of healthy diets with other issues of concern such as climate change and environmental protection (e.g. showing leadership via the forthcoming 8th Environmental Action Programme and engaging with the European Environmental Agency, with its theme 'environment and health.')
5	302	Monitoring	Recommend and support Member States to set up a monitoring system to assess the status of food environments, and to measure progress on achieving the goals of nutrition and health plans.
6	306	Leadership	Develop and adopt clear and specific population intake targets for specific nutrients (salt, added sugars, saturated fat) and specific foods (fruit and vegetables) at EU level aligned with the WHO targets and guidelines.
7	354	Leadership	Make diet-related health outcomes key political criteria in the European Semester and Health strand of the European Social Fund Plus (ESF+) Programme. ^{1,2}
8	359	Governance	Develop and adopt a procedure that ensures a good balance of scientific evidence from several disciplines (e.g. economics, psychology, health science, law and consumer science) is used in the development of food and nutrition policies (e.g. secure representation from various disciplines in committees/policy boards responsible for the development of food and nutrition policies).
9	378	Monitoring	Evaluate food environment actions in the Member States (e.g. the recent trans-fat targets/limits in foods) by: (1) setting up an EU coordinated evaluation study of EU food environments or (2) providing funding to Member States to collect data to support this evaluation.
10	422	Funding and Resources	Establish an EU health promotion agency to support the design, implementation, monitoring and evaluation of actions on food environments, population nutrition and diet-related NCDs and their inequalities, e.g. such as the European Environment Agency (EEA).

11	429	Funding and Resources	Increase EU funded research targeting issues related to the food environment (including attention for research targeting disadvantaged groups and underrepresented household types, that are at a higher risk of NCDs and food insecurity).
12	448	Funding and Resources	Reallocate more Common Agricultural Policy (CAP) resources to diet-related actions targeted at consumers like the EU School Fruit and Vegetable Scheme.
13	456	Governance	Adopt the proposal ³ to make the EU transparency register mandatory for lobbyists covering the Commission, Council and Parliament (including details of specific lobbying activities, e.g. when, who, what).
14	458	Funding and Resources	Include a heading on public health promotion in the Multiannual Financial Framework.
15	462	Health-in-all-Policies	Develop and adopt a health-in-all policies approach within the EU policy process and make it legally binding (by integrating health into all major EU spending programmes and setting an ambitious goal for health mainstreaming across all EU programmes, e.g. with a target of 25% of EU expenditure contributing to health objectives, as has been done with climate mainstreaming ⁴).
16	477	Health-in-all-Policies	Establish a 'Health in All Policies' online portal containing at least: (1) a tracking tool providing an overview of all ongoing EU-level policy initiatives with potential impacts on health and well-being, in particular NCDs, and (2) an online directory where all impact assessments conducted for the policy initiatives identified in the first point are gathered and published.
17	479	Health-in-all-Policies	Make health impact assessments mandatory for all policies.
18	577	Health-in-all-Policies	Include diet-related health indicators when analysing health/health systems as part of the EU economic governance (the European Semester) and include health (equity) impact assessments as part of the governance-related Country Specific Recommendations of the Semester. E.g. by including diet-related outcomes as one of the indicators of the Social Scoreboard ⁵ (which monitors Member States' performance in relation to the European Pillar of Social Rights), which feeds into the preparation of the Country Reports prepared in the context of the European Semester and in the dialogue with Member States throughout the year.

- The actions are listed in order of priority considering both importance and achievability.
- The top 5 infrastructure support actions based on importance and achievability are marked grey.

¹ European Commission. European Social Fund. A new, stronger European Social Fund Plus. <https://ec.europa.eu/esf/main.jsp?catId=62&langId=en#:~:text=The%20European%20Social%20Fund%20Plus,the%20existing%20European%20Social%20Fund>

² ESF+ resources will be allocated to key political priorities and citizens' concerns: ESF+ programs and projects will have to concentrate on related challenges identified under the European Semester

³ European Commission. Transparency: Parliament, Commission and Council held a third round of talks on the proposal for a mandatory transparency register (2019). https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_19_1152

⁴ European Commission. Funding for Climate Action. Supporting climate action through the EU budget. https://ec.europa.eu/clima/policies/budget/mainstreaming_en

⁵ Eurostat. European pillar of social rights- indicators- social score board of indicators. <https://ec.europa.eu/eurostat/web/european-pillar-of-social-rights/indicators/social-scoreboard-indicators>

Supplementary file 8

2

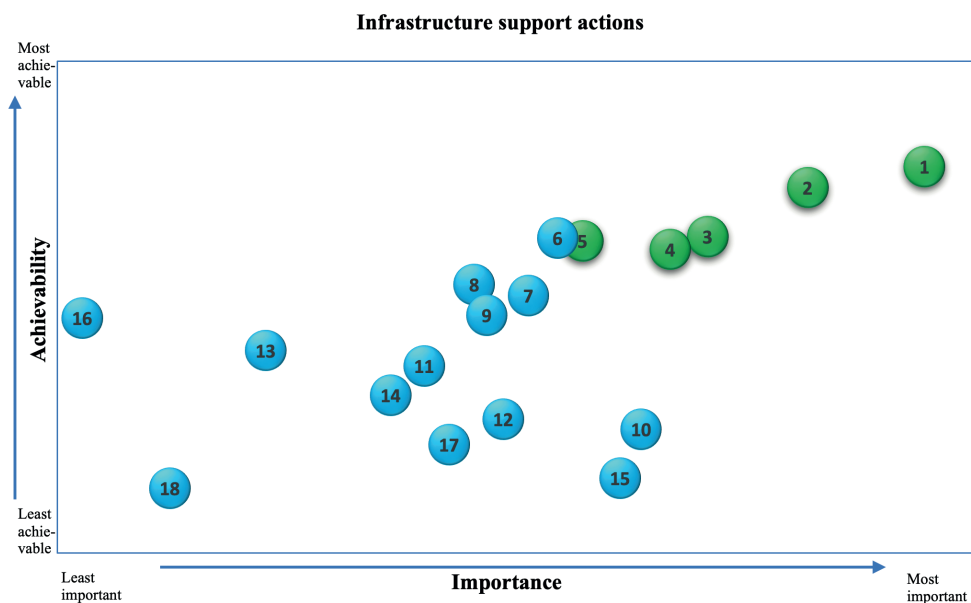


Figure S3. Importance and achievability of the 18 recommended infrastructure support actions (top 5 priority actions in green) for the EU.²

[Food-EPI EU study, 2019-2020]

² The numbers of the actions (1-18) align with the numbers of the actions included in Table S3. Number 1 has the highest ranking on a combination of importance and achievability, number 18 has the lowest ranking on a combination of importance and achievability.



3

How can national government policies improve food environments in the Netherlands?

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ABSTRACT

Objectives: Government policies are essential to create food environments that support healthy diets. The aims of this study were 1) to benchmark the implementation of Dutch government policies influencing food environments, and 2) to identify and prioritize actions to improve food environments in the Netherlands.

Methods: The Healthy Food Environment Policy Index (Food-EPI) was applied. The Food-EPI includes 46 indicators of food environment policy and infrastructure support. Independent experts (n = 28) rated the extent of implementation on these indicators against international best practices, and formulated and prioritized policy and infrastructure support actions to improve food environments.

Results: Most policy indicators were rated as having a low (50%) or very low (41%) level of implementation. Most infrastructure support indicators were rated as having a fair (42%) or medium (42%) level of implementation. 18 policy and 11 infrastructure support actions were recommended by experts to improve food environments in the Netherlands.

Conclusion: There is large potential for the Dutch national government to strengthen its policy action and infrastructure support in order to improve the healthiness of food environments in the Netherlands.

INTRODUCTION

Overweight, obesity and diet-related chronic diseases are a major public health challenge globally (1, 2). In the Netherlands, approximately 50% of the adult population is overweight (3, 4). An unhealthy diet is an important determinant of overweight, obesity and diet-related chronic diseases (5, 6). Unhealthy diets are not merely the result of individual decisions, but strongly influenced by the food environment (7–9).

The food environment can be defined as the physical (e.g., food availability, marketing), economic (food prices), policy and sociocultural surroundings, opportunities and conditions that influence people's food choices and nutritional status (9). Over the past few decades, the availability and marketing of ultra-processed, high-fat and sugar-rich products increased, and prices of these products have decreased relatively to healthier foods (8–10). As commercial interests have been allowed to prevail over public health, this has resulted in so-called obesogenic environments, in which unhealthy food choices are easier made than healthy food choices (8, 11–13).

To correct for this market failure, it is essential that governments develop policies to reverse the obesogenic nature of food environments (8, 11, 14). Structural, government policies can play an important role to create healthy food environments, supporting the entire population to make healthy food choices (14–17). These policies are known to be more effective in improving population diet than interventions which address individual behavior (e.g., health mass media campaigns) (8, 18). Globally, the implementation of policies to create supportive food environments is low (8, 19). However, some governments are making progress, for example the Chilean government which implemented a Law of Food Labeling and Advertising, to introduce easy-to-understand front-of-pack labeling and specific messages addressing critical nutrients and to restrict unhealthy food marketing to children across media (20, 21).

In the Netherlands, Article 22 of the Dutch Constitution states that the government should take measures to promote public health (22). The Dutch government has indeed implemented several voluntary measures to create healthy food environments. For instance, in 2014, the Dutch government signed an Agreement on Product Improvement with the food industry to reduce the amounts of salt, saturated fat and added sugar in products (23). More recently, in 2018, the Dutch government signed the “National Prevention Agreement” (NPA) together with more than seventy public and private organizations (24, 25). The NPA specifies goals to reduce overweight among adults from 48.7% in 2017 to 38% in 2040, and among children and adolescents from 13.5% in 2017 to 9.1% in 2040. In addition, the NPA aims to reduce obesity among adults from 14.5% in 2017 to 7.1% in 2040, and among children and adolescents from 2.8% in 2017 to 2.3%

in 2040 (24, 25). To achieve these goals, several voluntary actions have been described in the NPA, e.g., supermarkets will encourage consumers to buy products that are in line with Dutch dietary guidelines (Wheel of Five); the government will introduce a new, broadly supported food-choice logo; and a restriction on the use of licensed media characters aimed at children under 13 years of age on product packaging and point-of-sale materials will be included in the self-regulated Advertising Code for Food (24, 25). While these voluntary actions can be supportive of healthy food environments, there is lack of structural policies in the NPA (such as the highly contested sugar-sweetened beverages tax, still not implemented in the Netherlands (26)). Contrary to these NPA actions, the Dutch government increased the value-added tax on all foods, including fruit and vegetables, from 6 to 9% in 2019 (27).

Although some actions regarding the improvement of food environments can be observed, a clear and comprehensive picture and evaluation of the current food environment policy landscape in the Netherlands is lacking. To gain more insight into where the largest policy implementation gaps lie and how the Dutch national government could improve its food environment policies, this study applied the Healthy Food Environment Policy Index (Food-EPI) developed by the International Network for Food and Obesity/non-communicable diseases Research, Monitoring and Action Support (INFORMAS) (14). In applying the Food-EPI tool, this study aims:

1. To benchmark, against international best practices, the extent to which the Dutch national government has implemented policies contributing to a healthy food environment, as well as infrastructure support that facilitates effective policy development and implementation, and
2. To identify and prioritize context-specific actions that can improve food environments in the Netherlands.

METHODS

Study design

This mixed-methods study is conducted as part of the Policy Evaluation Network (PEN) (<https://www.jpi-pen.eu/>), and under the umbrella of INFORMAS (informas.org). Over the period 2019–2020, we adapted and applied the Food-EPI in the Netherlands (14). Globally, the Food-EPI has already been applied in more than thirty countries (28). All procedures performed were in accordance with the ethical standards of the institutional committee [Science-Geosciences Ethics Review Board (SG-ERB), Utrecht University, Netherlands (ERB Review Geo L-19254)] and the Helsinki declaration. All study participants signed informed consent before participation.

Study procedure

The Food-EPI is an international standardized tool and process to identify important gaps in policies and infrastructure support, and to identify and prioritize future actions to improve food environments (14). The tool comprises indicators across seven food environment *policy* domains (food composition, labeling, promotion, prices, provision, retail, trade, and investment) and six *infrastructure support* domains (leadership, governance, monitoring and intelligence, funding and resources, platforms for interaction, health-in-all-policies) (14). This study consisted of six steps (see Supplementary Material S1 for an overview of the steps and timeline), which are further outlined below.

Step 1: Tool adaptation (February–May 2019)

Before applying the Food-EPI to the European context, PEN researchers consulted other researchers/experts to review the 47 original Food-EPI indicators. For each indicator, it was assessed whether the jurisdiction lies with the European Union, national governments or both. Furthermore, PEN researchers asked the participating researchers/experts to indicate whether indicators were clear, needed to be (dis) aggregated or whether indicators were missing. In the food promotion domain one indicator was disaggregated (into restricting promotion through online and social media and promotion in “non-broadcast” media) and one indicator was added (restricting promotion on food packages). In the food provision domain one indicator on public procurement standards in public sector settings was added. It was decided to include the trade domain (including two indicators) in the EU Food-EPI, but not in the national Food-EPI's. This resulted in a total of 46 indicators included in the Dutch Food-EPI, i.e., 22 policy and 24 infrastructure support indicators (Supplementary Material S2).

Steps 2–3: “Evidence document” and online benchmarking survey

In step 2, evidence for the implementation of policies for each of the 46 Food-EPI indicators (up until 22 April 2020) in the Netherlands was collected through systematically searching for and reading national policy documents. We used several main sources to search for the relevant policy documents, including the national government websites (e.g., <https://wetten.overheid.nl>, <https://www.rivm.nl>, <https://www.voedingscentrum.nl>, <https://www.rijksoverheid.nl>). Via these websites we found information and links to additional useful documents including the Agreement on Product Improvement, the NPA, and the Advertising Code for Food. All policies identified at the national level with a potential influence on the food environment have been summarized in an 34-page “evidence document” (29). This document was verified for completeness and accuracy by governmental officials, for example by officials working at the Ministry of Health, Netherlands Nutrition Centre and the National Institute for Public Health and the Environment.

After a brainstorm with the research team we developed a long list of relevant Dutch organizations in the field of food and nutrition, public health, obesity, and/or diet-related chronic diseases, i.e., academia, health organizations, health professional associations, non-governmental organizations, and local governments. Further, we created a long list of names of people working at these organizations, and purposively invited them to participate in the Dutch Food-EPI expert panel (March–May 2020). To ensure that all relevant expertise would be represented in the expert panel, invited experts were asked to supply the research team with any names of other relevant experts that should be invited for the Food-EPI expert panel.

In total 52 independent experts were invited. In step 3, they were asked to benchmark the implementation of policies and infrastructure support against international best practices during an online survey. A total of 28 experts filled out the survey (May–July 2020), of which 25 experts fully completed and 3 partly. Participants benchmarked the implementation of each of the 22 policy and 24 infrastructure support indicators, by comparing the level of implementation as described in the evidence document to international best practices (i.e., comprehensive examples of policy implementation worldwide which were provided for each indicator). The guidance that was given to the experts to determine the level of implementation has been included in Supplementary Material S3. A five-point Likert scale was included to benchmark the implementation of policies, with 1 = 0–20% implementation (=very low), 2 = 20–40% implementation (=low), 3 = 40–60% implementation (=medium), 4 = 60–80% implementation (=fair), and 5 = 80–100% implementation (=high). There was also a ‘cannot rate’ option and experts could comment on their rating in a text box.

Moreover, experts were asked to write down concrete actions (for each policy and infrastructure domain) that they considered important in order to improve the healthiness of food environments in the Netherlands.

Steps 4–6: Identification and prioritization of actions to improve food environments in the Netherlands

Due to the 2020 Covid-19 bans on travel and meetings, the next logical step in the Food-EPI process, i.e., a face-to-face workshop with the expert panel to discuss the proposed actions, was not possible. Therefore, a different approach than outlined in the Food-EPI protocol (30) was taken, as described below in step 4–6.

Step 4 Online workshops

To combine and narrow down (e.g., omit duplications) the actions as proposed by the expert panel (n = 28) during the online benchmarking survey (step 3), two online workshops of 3-hours each were held (September 2020). As there were many (189) actions formulated during the online benchmarking survey which had to be combined and

narrowed down, we invited a selected group of experts ($n = 4$) (who also had completed the online benchmarking survey) to ensure an effective and efficient online discussion. Two of these experts were specialized in public health and nutrition working in health organizations and two of these experts were specialized in nutrition and food law/politics working in academia. For each domain, the experts were also consulted if any important actions were missing on the list.

Step 5a Refining actions

The research team made final adjustments to the list of actions according to the input received during the workshops. This adjusted list of actions was then sent to the four experts who participated in the online workshops for verification.

Step 5b Online selection survey to investigate which actions to recommend

The expert panel ($n = 28$) was invited for a second online selection survey in October 2020. They were asked to indicate for each of the actions if they would recommend the Dutch government to implement this action, using a five-point Likert scale: 1) very much disagree 2) disagree 3) neutral 4) agree 5) very much agree. A total of 17 experts participated in this survey.

Step 6 Prioritization of the recommended actions

In the third and final online survey (November 2020), the expert panel ($n = 28$) was asked to prioritize the recommended actions that received an average score of 4.0 or higher in step 5b. A total of 21 experts completed this prioritization survey. Experts ranked the policy actions three times on 1) importance, 2) achievability and 3) equity, i.e., the effect on socioeconomic inequalities in diet. Experts ranked the infrastructure support actions twice on 1) importance and 2) achievability. Importance includes criteria on need, impact, and other positive and negative effects. Achievability includes criteria on feasibility, acceptability, affordability, and efficiency. And equity includes criteria on socioeconomic effects (regressive/progressive) and the extent to which a given policy requires environmental change rather than individual choices. Supplementary Material S4 includes a comprehensive description of the ranking criteria. When an action was ranked as #1 it was considered to be most important, achievable or equitable.

Data analysis

The mean score on the five point Likert scale was calculated for each indicator to determine the implementation of policies. The Gwet AC2 inter-rater reliability coefficient and its variance were determined using AgreeStat software (Agreestat 2015.6.1, Advanced Analytics, Gaithersburg, United States). For estimation of the variance, the sample of subjects to rate was set at 100% since all indicators of the Food-EPI were included for rating, while the sample of raters was set at 54% (as per the response rate of experts invited), and the finite population correction was applied (step 3).

Regarding step 5b, the mean score was calculated for each action based on the five point Likert scale. Actions with a mean score of 4.0 or higher were included in step 6.

In step 6, we identified the highest prioritized policy and infrastructure actions by summing the ranking scores for each action. First, we calculated the scores for importance and achievability separately. Second, we calculated the total score for each action by summing the scores on importance and achievability. Sum scores could vary from 42 to 756 (policy domains) and from 42 to 462 (infrastructure support domains). A lower sum score indicated a higher perceived priority. These sum scores were used to determine the top 5 prioritized policy actions and the top 5 prioritized infrastructure support actions. For the policy actions, we also calculated the sum of the scores on equity for each action and determined the top 5 actions which were perceived most effective to reduce socioeconomic inequalities in diet.

RESULTS

Expert Panel

The 28 experts that participated in this study were working in academia, health organizations/health professional associations, non-governmental organizations (NGO's) and local governments, and specialized in food, nutrition, public health, obesity and/or diet-related chronic diseases (Supplementary Material S5). In the online benchmarking survey participation was highest (12 experts from academia, six from health organizations/health professional associations, four from NGO's and six from local governments), followed by the prioritization survey (10 experts from academia, five from health organizations/health professional associations, three from NGO's and three from local governments). The least experts participated in the selection survey (eight from academia, five from health organizations/health professional associations, three from NGO's and one from a local government).

Ratings of the extent of implementation of policies and infrastructure support influencing food environments compared to best practice

Figures 1 and 2 present for each Food-EPI indicator separately, the mean implementation score of policies and infrastructure support in the Netherlands compared to international best practices, according to the experts. The Inter-rater reliability (Gwet's AC2) for all Food-EPI indicators was 0.57 (95% CI = 0.51–0.62), which indicates that there was moderate agreement among experts about the implementation of policies against international best practices. There was strong agreement about the policy indicators (Gwet's AC2 was 0.78; 95% CI = 0.73–0.83), but lower agreement about the infrastructure support indicators (Gwet's AC2 was 0.46; 95% CI = 0.39–0.53).

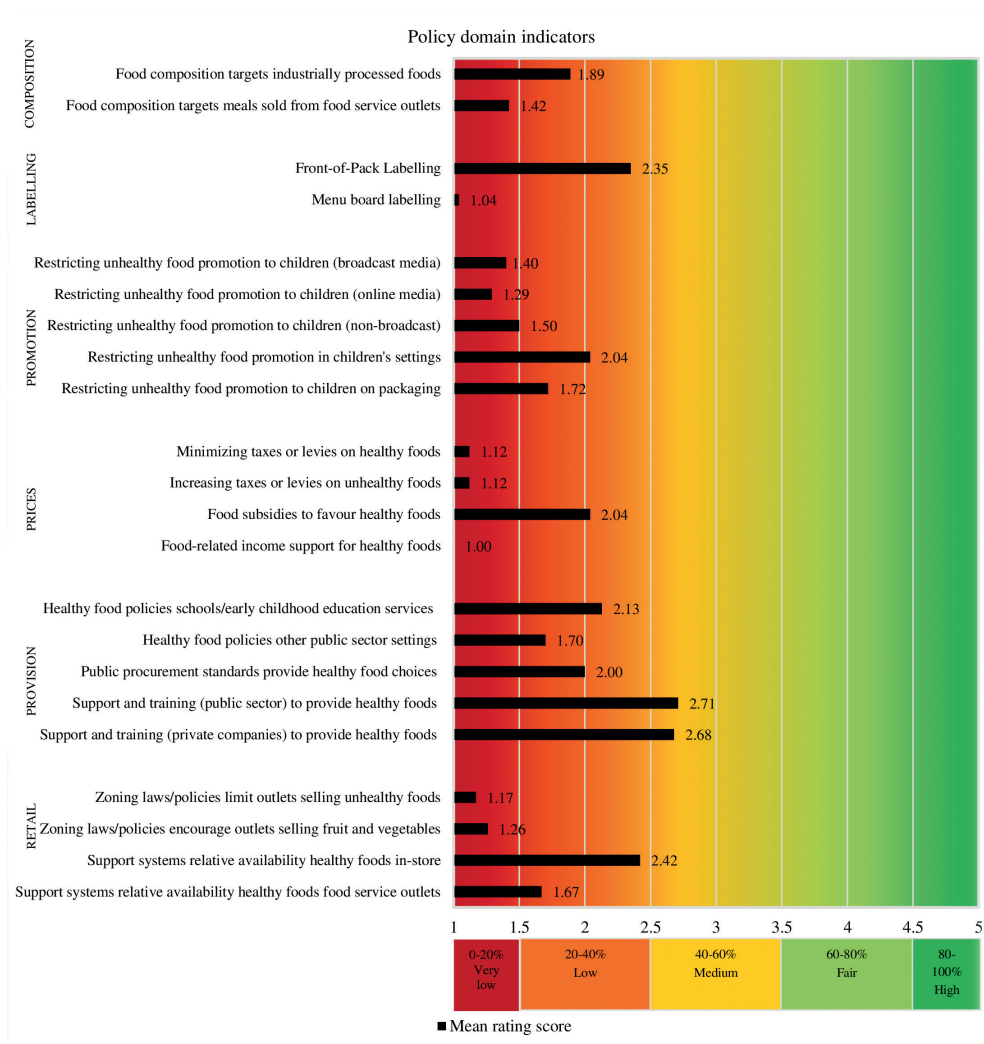


Figure 1. Ratings of the extent of implementation of policies influencing food environments. (Food-EPI study, the Netherlands, 2019–2020).

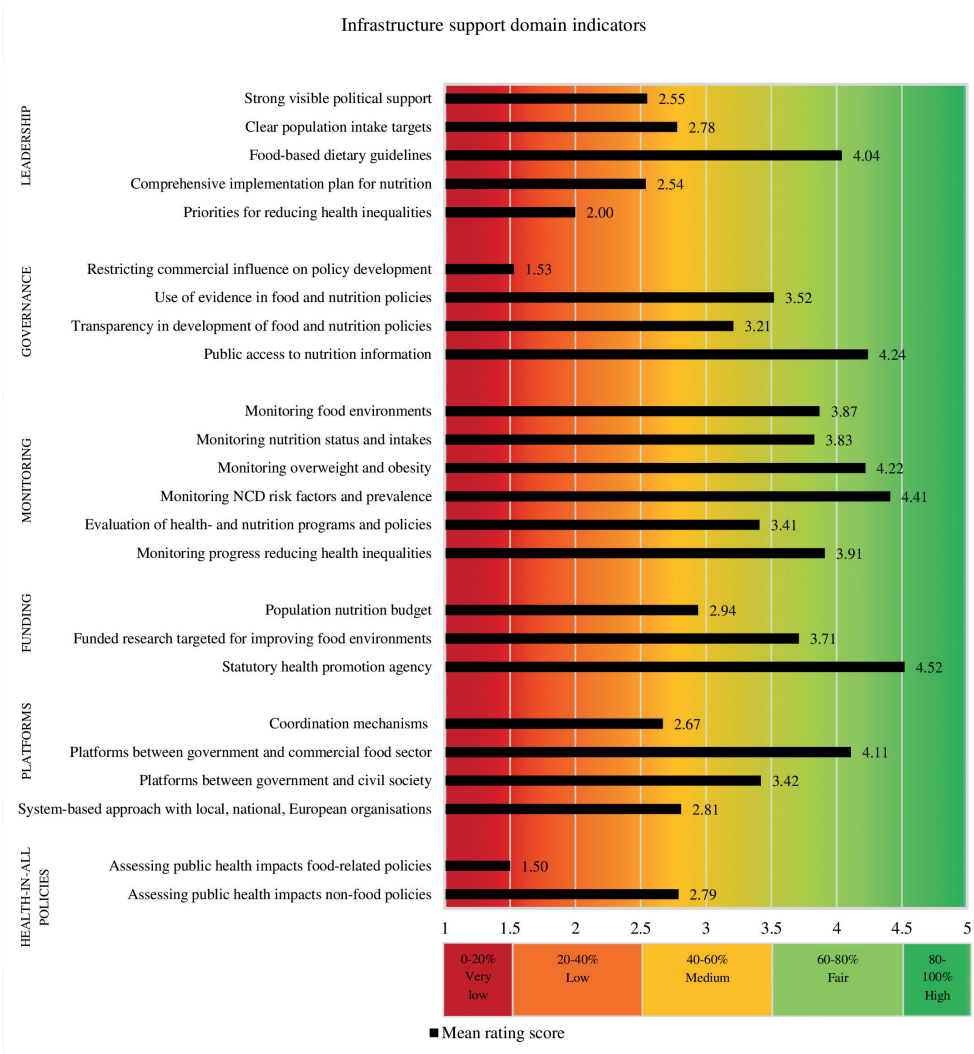


Figure 2. Ratings of the extent of implementation of infrastructure support influencing food environments. (Food-EPI study, the Netherlands, 2019–2020).

Policy domains

The implementation of 50% of the indicators in the policy domains (11 of the 22 indicators) was rated as being “low” (20–40% implementation) (Figure 1). Yet, the implementation of 41% of the policies (nine of the 22 indicators) was rated even being “very low” (0–20% implementation). The expert panel considered the implementation of policies with respect to two of the 22 (9%) policy indicators as being “medium” (40–60% implementation).

Infrastructure support domains

The implementation of infrastructure support indicators was generally rated higher than policy indicators (Figure 2). The implementation of one of the 24 infrastructure support indicators, namely “having a statutory health promotion agency in place” (*Funding domain*) was rated “high” by the expert panel. This includes the Netherlands Nutrition Centre and the National Institute for Public Health and the Environment.

Further, the implementation of 10 of the 24 infrastructure support indicators (42%) was rated being “fair,” another 10 (42%) as being “medium,” and three indicators (12%) were rated as having “low” implementation compared to international best practices (Figure 2). In contrast to the policy indicators, no infrastructure support indicators were rated as having “very low” implementation.

Identification and prioritization of actions to improve policies and infrastructure support

Based on step 3 (benchmark survey), step 4 (workshops) and step 5a (refinements), a total of 46 actions were proposed by the expert panel, namely 27 policy actions and 19 infrastructure support actions. In step 5b (selection survey), a total of 29 actions, including 18 policy actions and 11 infrastructure support actions were scored with a 4.0 or higher and thereby recommended to the national government to create healthy food environments in the Netherlands.

Recommended and prioritized policy actions

The 18 policy actions recommended by the experts are detailed in Table 1. The actions are listed in order of priority considering both importance and achievability. The five actions with the highest potential to reduce dietary socioeconomic inequalities according to the experts are marked with an asterisk (*).

Four of the top 5 prioritized policy actions on importance and achievability, also appeared in the top 5 actions with the greatest potential to reduce dietary socioeconomic inequalities. These four actions, together with the other top 5 action on importance and achievability, and the other top 5 action on equity (six in total) were recommended to the government for immediate implementation.

In Figure 3, the scores on importance and achievability for each action are plotted in a graph, and the five actions with the greatest potential to reduce socioeconomic inequalities in diet are indicated by a yellow shadow.

Table 1. Policy actions to create healthy food environments, recommended by the Food-EPI expert Panel (listed in order of prioritization on a combination of importance and achievability).

(Food-EPI study, the Netherlands, 2019-2020)

Ranking	Sum score importance + achievability	Domain	Action
1	193	FOOD COMPOSITION*	Ensure that the new product improvement system, in continuation of the agreement on product composition improvement, meets at least the following requirements: <ul style="list-style-type: none"> • It includes more ambitious food composition targets than the current targets in the agreement on product composition improvement. • It includes annual targets to reduce the amounts of salt, saturated fat and added sugars in all product categories which have an impact on the salt, saturated fat, and added sugars intake, where a reduction in one nutrient does not lead to an increase in another nutrient. • There is a clear timeline with annual independent monitoring including baseline measurement, with publicly accessible reporting, to make the progress visible. • It includes proven effective incentives per product category that ensure that food producers comply with agreements.
2	275	FOOD PROMOTION*	Ban all forms of marketing (Article 1 of the Dutch Advertising Code) aimed at children under the age of 18 years old for foods that fall outside the Dutch healthy dietary guidelines (i.e. the Wheel of Five) (an advertisement is aimed at children when the advertisement reaches an audience consisting of 10% children under 18 or more), via: <ul style="list-style-type: none"> • Media channels such as tv, radio, online and social media, point of sale, packages, games, cinema, print, sponsorship, kids clubs, sales promotion, product placement, films, peer-to-peer etc. • Marketing methods such as the use of children's idols, cartoons, animation figures, games, puzzles etc.
3	276	FOOD PRICES*	Increase the prices of unhealthy foods such as sugar-sweetened beverages, for example via a proven effective VAT-increase or excise tax.
4	306	FOOD PROVISION/ RETAIL	Formulate clear rules and regulations for caterers, quick service restaurants, supermarkets and shops to increase the relative availability of healthy foods (with sufficient fiber, vitamins, and/or minerals) compared to the total food product availability.
5	315	FOOD PRICES*	Decrease the prices of healthy foods such as fruit and vegetables, for example by reducing the VAT to 0% (when this is possible with the new European legislation).
6	335	FOOD RETAIL/ FOOD PROMOTION	Encourage supermarkets and food producers to promote healthy foods via proven effective incentives.
7	352	FOOD PROMOTION	Ensure that supermarkets and food producers report annually in a measurable and comparable manner about actions, promotions and advertising aimed at healthy foods in relation to the total product promotion.

8	360	FOOD COMPOSITION	Encourage the European Union to remove bottlenecks so that the Netherlands can make binding agreements with food producers to achieve product improvement targets, including sanctions imposed by the government in the event of non-compliance.
9	381	FOOD COMPOSITION	Initiate an agreement to improve meal composition for caterers as well as quick service restaurants with targets to reduce the amounts of salt, saturated fat and added sugars and increase the amounts of fiber, vitamins and minerals (through healthy foods) in meals sold by caterers and quick service restaurants, for example by including gradual targets in such an agreement.
10	434	FOOD PRICES*	Finance food-related income support, for example by providing vouchers to people below a certain income level to purchase healthy foods free of charge (such as fruits and vegetables, such as the Healthy Start programme in the UK).
11	448	FOOD RETAIL	Formulate clear rules and regulations for retail, catering and hospitality, to discourage unhealthy food choices in supermarkets, shops, canteens and quick service restaurants and encourage healthy food choices, for example banning sweets at the checkout counter or prescribing a maximum percentage of unhealthy foods in relation to the total food availability and in promotions.
12	465	FOOD PROVISION	Facilitate the provision of healthy foods and school meals (e.g. lunch) in primary schools by providing an infrastructure (staffing, logistics, procurement), policies and subsidies (and make the contribution of parent income-related, whereby the school meals (e.g. lunch) are free for lower socioeconomic groups).
13	474	FOOD PROVISION	Tighten the criteria of the dietary guidelines 'Healthier Canteens' and 'Healthier Eating environments' of the Dutch Nutrition Centre and encourage schools, hospitals, company canteens, and government-funded institutions to implement these guidelines with proven effective incentives to ensure compliance.
14	489	FOOD PRICES	Invest the revenues of the increased prices on unhealthy foods (VAT, excise tax) in broad proven effective health programs for promoting healthy food consumption and prevention of lifestyle-related (chronic) diseases (e.g. promotion of healthy foods, subsidy for providing healthy foods at schools).
15	495	FOOD RETAIL	Implement regulations with regard to improving the food availability in municipalities, for example by providing local governments certain criteria which prohibit the presence of fast food outlets or quick service restaurants or set a maximum number of such food providers ("zoning").
16	527	FOOD PROMOTION	Ban sponsorship by food producers who have unhealthy foods in their product portfolio and ban sponsoring of unhealthy foods in schools, hospitals, company canteens, government-funded institutions, sport canteens (e.g. sponsored soft drinks vending machines in these locations).
17	528	FOOD PRICES	Implement a 'True Pricing' policy, in which, among other things, the health care costs arising from health problems related to the consumption of unhealthy foods, are passed on in the price of these products (making healthy foods cheaper and unhealthy foods more expensive).

18	529	FOOD PROVISION	Facilitate the provision of healthy foods in secondary schools by providing an infrastructure (staffing, logistics, procurement), policies and subsidies for the provision of healthy school meals, a healthy lunch assortment and healthy products in vending machines.
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* The top 5 prioritized actions on equity are marked with an Asterix (*)

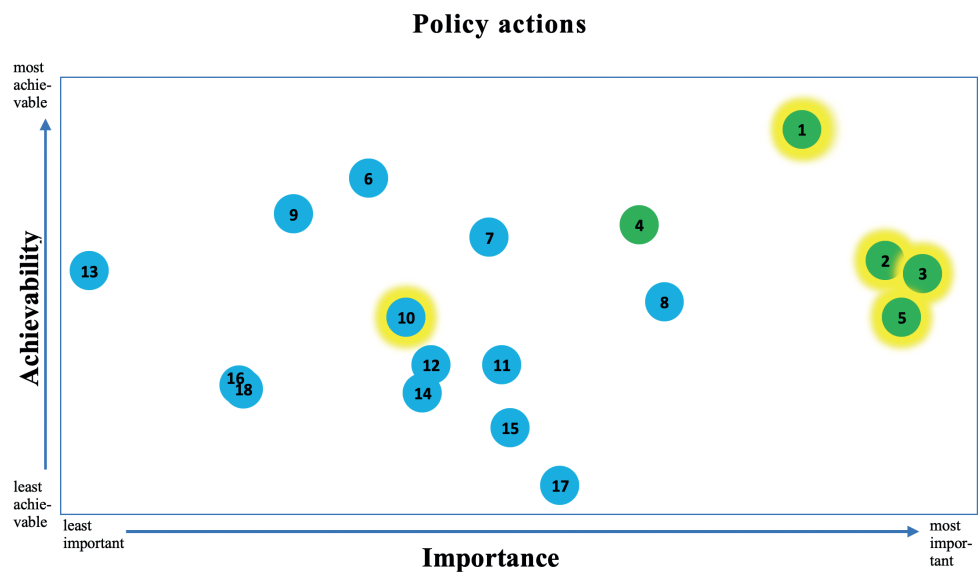


Figure 3. Importance and achievability of recommended policy actions for the Dutch national government and the top 5 actions which have the greatest potential to reduce socioeconomic inequalities in diet*.

*The top 5 priority policy actions on a combination of importance and achievability are shown in green; the five actions which have the greatest potential to reduce socioeconomic inequalities in diet are indicated by the yellow shadow. See Table 1 for a description of the 18 policy actions. (Food-EPI study, the Netherlands, 2019–2020)

Recommended and prioritized infrastructure support actions

The 11 infrastructure support actions recommended by the Food-EPI expert panel are detailed in Table 2. The actions are listed in order of priority considering both importance and achievability. The top 5 prioritized actions were recommended to the government for immediate implementation. Each infrastructure support action is plotted on importance and achievability in Figure 4.

Table 2. Infrastructure support actions, recommended by the Food-EPI expert panel (listed in order of prioritization on a combination of importance and achievability).**(Food-EPI study, the Netherlands, 2019-2020)**

Ranking	Sum score Importance + achievability	Domain	Action
1	135	LEADERSHIP	Develop a government-wide national prevention policy and implementation plan containing universal, selective, indicated and care-related prevention measures, aimed at, among other things, a healthy food consumption and the reduction of diet-related (chronic) diseases among the entire population. Address the physical, socioeconomic and digital living environment so that it contributes to the promotion of health and underlying socioeconomic determinants of unhealthy food consumption (e.g. poverty, stress). Make all ministries co-owners of this policy and encourage the collaboration between the ministries in this field.
2	169	PLATFORMS FOR INTER-ACTION	Support local governments with developing and implementing prevention measures aimed at a healthy food consumption, a healthy food environment and the reduction of diet-related (chronic) diseases.
3	169	MONITORING AND INTELLIGENCE/GOVERNANCE	Develop concrete, measurable targets with regard to prevention measures (preferably integrated in a national prevention policy), aimed at a healthy food consumption, a healthy food environment and the reduction of diet-related (chronic) diseases, which can be tested by an independent organization (RIVM) and make the total overview of the achieved and not achieved results on these targets publicly available.
4	236	FUNDING AND RESOURCES	Increase the budget for universal, selective, indicated and care-related prevention in the national budget, with at least 10% of the health care budget going to prevention in the first four years and gradually reversing the financing pyramid for health care (with the vast majority of it going to prevention instead of curative care).
5	253	MONITORING AND INTELLIGENCE	Develop an instrument for reporting about the food availability in supermarkets, shops, quick service restaurants and catering that shows the share of healthy foods in relation to the total food product range, and make binding agreements with the involved parties (local governments, schools, hospitals, food producers etc.) about monitoring and reporting thereof.
6	262	GOVERNANCE	Ensure transparency about the decision-making of prevention measures (preferably integrated in a national prevention policy) aimed at a healthy food consumption, a healthy food environment and the reduction of diet-related (chronic) diseases, by reporting about the process and taken decisions and making these publicly available.

7	282	FUNDING AND RE-SOURCES	Develop a joint knowledge agenda and a comprehensive research program for institutions and science (National Institute for Public Health and Environment (RIVM), Local Public Health Services (GGD-en), The Netherlands Organisation for Health Research and Development (ZonMw), Dutch Research Council (NWO)), including funding for the evaluation of existing government policies and the development of a new, structural policy, aimed at upstream factors 1) to promote the availability of healthy foods, 2) to reduce overweight, obesity and diet-related diseases and 3) to utilize the health potential.
8	285	GOVERNANCE	Develop a framework with binding agreements about the involvement of and cooperation with non-state actors ¹ in the development and implementation of prevention measures aimed at a healthy food consumption, a healthy food environment and the reduction of diet-related (chronic) diseases, as also described in the WHO Framework of Engagement with Non-State Actors (FENSA) ² .
9	301	HEALTH-IN-ALL-POLICIES	Develop an intersectoral, health policy (health-in-all policies; including a healthier food system) with shared ambitions, concrete targets and multi-year plans and make this legally binding (by mentioning health explicitly in policy programs and integrating health into all ministerial budgets).
10	336	MONITORING AND INTELLIGENCE	Increase the control and enforcement by the Dutch Food and Consumer Food Safety Authority (NVWA) on food labels and health claims in addition to the control and enforcement that currently mainly focuses on allergens and food safety. Perform product measurements as part of this control and enforcement.
11	344	HEALTH-IN-ALL-POLICIES	Develop Health Impact Assessments (HIAs) that pay attention to the health of humans, animals and planet and that create clear frameworks for the various policy areas and sectors about what needs to be evaluated. Make HIA's mandatory in the development of policies (for example in ex ante evaluations and to include health interests in the development of policies) and for sectors (as is done with Environmental Impact Reports).

1 Civil society organizations, private sector, philanthropic foundations and academic organizations.

2 https://www.who.int/about/collaborations/non-state-actors/A69_R10-FENSA-en.pdf?ua=1

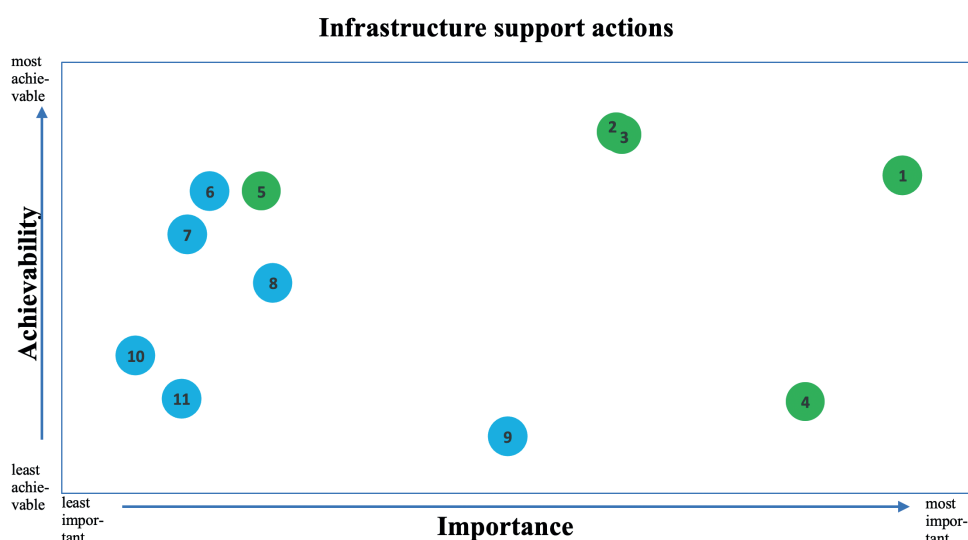


Figure 4. Importance and achievability of recommended infrastructure support actions for the Dutch national government*.

*The top 5 priority infrastructure support actions on a combination of importance and achievability are shown in green. See Table 2 for a description of the 11 infrastructure support actions. (Food-EPI study, the Netherlands, 2019-2020)

DISCUSSION

This study showed that there are several gaps in the implementation of food environment policies and infrastructure support in the Netherlands. Moreover, results indicate that there are relatively more implementation gaps with regard to policies directly influencing food environments (*policy domains*) than with regard to infrastructure support facilitating the development and implementation of policies (*infrastructure support domains*). A total of 18 policy and 11 infrastructure support actions to create healthier food environments in the Netherlands have been identified that can be implemented by the Dutch government.

The outcomes of this Food-EPI study for the Netherlands were in line with international observations. An 11-country Food-EPI comparison study showed that the implementation of infrastructure support was rated higher than the implementation of food environment policies in all countries, except Chile (20). Also in Ireland and Norway, where comparable Food-EPI studies were conducted as part of the Policy Evaluation Network, the implementation of infrastructure support was rated higher than the implementation of the policy indicators (31, 32).

There are a number of possible explanations for the low implementation of policies directly influencing food environments. First, the food industry has a diverse range

of strategies to influence governmental policies, such as lobbying, participation in meetings with governments, and promoting industry-preferred solutions such as education and voluntary initiatives which rely on self-regulation, rather than mandatory governmental regulations (12, 33–37). Second, the influence of these strategies is strengthened by a lack of political will to implement structural, universal, obesity and diet-related chronic diseases prevention measures (37). The WHO indicated that not one single country has managed to turn around the obesity epidemic, because of a failure of political will to take on big business (38). Like the default in many countries (39), voluntary self-regulation is the common approach to improve food availability and promotion in the Netherlands. The past governing coalitions consisted of mainly liberal and confessional parties where self-regulation by the industry has been an important tradition in health policy development and implementation (40). To illustrate, in 2014, the Ministry of Health came to a national agreement with representatives of the food industry to improve product composition (23, 41). Businesses concluded voluntary chain agreements to reduce the content of salt, saturated fat and added sugar in their products (42). There were no incentives from the government if the industry would not meet these agreements (23). More recently (2018), as part of the NPA, the national government installed a committee with 70 organizations that represented a wide variety of stakeholders including associations of health charities, municipalities, primary and secondary education, municipal health services, health professionals, health care insurance companies, but also associations of the food industry, supermarkets, catering companies, and restaurants (43). As part of this committee agreements to reduce overweight prevalence in the Netherlands were brokered (43). This led to an NPA only containing voluntary measures to create healthy food environments (24, 25). According to the National Institute for Public Health and the Environment, with the agreements to improve product composition only small steps are taken (44–46) and the measures in the NPA will only lead to a limited slowdown in the increase in overweight and obesity (47). Indeed, according to literature, improvements of the food environment as a result of voluntary self-regulated approaches by the industry are mostly weak and there is little evidence of their effectiveness in improving population diet and preventing obesity and diet-related chronic diseases (39, 48).

As appears from the recommended and prioritized actions in our study, there is a need for less self-regulation and more ambitious, structural, universal interventions by the Dutch government. This need has also been recognized by the State Secretary for Health in a reaction to our Food-EPI report (49). In the recently published coalition agreement 2021–2025, the new Dutch government announces a few structural and strict measures towards healthier food environments (50). Actions included in this agreement are making *binding* agreements with the food industry about healthier foods, increasing taxes on sugar-sweetened beverages and investigating how to introduce a sugar tax and

lower the current VAT tariff of 9% on vegetables and fruit to 0% (50). Furthermore, the government promises to protect children against inappropriate online promotion and marketing (50). However, it is not specified if this will also include protection against food marketing, which is currently regulated via the Advertising Code for Food products (2019) (51) initiated by the Dutch Food Industry Federation (52, 53).

Like the Netherlands, most European countries currently also have mainly voluntary initiatives (54), but some have already implemented more extensive measures. For example, regarding restricting unhealthy food marketing to children, the UK is considering a total ban on online advertising of foods high in fat, sugar, or salt to children (55). In Portugal, Law 30/2019 restricts unhealthy food advertising directed to children via broad-cast media and digital marketing (56).

Related to price measures, various other European countries have already implemented food-related health taxes, such as the sugar-sweetened beverages taxes in the UK, Ireland, France, Spain, Portugal and the public health product tax in Hungary (57). Also, several European countries apply a lower VAT-tariff on fruit and vegetables than the 9% in the Netherlands, such as the UK and Ireland (0%), Spain and Italy (4%) and Poland and Latvia (5%) (58). Such structural policies more likely result in sustainable food consumption changes of the whole population including vulnerable groups, which could contribute to a reduction in socioeconomic inequalities in diet (8, 59, 60). As the impact of combined interventions is greater than the impact of single interventions, experts in this study emphasized that measures should be part of a comprehensive, population-wide approach to prevent obesity and diet-related chronic diseases (61, 62).

Differently than in other Food-EPI studies, in the PEN Food-EPI's experts were also asked to prioritize the policy actions on equity. Experts in our study indicated that price actions have the greatest potential to reduce socioeconomic inequalities in diet, which was also shown by an umbrella and systematic review (63, 64). However, experts also indicated that food composition and marketing policies could be pro-equity, for which less empirical evidence was found (63, 64).

For this study we also have to consider that the Dutch national government is dependent on EU regulations. A Food-EPI study at EU level was conducted to gain insight into the policies that need to be improved to create healthy food environments in EU Member States (65). Thus, in addition to the actions that the Dutch national government can implement immediately, some actions (e.g., allowing a VAT of 0% on fruit and vegetables which was recently agreed on by the EU finance ministers and on which the European Parliament will be consulted (66)) cannot be implemented without policy changes at

EU level. It is therefore essential that national governments stimulate the EU to remove bottlenecks for creating healthy food environments at national level.

Strengths and limitations

This study has some important strengths. This is the first study in the Netherlands that applied a comprehensive mixed-methods approach in order to generate insight into the largest policy and infrastructure support implementation gaps as well as government actions to improve food environments. Second, policies described in the evidence document were verified by governmental officials and implementation of policies was evaluated by independent experts.

Nevertheless, some limitations should be acknowledged. First, due to the Covid-19 restrictions on travel and meetings, the workshop (step 4) was conducted online with a small group of experts instead of the envisaged face-to-face meeting with the entire expert panel. In addition, we were experiencing drop-out in participation, as a lower number experts participated in the follow-up surveys ($n = 17$, $n = 21$) compared to the first survey ($n = 28$), which showed the limitations of an online procedure. This might have impacted on the results regarding the recommended actions and ranking of the actions that should be considered. However, the diverse range of expertise of experts that did participate in the follow-up surveys, still make the results representative for the Dutch experts in the field of food, nutrition, public health, obesity, and/or diet-related chronic diseases. Moreover, compared to other international Food-EPI studies, the number of experts that participated in our final online prioritization survey ($n = 21$) is in line with other countries (31, 32). Although we used an international standardized framework to assess food environmental policies from a public health perspective, the methodology is susceptible to subjectivity. A final limitation is that the Food-EPI does not identify *why* policies have or have not been successfully implemented (67). Identifying the barriers and facilitators to implementing food environment policies could give important additional insights into how the national government could enable the implementation of these policies (68).

We also have some recommendations for future research. This study constructed scorecards (Figures 1, 2) on the implementation of national government policies, which facilitates monitoring of these policies over time, for example every five years. In the long-term, this study can contribute to a global database for monitoring and evaluating food environment policies. Another recommendation is to identify *why* recommended policies have or have not been successfully implemented, which can support uptake of policies (68). A final recommendation is to compare the study outcomes, with outcomes of the other Food-EPI studies conducted as part of PEN (EU-level, Ireland, Norway,

Poland, Germany) and the H2020 Science and Technology in childhood Obesity Policy (STOP) project (Slovenia, Spain, Portugal, Estonia, Finland).

CONCLUSION

Experts consider the implementation of Dutch government policies directly influencing food environments largely as very low to low, while the implementation of infrastructure support was rated fair to medium. Recommended actions should be implemented by the Dutch government to create healthier food environments in the Netherlands.

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SUPPLEMENTARY MATERIAL
Supplementary file 1

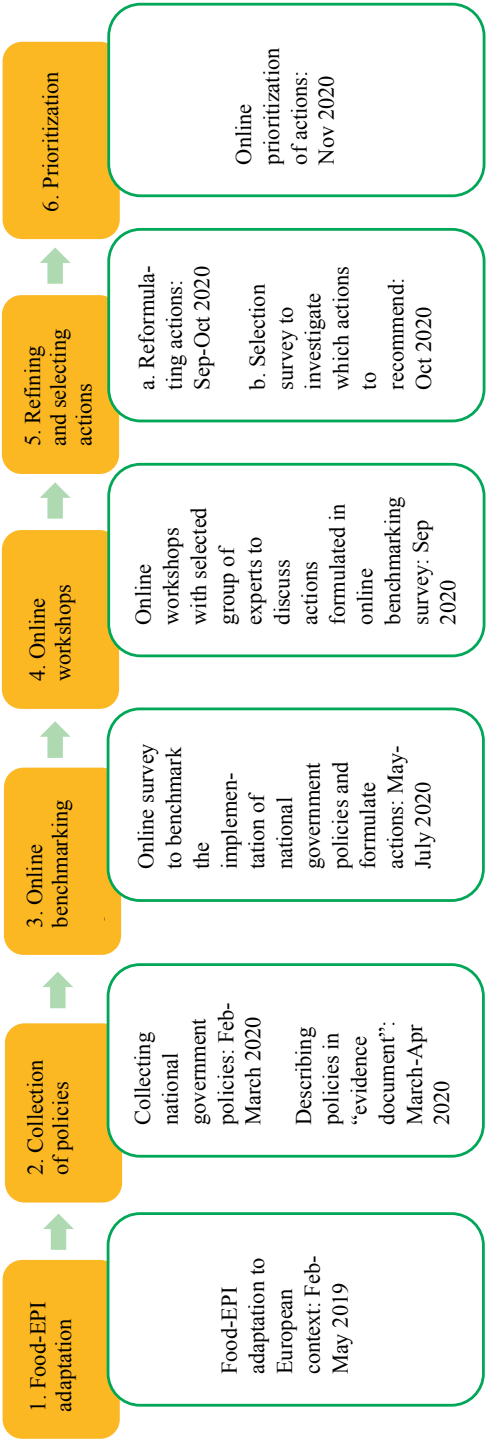


Figure S1. Steps of the Healthy Food Environment Policy Index 2019-2020 applied in this study (2019-2020) benchmarking the implementation of food environment policies and identifying priority actions for the Dutch national government.
[Food-EPI study, the Netherlands, 2019-2020]

Supplementary file 2

This study applied the Healthy Food Environment Policy Index (Food-EPI), a monitoring framework, developed by the International Network for Food and Obesity/Non-communicable Diseases Research, Monitoring and Action Support (INFORMAS).³ The Food-EPI includes seven policy domains that represent key aspects of food environments (food composition, labeling, marketing, provision, retail, prices and trade) that can be influenced by governments to facilitate the accessibility, availability, acceptability and affordability of foods contributing to a healthy diet. In addition, the Food-EPI is comprised of six infrastructure domains (leadership, governance, funding and resources, monitoring and intelligence, platforms for interaction and health-in-all-policies), which are based on the WHO building blocks for health systems, and facilitate policy development and implementation to create healthy food environments (Figure S2).

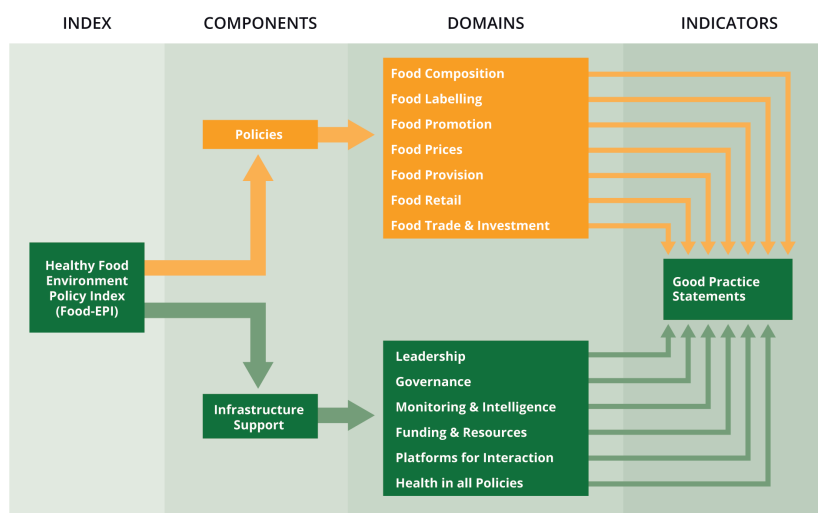


Figure S2. The Healthy Food Environment Policy Index (Food-EPI). Swinburn B, Vandevijvere S, Kraak V, Sacks G, Snowdon W, Hawkes C, et al. (2013). *[Food-EPI study, the Netherlands, 2019-2020]*

There are 50 good practice indicators contained in each of the domains that encompass actions necessary to improve the healthiness of food environments and to help prevent obesity and diet-related NCDs (see Table S1). 46 of these good practice indicators have been included in this Food-EPI study at national government level in the Netherlands (excluded are LABEL1, LABEL2, TRADE1 and TRADE2 as the jurisdiction of these indicators lies at the EU-level).

3 Swinburn B, Vandevijvere S, Kraak V, Sacks G, Snowdon W, Hawkes C, Barquera S, Friel S, Kelly B, Kumanyika S, L'Abbé M, Lee A, Lobstein T, Ma J, Macmullan J, Mohan S, Monteiro C, Neal B, Rayner M, Sanders D, Walker C; INFORMAS. Monitoring and benchmarking government policies and actions to improve the healthiness of food environments: a proposed Government Healthy Food Environment Policy Index. *Obes Rev.* 2013 Oct;14 Suppl 1:24-37. doi: 10.1111/obr.12073. PMID: 24074208.

Table S1. Food-EPI Domains and Indicators. *[Food-EPI study, the Netherlands, 2019-2020]*

Food-EPI Policy Domains	
Food-EPI Domain	Food-EPI Indicators
<p>DOMAIN 1 – FOOD COMPOSITION</p> <p>Food composition targets/standards/restrictions for processed foods:</p> <p>There are government systems implemented to ensure that, where practicable, processed foods minimise the energy density and the nutrients of concern (salt, saturated fat, trans fat, added sugar).</p>	<p>COMP1 Food composition targets/standards/restrictions have been established by the government for the content of the nutrients of concern (trans fats, added sugars, salt, saturated fat) in industrially processed foods, in particular for those food groups that are major contributors to population intakes of those nutrients of concern.</p> <p>COMP2 Food composition targets/standards/restrictions have been established by the government for the content of the nutrients of concern (trans fats, added sugars, salt, saturated fat) in meals sold from food service outlets, in particular for those food groups that are major contributors to population intakes of those nutrients of concern.</p>
<p>DOMAIN 2 – FOOD LABELLING</p> <p>There is a regulatory system implemented by the government for consumer-oriented labelling on food packaging and menu boards in restaurants to enable consumers to easily make informed food choices and to prevent misleading claims.</p>	<p>LABEL1 Ingredient lists and nutrient declarations in line with Codex recommendations are present on the labels of all packaged foods.</p> <p>LABEL2 Evidence-based regulations are in place for approving and/or reviewing claims on foods, so that consumers are protected against unsubstantiated and misleading nutrition and health claims.</p> <p>LABEL3 Evidence-based regulations are in place for approving and/or reviewing claims on foods, so that consumers are protected against unsubstantiated and misleading nutrition and health claims.</p> <p>LABEL4 A simple and clearly-visible system of labelling the menu boards of all quick service restaurants (i.e. fast food chains) is applied by the government, which allows consumers to interpret the nutrient quality and energy content of foods and meals on sale.</p>
<p>DOMAIN 3 – FOOD PROMOTION</p> <p>There is a comprehensive policy implemented by the government to reduce the impact (exposure and power) of promotion of unhealthy foods to children across all media.</p> <ul style="list-style-type: none"> • Exposure of food marketing concerns the reach and frequency of a marketing message. This is dependent upon the media or channels which are used to market foods. • The power of food marketing concerns the creative content of the marketing message. For example, using cartoons or celebrities enhances the power (or persuasiveness) of a marketing message because such strategies are attractive to children. 	<p>PROMO1 Effective policies are implemented by the government to restrict exposure and power of promotion of unhealthy foods to children including adolescents through broadcast media (TV, radio).</p> <p>PROMO2 Effective policies are implemented by the government to restrict exposure and power of promotion of unhealthy foods to children including adolescents through online and social media.</p> <p>PROMO3 Effective policies are implemented by the government to restrict exposure and power of promotion of unhealthy foods to children including adolescents through nonbroadcast media other than packaging and online/social media.</p> <p>PROMO4 Effective policies are implemented by the government to ensure that unhealthy foods are not commercially promoted to children including adolescents in settings where children gather (e.g. preschools, schools, sport and cultural events).</p> <p>PROMO5 Effective policies are implemented by the government to ensure that unhealthy foods are not commercially promoted to children, including adolescents on food packages</p>

DOMAIN 4 – FOOD PRICES

Food pricing policies (e.g., taxes and subsidies) are aligned with health outcomes by helping to make the healthy eating choices the easier, cheaper choices.

PRICES1 Taxes or levies on healthy foods are minimised to encourage healthy food choices (e.g. low or no sales tax, excise, value-added or import duties on fruit and vegetables).

PRICES2 Taxes or levies on unhealthy foods (e.g. sugar-sweetened beverages, foods high in nutrients of concern) are in place and increase the retail prices of these foods by at least 10% to discourage unhealthy food choices, and these taxes are reinvested to improve population health.

PRICES3 The intent of existing subsidies on foods, including infrastructure funding support (e.g. research and development, supporting markets or transport systems), is to favour healthy rather than unhealthy foods.

PRICES4 The government ensures that food-related income support programs are for healthy foods.

DOMAIN 5 – FOOD PROVISION

The government ensures that there are healthy food service policies implemented in government-funded settings to ensure that food provision encourages healthy food choices, and the government actively encourages and supports private companies to implement similar.

PROV1 The government ensures that there are clear, consistent policies (including nutrition standards) implemented in schools and early childhood education services for food service activities (canteens, food at events, fundraising, promotions, vending machines etc.) to provide and promote healthy food choices.

PROV2 The government ensures that there are clear, consistent policies in other public sector settings for food service activities (canteens, food at events, fundraising, promotions, vending machines, etc.) to provide and promote healthy food choices.

PROV3 The government ensures that there are clear, consistent public procurement standards in public sector settings for food service activities to provide and promote healthy food choices.

PROV4 The Government ensures that there are good support and training systems to help schools and other public sector organisations and their caterers meet the healthy food service policies and guidelines

PROV5 The Government actively encourages and supports private companies to provide and promote healthy foods and meals in their workplaces.

DOMAIN 6 – FOOD IN RETAIL

The government has the power to implement policies and programs to support the availability of healthy foods and limit the availability of unhealthy foods in communities (outlet density and locations) and in-store (product placement).

RETAIL1 Zoning laws and policies are implemented to place limits on the density or placement of quick serve restaurants or other outlets selling mainly unhealthy foods in communities and/or access to these outlets (e.g. opening hours).

RETAIL2 Zoning laws and policies are implemented to encourage the availability of outlets selling fresh fruit and vegetables and/or access to these outlets (e.g. opening hours, frequency i.e. for markets).

RETAIL3 The Government ensures existing support systems are in place to encourage food stores to promote the in-store availability of healthy foods and to limit the in-store availability of unhealthy foods.

RETAIL4 The government ensures existing support systems are in place to encourage the promotion and availability of healthy foods in food service outlets and to discourage the promotion and availability of unhealthy foods in food service outlets.

<p>DOMAIN 7 – FOOD TRADE AND INVESTMENT</p> <p>The government ensures that trade and investment agreements protect food sovereignty, favour healthy food environments, are linked with domestic health and agricultural policies in ways that are consistent with health objectives, and do not promote unhealthy food environments.</p>	<p>TRADE1 The Government undertakes risk impact assessments before and during the negotiation of trade and investment agreements, to identify, evaluate and minimize the direct and indirect negative impacts of such agreements on population nutrition and health.</p> <p>TRADE2 The government adopts measures to manage investment and protect their regulatory capacity with respect to public health nutrition.</p>
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Food-EPI Infrastructure Support Domains

Food-EPI Domain	Food-EPI Indicators
<p>DOMAIN 8 – LEADERSHIP</p> <p>The political leadership ensures that there is strong support for the vision, planning, communication, implementation and evaluation of policies and actions to create healthy food environments, improve population nutrition, and reduce diet-related inequalities.</p>	<p>LEAD1 There is strong, visible, political support (at the head of government or state/ministerial level) for improving food environments, population nutrition, diet related NCDs and their related inequalities”</p> <p>LEAD2 Clear population intake targets have been established by the government for the nutrients of concern and/or relevant food groups to meet WHO and national recommended dietary intake levels.</p> <p>LEAD3 Clear, interpretive, evidenced-informed food based dietary guidelines have been established and implemented.</p> <p>LEAD4 There is a comprehensive, transparent, up-to-date implementation plan linked to national needs and priorities, to improve food environments, reduce the intake of the nutrients of concern to meet WHO and national recommended dietary intake levels, and reduce diet-related NCDs.</p> <p>LEAD5 Government priorities have been established to reduce inequalities or protect vulnerable populations in relation to diet, nutrition, obesity and NCDs.</p>
<p>DOMAIN 9 – GOVERNANCE</p> <p>Governments have structures in place to ensure transparency and accountability, and encourage broad community participation and inclusion when formulating and implementing policies and actions to create healthy food environments, improve population nutrition, and reduce diet-related inequalities.</p>	<p>GOVER1 There are procedures in place to restrict commercial influences on the development of policies related to food environments where they have conflicts of interest with improving population nutrition. For example: restricting lobbying influences.</p> <p>GOVER2 Policies and procedures are implemented for using evidence in the development of food and nutrition policies.</p>

	<p>GOVER3 Policies and procedures are implemented for ensuring transparency in the development of food and nutrition policies.</p> <p>GOVER4 The government ensures public access to comprehensive nutrition information and key documents (e.g. budget documents, annual performance reviews and health indicators) for the public.</p>
<p>DOMAIN 10 – MONITORING AND INTELLIGENCE</p> <p>The government's monitoring and intelligence systems (surveillance, evaluation, research and reporting) are comprehensive and regular enough to assess the status of food environments, population nutrition and diet-related NCDs and their inequalities, and to measure progress on achieving the goals of nutrition and health plans.</p>	<p>MONIT1 Monitoring systems, implemented by the government, are in place to regularly monitor food environments (especially for food composition for nutrients of concern, food promotion to children, and nutritional quality of food in schools and other public sector settings), against codes/guidelines/standards/targets.</p> <p>MONIT2 There is regular monitoring of adult and childhood nutrition status and population intakes against specified intake targets or recommended daily intake levels.</p> <p>MONIT3 There is regular monitoring of adult and childhood overweight and obesity prevalence using anthropometric measurements.</p> <p>MONIT4 There is regular monitoring of the prevalence of NCD metabolic risk factors and occurrence.</p> <p>MONIT5 Major programs and policies are regularly evaluated to assess their effectiveness and contributions to achieving the goals of the nutrition and health plans.</p> <p>MONIT6 Progress towards reducing health inequalities or health impacts in vulnerable populations and social and economic determinants of health are regularly monitored.</p>
<p>DOMAIN 11 – FUNDING AND RESOURCES</p> <p>Sufficient funding is invested in 'Population Nutrition Promotion' (estimated from the investments in population promotion of healthy eating and healthy food environments for the prevention of obesity and diet-related NCDs, excluding all one-on-one promotion (primary-care, antenatal services, maternal and child nursing services etc.), food safety, micronutrient deficiencies (e.g. folate fortification and undernutrition)) to create healthy food environments, improved population nutrition, reductions in obesity, diet-related NCDs and their related inequalities.</p>	<p>FUND1 The 'population nutrition' budget, as a proportion of total health spending and/or in relation to the diet-related NCD burden sufficiently contributes to reducing diet-related NCD's.</p> <p>FUND2 Government funded research is targeted for improving food environments, reducing obesity, NCDs and their related inequalities.</p> <p>FUND3 There is a statutory health promotion agency in place that includes an objective to improve population nutrition with a secure funding stream.</p>

DOMAIN 12 – PLATFORMS AND INTERACTION

There are coordination platforms and opportunities for synergies across government departments, levels of government, and other sectors (NGOs, private sector, and academia) such that policies and actions in food and nutrition are coherent, efficient and effective in improving food environments, population nutrition, diet-related NCDs and their related inequalities.

PLAT1 There are robust coordination mechanisms across departments and levels of government (national, state and local) to ensure policy coherence, alignment, and integration of food, obesity and diet-related NCD prevention policies across governments.

PLAT2 There are formal platforms (with clearly defined mandates, roles and structures) for regular interactions between government and the commercial food sector on the implementation of healthy food policies and other related strategies.

PLAT3 There are formal platforms (with clearly defined mandates, roles and structures) for regular interactions between government and civil society on the development, implementation and evaluation of healthy food policies and other related strategies.

PLAT4 The governments work with a system-based approach with (local and national) organisations/partners/groups to improve the healthiness of food environments at a national level.

DOMAIN 13 – HEALTH IN ALL POLICIES

Processes are in place to ensure policy coherence and alignment, and that population health impacts are explicitly considered in the development of government policies.

HIAP1 There are processes in place to ensure that population nutrition, health outcomes and reducing health inequalities or health impacts in vulnerable populations are considered and prioritised in the development of all government policies relating to food.

HIAP2 There are processes e.g. Health Impact Assessment's (HIAs) to assess and consider health impacts during the development of other non-food policies.

Supplementary file 3. Guidance given to experts to determine the level of implementation of policies and infrastructure support

[Food-EPI study, the Netherlands, 2019-2020]

Introduction to the Food-EPI

The Food Environment Policy Index (Food-EPI) is developed by the International Network for Food and Obesity / Non-communicable Diseases Research, Monitoring and Action Support (INFORMAS) (<https://www.informas.org/modules/public-sector/>). The Food-EPI is a tool to assess to what extent government policies and actions for creating healthy food environments have been put forward. The Food-EPI consist of two components: a 'policy' component with seven domains on specific aspects of food environments and an 'infrastructure support' component with six domains to strengthen systems to prevent obesity and diet-related NCDs (see Figure S2). The 13 domains include 47 good practice indicators.

For each of the 47 Food-EPI indicators, evidence for the existence of national policies in the Netherlands has been extracted from policy documents by the research team. Policies at the national level with a potential influence on the food environment in the Netherlands have been outlined in the "evidence document" under the heading of each of the 47 Food-EPI indicators (see the attachment to the e-mail). This evidence document has been verified by governmental officials.

Instructions for rating

You are invited to participate in the Dutch Food-EPI 2020 expert panel. This will involve rating the current level of government policies impacting on the Dutch food environment for 47 good practice indicators, against international best practice, on a Likert scale from 1 to 5.

The meaning of the Likert scale is:

1. 0-20% implemented compared to international best practice
2. 20-40% implemented compared to international best practice
3. 40-60% implemented compared to international best practice
4. 60-80% implemented compared to international best practice
5. 80-100% implemented compared to international best practice

In rating the degree of implementation of current national policies/actions it is important to assess how these improve the healthiness of food environments. You may think of the following questions:

- What is the scope of the policy/action?
- Which settings, food groups, population groups are included?
- Which type(s) of policy instruments has/have been implemented?
- Are the policies/actions voluntary, mandatory or co-regulatory?
- Do they use a strict nutrient profile model to define unhealthy foods?

There is also a 'cannot rate' option, but please only use this if really needed and provide comments in the comment box on why you cannot rate for a particular good practice indicator.

The Food-EPI evidence document gives you the full details of the current evidence of implementation by the national government in the Netherlands for each good practice indicator. A summary of the evidence and the international best practice examples (benchmarks) are available within this online questionnaire used for the rating process. **It is important to read the evidence of implementation and international best practice exemplars (benchmarks) before putting in your rating for each good practice indicator.**

At the end of each domain we will ask you if you think the government should take more action on one of the indicators in the specific domain. This gives you the opportunity to define specific actions for the government, which will be used to come to a final set of defined and prioritized policy actions for the government.

The survey will save your ratings automatically online so that you can come back to where you left at a later stage. To send in your final ratings, please click on the right arrow at the bottom of the last page of the survey.

Supplementary file 4. Prioritization criteria for policy and infrastructure support actions

[Food-EPI study, the Netherlands, 2019-2020]

Importance	Achievability	Equity
Need The size of the implementation gap	Feasibility How easy or hard the action is to implement	Socio-economic effect Progressive/regressive effects on reducing food/diet-related inequalities
Impact The effectiveness of the action on improving food environments and diets (including reach and effect size)	Acceptability The level of support from key stakeholders including government, the public, public health and industry	Structures vs. Individuals Extent to which a given policy requires environmental change rather than individual choices
Other positive effects (e.g. on protecting rights of children and consumers)	Affordability The cost of implementing the action	
Other negative effects (e.g. regressive effects on household income, infringement of personal liberties).	Efficiency The cost-effectiveness of the action	

Supplementary file 5: Expert panel

[Food-EPI study, the Netherlands, 2019-2020]

Stakeholder Group	Expertise	Participants approached (n=52)	Participants declined (n=24)	Online benchmarking survey (n=28)	Selection survey (n=17)	Prioritization survey (n=21)
Academia	Academics in the field of obesity prevention, nutrition and health, food and health policies, medical science, political science, behavioural science (n=12)	20	No response=3 No time= 2 Conflicts of interest= 1 Not sufficient knowledge= 2	12	8	10
Health organizations/ health professional associations	Representatives of non-government health professional associations and health organizations in the field of nutrition and health promotion, diet-related chronic diseases (n=6)	19	No response=6 No time=5 Not sufficient knowledge= 2	6	5	5
Non-governmental organizations (NGOs)	Representatives of non-profit organizations in the field of nutrition, health and policies (n=4)	7	No response=3	4	3	3
Local governments	Representatives of local governments in the Netherlands (n=6)	6		6	1	3

The image features a large, stylized number '4' in a dark teal color, centered on a white background. The background is composed of several large, overlapping geometric shapes in shades of light blue and grey, creating a modern, abstract design. The number '4' is rendered in a clean, sans-serif font with a slight shadow effect, giving it a three-dimensional appearance as if it's floating or attached to the surface.

4

How theory can help to understand the potential impact of food environment policies on socioeconomic inequalities in diet: an application of Bourdieu's capital theory and the scarcity theory

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ABSTRACT

Government policies that promote healthy food environments are considered promising to reduce socioeconomic inequalities in diet. Empirical evidence of effects on these inequalities, however, is relatively scarce and, with a few exceptions, tends to be inconclusive. We use two contemporary theories that help to understand socioeconomic inequalities in health and health-related behaviors (Bourdieu's capital theory and Mullainathan and Shafir's scarcity theory) to reason how policies influencing food environments may differentially impact lower and higher socioeconomic groups. In essence, these theories enable us to understand how specific elements of broader daily living conditions (e.g. social practices that lead to habitus formation, material conditions that shape experiences of scarcity) may lead to a greater benefit of certain food environment policies for the healthfulness of diets of lower or higher socioeconomic groups. We conclude that the application of theories on the mechanisms underlying socioeconomic inequalities in health can help to guide future empirical studies in testing theory-based hypotheses on differential effects of policies, and thereby enhance the development of effective policies tackling socioeconomic inequalities in dietary intake.

Introduction

Socioeconomic inequalities in diet are observed across the world and in many European countries (1,2). Overall, lower socioeconomic groups report less healthy dietary intakes than higher socioeconomic groups (e.g. lower fruit and vegetable consumption, higher intake of energy-dense foods) (1), which contributes to higher prevalence rates of obesity and diet-related chronic diseases³ among lower socioeconomic groups (4). Increasing patterns of inequalities in dietary intake over the past decades have coincided with large and detrimental changes in the food environment (4). Food environments are defined as the collective physical, economic, policy, sociocultural and commercial surroundings, opportunities and conditions that influence people's food and beverage choices and nutritional status (5). An easy availability and prominent marketing of cheap, ultra-processed, energy-dense and nutrient-poor food products, currently characterize food environments of high-income countries and increasingly those of middle-income countries as well (6). As a result, diets have become less healthy in most regions of the world (4), and apparently more in lower than higher socioeconomic groups (1,2).

Government policies that lead to healthier food environments are considered promising to reduce socioeconomic inequalities in diet (7). Such policies are specified in the Healthy Food-Environment Policy Index (Food-EPI), which was developed based on high level international recommendations and expert consultations (7). The Food-EPI specifies important policy domains and good practice indicators via which governments can improve the healthfulness of food environments, e.g. by regulating the availability, accessibility and quality of foods in shops, schools, workplaces; or by price reductions of healthy foods (5,7). The seven policy domains included in the Food-EPI are food composition, food labeling, food promotion, food prices, food provision, food in retail, and food trade and investment (7).

Food-EPI related governmental policies are mainly universal by nature; whole populations, rather than specific parts of populations, are exposed to their implementation. Universal interventions that make changes to the structural environment (e.g. food marketing policies) are considered more likely to reduce health inequalities than individual-level interventions (e.g. health mass media campaigns) (8–10). However, empirical evidence on the differential impact of food environment policies for lower and higher socioeconomic population groups is scarce (10,11). A recent umbrella review showed that most research on this has been done regarding food price policies, i.e. economic measures to incentivize healthy or disincentivize unhealthy food purchases (11). The review concluded that taxation of unhealthy foods and beverages, and food-related income support programs for lower socioeconomic groups, may reduce socioeconomic inequalities in diet (11). Here, the underlying mechanism explaining the

differential impact seems rather straightforward: lower socioeconomic groups often have less income and a smaller budget to spend on foods than higher socioeconomic groups. Therefore, lower socioeconomic groups are likely more susceptible to policies that increase the price of unhealthy foods, or financial support that increases their budget to spend on healthy foods. However, for other food environmental policies, evidence is scarce and potential underlying mechanisms are less clear.

Lower and higher socioeconomic groups not only differ in the healthfulness of their dietary intakes, but also in the material and sociocultural circumstances in which they are born, grow up, work and age, i.e. their daily living conditions (e.g. income, housing, wealth) (12). We argue that an application of theories explaining socioeconomic inequalities in health—which specify the role of specific elements in these daily living conditions—may help to increase our understanding via which underlying mechanisms food environment policies differentially affect lower and higher socioeconomic groups. Applying these theories is likely to provide better insights into the ultimate causes of socioeconomic inequalities in diet, and how these may affect the impact of food environment policies. While the recently published Nutrition Equity Framework also explicitly incorporates the idea of capitals and intergenerational equity shaping daily living conditions and influencing dietary intakes (12), most theories for explaining healthy dietary intakes have mainly focused on the more proximal determinants of food choices, such as knowledge, attitudes and self-efficacy towards healthy food consumption (as specified in health behavior theories like the Theory of Planned Behavior).

To illustrate our point, we considered two theories that can be applied to explain socioeconomic inequalities in health which have gained momentum over recent years and are particularly helpful to understand inequalities in ‘health-behaviors’ (including broader lifestyle behaviors) (13–20): Bourdieu’s capital theory and Mullainathan and Shafir’s scarcity theory. We first shortly introduce the capital theory, and then apply this theory by means of illustration, to one Food-EPI domain, namely food promotion policies. We then introduce the scarcity theory and apply it by means of illustration, to another Food-EPI domain, namely food labeling policies. We conclude with implications for research and practice.

Bourdieu’s capital theory and the concept of habitus and distinction

According to Bourdieu, capital is accumulated labor (in materialized or embodied forms) that enables individuals to maintain and enhance their position in the social world (13,21). Bourdieu distinguishes three forms of capital: economic, social and

cultural capital (13,21). Economic capital refers to material resources, i.e. money and other assets such as property rights (13). Social capital refers to the idea that social networks are a potential resource for individuals, communities and society (18). Cultural capital refers to the operational skills, linguistic styles, values and norms that one acquires through education and lifelong socialization (22). Cultural capital comes in three forms: incorporated cultural capital (e.g. norms, values, knowledge), objectified cultural capital (e.g. books, tools) and institutionalized cultural capital (e.g. educational degrees) (22). Incorporated cultural capital, e.g. 'long-lasting dispositions of the mind and the body', includes (health) values, norms, perceptions, skills, and knowledge acquired through a lifelong socialization process (21,23). Via socialization, these norms, values, preferences and habits become internalized as part of a broader 'habitus' (21), which is another important concept of Bourdieu's capital theory and plays an important role in the establishment of lifestyles (15,23). This 'habitus' can be understood as an embodied arrangement of social structures that predisposes an individual to certain actions (24) in accordance with the social context in which it is produced (19). Habitus expresses itself in all domains of life: in aesthetic preferences, cultural practices, as well as choices related to health behavior and lifestyles (14). According to Bourdieu, members of the same social groups often share a similar position in social space with an affinity in lifestyles between them, which may become part of an identity and is used as a 'distinction mechanism', reflecting differences between social groups (21). Recent studies have provided evidence that higher socioeconomic groups may indeed be more likely to adopt a healthy lifestyle as an expression of 'social distinction', which includes a healthy consumption pattern (e.g. eating recommended levels of fruit and vegetables everyday) (16,25). Importantly however, the impact of the habitus on broader lifestyles, which may for instance lead to socioeconomic differences in types of media used (26), may also be an important mechanism through which socioeconomic groups are differentially exposed to (online) food environments (e.g. advertising for fast-food).

Bourdieu and policies restricting unhealthy food marketing

'Food promotion' is one of the policy domains in the Food-EPI framework and concerns policies that restrict or ban the promotion of unhealthy foods to children and adolescents through broadcast media (television, radio), social and online media, and non-broadcast media (e.g. sport and cultural events, magazines) (7). Such policies are important for the healthy dietary intakes of children and adolescents, as studies have shown that marketing of unhealthy foods encourages purchase requests of children and adolescents towards unhealthy foods (27), leading to a higher consumption of unhealthy foods (e.g. sweet and salty snacks, fast-foods) and a lower consumption of healthy foods (e.g. fruit and vegetables) (27).

A digital divide, in which those with more economic capital had more access to new forms of media, has now been replaced by a media-dominated society to which both higher and lower socioeconomic groups are exposed. Food environments are also rapidly digitalizing and digital food marketing has become widespread using a range of techniques (e.g. advergames, harvesting personal data from digital platforms, online brand consumer engagement) (28). From the perspective of Bourdieu, television and internet use for leisure purposes 'trickled down' as cultural goods, and now contribute to the formation of cultural capital. Indeed, 'not watching broadcast television' or 'watching specific programs or channels' might be seen as a way to create distinction. Similarly, people can distinguish themselves via the use of non-broadcast media such as reading specific magazines or attending certain events (e.g. sports, cultural events). Media exposure increasingly can be seen a 'classifying practice' (29), in which persons occupying different positions in the space of social positions, select and use media differently.

Thus, differences in cultural capital between higher and lower socioeconomic groups may lead to different food and media preferences. This information is used by the industry for tailor-made food marketing strategies (including when, where and which foods are advertised) (30), leading to a higher exposure of lower socioeconomic groups to unhealthy food marketing (31). Moreover, exposure to (digital) food marketing may subsequently contribute to the habitus by influencing food choices, preferences and consumption (27) leading to a reinforcing feedback mechanism. This illustrates that different elements of the living conditions (e.g. social practices, habitus, media use, exposure to food marketing, food consumption) are interconnected, and that changes in one element affect other parts of the system via operating feedback loops, resulting in certain dietary behaviors of lower and higher socioeconomic groups (32).

Thus, food promotion policies that restrict or ban the promotion of unhealthy foods may protect children and adolescents across all population groups. Moreover, these policies can limit the potential of marketing to be a classifying practice and contribute to breaking the vicious circle described above. This is because, as a result of differences in elements of their living conditions (e.g. social practices, habitus, media use) lower socioeconomic groups may have a higher exposure to unhealthy food marketing than higher socioeconomic groups which in turn influences food preferences. Therefore, policies banning the promotion of all unhealthy foods or targeting foods or media for which especially lower socioeconomic groups have a preference, may especially protect these groups and eventually lead to a reduction of socioeconomic inequalities in dietary intake.

The scarcity theory

According to the scarcity theory, the scarcity mindset entails a feeling of not having enough of something, e.g. money or time (33). The feeling of scarcity comes from having limited resources in terms of money or time, but also from the subjective perception of what matters (e.g. how important a certain purchase is, or which tasks really need to be accomplished within a certain time frame). Scarcity can capture the mind and change how people think (33), it may lead to less 'cognitive bandwidth' resulting in a neglect of other concerns that may feel less urgent. Unfavorable daily living conditions (e.g. financial debts, deprived housing conditions, social problems) are more prevalent in lower socioeconomic groups, leading to a higher prevalence of scarcity in lower as compared to higher socioeconomic groups (17). The stress resulting from the experience of scarcity can lead to losing the capacity to give long term goals, such as optimal health, their full consideration, as the mind is fully occupied with more urgent concerns (34). Empirical evidence shows that experiencing scarcity for a longer period of time (at least two years) increases the consumption of discretionary calories (including those from industrially processed foods high in sodium, added sugar or saturated fat) and reduces the consumption of fruit and vegetables (17).

Scarcity and food labeling policies

The Food-EPI domain of food labeling concerns policies that require food producers to put nutrient information, ingredient lists or front-of-pack labels (like the traffic-light system) on packaged foods. Such information is thought to help consumers to be better able to make informed, healthy food choices, and therefore may promote healthier dietary intakes (35). However, such information has found to be less used by people with a lower than people with a higher socioeconomic position (36) (although evidence is inconclusive (37)). The scarcity theory can provide insights into potential underlying mechanisms for these socioeconomic inequalities in the use of nutrient information and front-of-pack labels.

Since the lists and declarations on food products are often not easy to read or understand, one needs to deliberately dedicate time and cognitive energy to read the labels, process its information, compare it to the nutrient information on alternative food products, and finally make an informed choice on which products to buy. Individual agency thus plays a large role for these policies to have a positive effect on the healthfulness of diets (8). This agency for making such informed choices may be constrained by scarcity especially experienced by members of lower socioeconomic groups, as their minds are occupied with urgent concerns related to their less favorable daily living conditions (e.g. financial debts, deprived housing conditions). Less cognitive bandwidth is then

available for pondering over healthy and unhealthy food choices, and for dedicating precious time and energy for processing nutrient information to be used for deliberate healthy choices.

Clearly, front-of-pack labels may be easier to read and understand than classical lists and declarations (38), but they still require individual agency to deliberately read these labels and choose to buy healthier foods and not buy unhealthy foods. For instance, parents with a lower socioeconomic position may deliberately choose to buy unhealthy foods to compensate for other domains of scarcity, thereby satisfying their children's requests for the unhealthy foods they like, and bolstering their sense of worth as caregivers (25). In addition, people experiencing scarcity may not want to waste time and resources buying and preparing healthy foods that their children will not eat, and thus choose for unhealthy foods satisfying children's likes and dislikes (39).

Thus, it is likely that socioeconomic differences in daily living conditions that lead to higher levels of experienced scarcity in lower socioeconomic groups may result in food labeling policies having more beneficial effects on the diets of higher than lower socioeconomic groups, and therefore may lead to a widening of dietary inequalities.

Conclusions

In this paper, we showed how two theories that have been increasingly used over the past years for explaining socioeconomic inequalities in health also can help to understand how food environment policies may impact lower and higher socioeconomic groups differently. Some of these food environment policies are so called 'agento-structural' policies. These require at least a certain amount of individual agency to result in a positive effect on the healthfulness of diets (8), and therefore could unintentionally increase socioeconomic inequalities in healthy food consumption. We reasoned that, due to generally less favorable daily living conditions of lower socioeconomic groups (e.g. higher levels of financial scarcity), individual agency to make healthy food choices is constrained. As a result, diets of lower socioeconomic groups less likely benefit from 'agento-structural' food environmental policies (like food labeling) than higher socioeconomic groups, and thus lead to a widening of inequalities. Other, more 'structural' type of food environment policies require little agency of individuals and lead to an improvement of the unfavorable food environmental features to which lower socioeconomic groups are more often exposed (8). These structural policies are more likely to decrease socioeconomic inequalities in healthy food consumption. For instance, we reasoned that, due to specific elements in daily living conditions (e.g. social practices, habitus, media use), lower socioeconomic groups may have a higher exposure to unhealthy food marketing which in turn influences food preferences. As a result,

policies restricting the promotion of unhealthy food products and with that limiting the potential of marketing to be a classifying practice, can be especially beneficial for lower socioeconomic groups.

Some limitations of our approach and reasoning should be acknowledged. In our illustration, we applied one theory to one food environment policy domain, and described potential mechanisms according to that specific theory. Certainly, this is an oversimplification of reality as food environment policies do not happen in a vacuum. In real life, also other factors than these theory-specific factors are at play, and multiple (food environment) policies may interact with each other in their effect on diet and health. In order to take into account the complexities of real life in the best possible way, the application of a systems perspective to account for the most important factors involved in the explanation of inequalities in dietary intake—as well as how these factors interact—is extremely important (32). Further, applying different theories for explaining health inequalities, may emphasize other underlying mechanisms on how food environment policies may contribute to a reduction or increase in socioeconomic inequalities in diet. For instance, the scarcity theory may emphasize more the less favorable daily living conditions of lower socioeconomic groups (e.g. higher levels of financial scarcity), while Bourdieu's capital theory emphasizes specific elements in daily living conditions of both lower as well as higher socioeconomic groups (e.g. social practices, habitus). The results of different studies, applying different health inequality-theories, testing different hypotheses will only strengthen the evidence base and lead to richer insights in the most promising food environment policies for reducing dietary inequalities. The application of theories that explicitly take into account the daily living conditions of different socioeconomic groups can have important implications for future research and practice:

- i. Theories used for explaining health inequalities can help to formulate innovative, theory-based hypotheses on the differential impact of food environment policies that could be tested in future research (e.g. studies on how front-of-pack labeling differentially impacts lower and higher socioeconomic groups with different exposures to scarcity).
- ii. Hypotheses on the impact of food environment policies on diets, based on theories that take elements of broader daily living conditions into account (e.g. the social practices that lead to habitus formation, the material conditions that shape experiences of scarcity) may potentially be more capable of forecasting their potential modest impacts.
- iii. To reduce dietary inequalities, food environment policies tackling proximal determinants of dietary behavior (e.g. knowledge on food ingredients) should be aligned and combined with other policies, tackling more distal determinants

of unhealthy diets (e.g. financial debts, deprived housing conditions, media exposure, social problems). As only then their effects are reinforced, and only then considerable decreases in inequalities may be expected.

- iv. To account for all the determinants involved in the numerous underlying mechanisms between socioeconomic position and dietary intakes—including food environment exposures, living conditions and individual-level factors—the application of a systems perspective (a system of multiple, interconnected factors exerting non-linear influence on dietary intakes), can enhance the development of effective policies tackling socioeconomic inequalities in dietary intake (32).

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5

Do financial constraints and perceived stress modify the effects of food tax schemes on food purchases: moderation analyses in a virtual supermarket experiment

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ABSTRACT

Objective

To investigate whether financial constraints and perceived stress modify the effects of food-related taxes on the healthiness of food purchases.

Design

A moderation analysis was conducted with data from a trial where participants were randomly exposed to: (i) control, (ii) SSBs tax or (iii) nutrient profiling tax condition. Outcome measures were: (i) overall healthiness of food purchases (%), (ii) energy content (kcal) and (iii) SSB purchases (liters). Effect modification was analyzed by adding interaction terms between the conditions and self-reported financial constraints or perceived stress in linear and ordinal regression models. Outcomes for each combination of condition and level of effect modifier were visualized.

Setting

Virtual supermarket.

Participants

Dutch adults (n = 386).

Results

Experiencing financial constraints or perceived stress did not significantly modify the effects of an SSBs tax or nutrient profiling tax on the outcome measures. The visualizations suggest that in the control condition, the overall healthiness of food purchases was lowest and SSB purchases were highest among those with moderate/high levels of financial constraint. Compared to the control condition, in a nutrient profiling tax condition the overall healthiness of food purchases was higher and SSB purchases were lower, especially among those with moderate/high levels of financial constraint. Such patterns were not observed for perceived stress.

Conclusion

Financial constraints and perceived stress did not significantly modify the effects of food-related taxes on the healthiness of food purchases. Further studies with larger samples are recommended to assess whether food-related taxes differentially affect food purchases of subgroups.

INTRODUCTION

Substantial socioeconomic inequalities in obesity, other diet-related chronic diseases and dietary intake exist, with higher prevalence rates of disease and unhealthier dietary patterns among people with a lower socioeconomic position (1, 2). Governmental food environment policies targeting the entire population, like sugar-sweetened beverage taxes (SSBs taxes), are promising strategies to reduce obesity, diet-related chronic diseases and related inequalities in health and dietary intake (1, 3). Such policies can be beneficial for overall population health, as these require little individual agency for behavioral change by creating an environment which stimulates healthy behavior and discourages unhealthy behavior (3).

Several European countries have already implemented SSBs taxes, including Belgium, Finland, France, Hungary, Ireland, Latvia, Norway, Portugal, the UK, Poland, and Spain (4). Evidence from countries in which an SSBs tax has been implemented shows a decrease in SSB consumption (5), or a lowering of sugar levels in SSB by producers (to avoid taxation) (6). Taxation of a wide range of unhealthy foods and beverages instead of only SSBs seems to have even more beneficial effects on diet quality and health (7, 8).

Some studies have shown that taxation may be more beneficial for dietary intakes of lower than higher socioeconomic groups (9, 10), although the evidence is inconclusive (8, 11). However, studies also reported concerns about the regressive burden of food-related taxes, because unhealthy food consumption is associated with lower socioeconomic status (12) and living on a small budget is more prevalent among lower socioeconomic groups, which makes the impact of these taxes larger for these groups (13, 14). To offset the regressive burden of food-related taxes, and to prevent other potential unintended effects (e.g. increasing financial stress), combining taxation of unhealthy foods with price reductions of healthy foods, such as fruit and vegetables, may help (14, 15).

Potential mechanisms for the different socioeconomic effects of taxation might be related to the different material (e.g. income, housing) and psychosocial circumstances (e.g. social support) in which lower and higher socioeconomic groups are born, grow up, work and age (i.e. daily living conditions) (16, 17). Unfavorable daily living conditions (e.g. low income, unemployment) to which lower socioeconomic groups are more often exposed than higher socioeconomic groups, can lead to experiencing financial constraints (18). This in turn may adversely influence healthy dietary behaviors (16, 18), as it is quite hard to eat a healthy and varied diet on a limited budget (19). Indeed, studies have shown that experiencing financial constraints combined with the higher

costs of healthy diets negatively influences people's food choices and, with that, dietary quality (20, 21).

Unfavorable daily living conditions may also cause stress and worries, e.g. about inadequate housing conditions, potential job loss (16, 22). Further, less resources may be available to effectively cope with stressors (e.g. less social support, lower sense of control), which may make that demands quicker exceed the available resources, leading to higher levels of perceived stress (23). Perceived stress may lead to unhealthier dietary behaviors as, explained in the scarcity theory, the energy and mental capacities needed to deal with stress leave less 'cognitive bandwidth' available to deal with other issues, like deliberately making healthy food choices (24, 25). Also, consuming unhealthy foods (e.g. snacking) can be used as a strategy to cope with perceived stress (16, 26, 27).

Based on these reasonings, we arrive at two contrary hypotheses on how food-related taxes can have differential effects on people experiencing different levels of financial constraint and perceived stress. On the one hand, higher levels of financial constraint may make people more likely to pay close attention to prices of food products, prioritizing low-cost in food choices (20). Indeed, studies have shown that low-income households are more price sensitive and as result are more likely to reduce their consumption in response to food-related taxes (28). Thus, we hypothesize that people experiencing financial constraints are more likely to act upon price increases of unhealthy foods as a result of food taxation, and therefore more likely reduce unhealthy food consumption compared to people with no financial constraints. On the other hand, higher levels of perceived stress may lead to less cognitive bandwidth available for making deliberate food choices taking price increases into account (24, 25), especially of foods that are perceived as needed in order to cope with stress (e.g. SSBs, snacks) (26, 27). Therefore, we hypothesize that people experiencing higher levels of perceived stress (are) less likely (able to) act upon price increases of unhealthy foods when food taxation is introduced, and therefore less likely reduce unhealthy food consumption compared to people with no perceived stress.

In a randomized controlled trial (RCT) in a virtual supermarket setting, we found that an SSBs tax and nutrient profiling tax were effective in decreasing SSB purchases (8). The nutrient profiling tax also increased the overall healthiness of food purchases, and decreased the energy content (8). The effects of an SSBs tax and nutrient profiling tax on food purchases did not significantly differ across individuals with different educational levels (8). The data collected with this RCT offer a unique opportunity to further explore two concrete, potential factors that may influence food purchases, and could modify the effects of food-related taxes on the healthfulness of food purchases: financial constraints and perceived stress (29). Thus, by a moderation analysis of the RCT data,

we aimed to investigate whether experiencing financial constraints or perceived stress modifies the effects of an SSBs tax and a nutrient profiling tax on the healthfulness of food purchases.

METHODS

This study is a moderation analysis of an RCT that investigated the effects of an SSBs tax and nutrient profiling tax on food purchases in a virtual supermarket setting (8). More details about the methods, e.g. the recruitment of participants and procedures of the study can be found elsewhere (8).

Setting: The virtual supermarket

Data were collected in a Dutch virtual supermarket (30). A total of 580 food products were available in the Dutch virtual supermarket, including 119 types of non-alcoholic beverages. The Dutch Food Composition Database (NEVO) (online version 2019) (31) was used to update the information on the nutritional composition of the products. Nutri-Scores were calculated using a calculation tool of the French National Public Health Agency (32).

Study design: a randomized controlled trial

Participants were randomly assigned to one of the following conditions in the virtual supermarket: (i) a control condition (ii) an experimental condition with a two-tiered SSBs tax, or (iii) an experimental condition with a nutrient profiling tax:

- *Control condition (no tax).* In the control condition, regular prices were used. In the Netherlands, regular food prices include a value-added tax rate of 9% that applies to all food and beverage products (33). Moreover, a consumption tax of €0.0883 per liter applies to fruit and vegetable juices, soft drinks and mineral water, with no distinction between SSB and sugar-free beverages (e.g. water or non-caloric sweetened beverages) (34).
- *SSBs tax condition.* In this condition, prices of SSBs were taxed on a scheme similar to the UK Soft Drinks Industry Levy, where beverages containing 5 to 8 grams of sugar per 100 milliliters are taxed €0.21 per liter and beverages containing 8 grams or more sugar per 100 milliliters are taxed €0.28 per liter (4). The levy does not apply to milk-based beverages, milk replacement beverages, alcohol replacement beverages and fruit juices without added sugar (4). In the virtual supermarket, the SSBs tax rate corresponded to an average price increase of 22 percent for beverages liable for the levy. In total, 34 beverage products (6 percent of the stock of the virtual supermarket) were taxed.

- *Nutrient profiling tax condition.* In this condition, taxation of energy-dense, nutrient-poor foods and beverages was based on the Nutri-score. The Nutri-score is a nutrition label which presents the overall diet quality of foods and beverages on a five-point color-coded scale from dark green ("A") to red ("E") using the British Food Standards Agency nutrient profiling system (35). In this study, food and beverages with a label "D" or "E" were classified as "unhealthy (i.e. not contributing to a healthy diet)" and taxed at a 20 percent level. In total, 225 foods and beverages (39 percent of the stock of the virtual supermarket) were taxed in this condition including 34 SSBs.

To reflect a realistic situation in which the taxes were introduced (36), participants in the experimental conditions were informed about the taxation before entering the virtual supermarket. Participants in the control condition did not receive such a notification.

Recruitment of participants

Participants were recruited on the basis of the following inclusion criteria: (i) being 18 years or older, (ii) being familiar with the Dutch language, (iii) being largely/totally responsible for grocery shopping in their household, and (iv) having access to a laptop or computer. Overall, 404 participants completed their shop in the virtual supermarket.

Ethics of human subject participation: The study was conducted according to the guidelines laid down in the Declaration of Helsinki. The trial protocol was evaluated by the Research Ethics Review Committee of the Faculty of Sciences, Vrije Universiteit Amsterdam. The trial protocol was registered in the Netherlands Trial Register (NTR) (registration number NL8616). All participants provided informed consent.

Procedures

Participants were instructed to conduct a weekly grocery shop for their household (i.e. to buy the food and beverages they and the other members of their household need for a week) in the virtual supermarket. Participants were allocated a household-specific shopping budget, based on their household size and composition, according to the National Institute for Family Finance Information (37). When finished shopping, participants had to fill in an online closing questionnaire, to report on demographic characteristics (e.g. age, sex) and their living conditions (e.g. financial constraints, experienced stress).

Measures

Three outcome measures were calculated based on the food and beverages participants had put in their shopping trolley during the shopping task in the virtual supermarket: 1) **overall healthiness of the total weekly food shopping basket** which was calculated as the % of food items with a Nutri-Score label "A", "B" or "C" of the total weekly food

shopping basket), 2) **energy (kcal) content of the total weekly food shopping basket** and 3) **SSB purchases in liters in the total weekly food shopping basket**. The overall healthiness and energy content of the total weekly food shopping basket followed a normal distribution. Because a large proportion of the participants did not purchase any SSBs, SSB purchases were transformed into an ordinal variable, with the following categories: "0 liters" (reference category), "0-0.74 liters", "0.75-1.49 liters", "1.5-2.99 liters", "3-5.99 liters" and "6 liters or more".

Effect modifiers

Financial constraints

One item was included in the survey: "In the last 12 months, did you have difficulties making ends meet on your household income?" with answering options on a four-point Likert scale: 1 "No, no difficulties at all", 2 "No, no difficulties, but I have to pay attention to my expenses", 3 "Yes, some difficulties", and 4 "Yes, many difficulties". These last two categories were combined into one category "Yes, some or many difficulties", because only a very small amount/percentage of the participants (15 out of the 394 included participants; 3.8%) indicated to have many difficulties to make ends meet on their household income. This variable thus identifies three categories of financial constraint: 1 "no financial constraints" (no difficulties at all), 2 "low level of financial constraint" (having to pay attention to expenses)" and 3 "moderate/high level of financial constraint" (some or many difficulties)". For the analyses, these categories were dummy coded, with "no financial constraints" as the reference category.

Perceived stress

We used the four-item perceived stress scale developed by Cohen (38) to assess the degree to which people feel that the demands in their lives exceed their abilities to cope effectively with these demands. Participants were asked four questions: (1) "In the past four weeks, how often have you felt that you were unable to control important things in your life?"; (2) "In the past four weeks, how often have you felt confident about your ability to handle personal problems?"; (3) "In the past four weeks, how often have you felt that things were going your way?" and (4) "In the past four weeks, how often have you felt difficulties were piling up so high that you could not overcome them?". Answers to each of these questions could be indicated on a five-point Likert scale ranging from 1 "always" to 5 "never". The items (1) and (4) were reverse coded, and based on the four items (Cronbach's alpha's 0.73), a mean score was calculated (38), resulting in a continuous score that ranged from one to five, with higher scores representing higher perceived stress. In addition, the continuous variable perceived stress was mean centered by deducting the mean from the original variable.

Covariates

The following socio-demographic characteristics were included as covariates in the analyses: household size, sex, educational level, and BMI. Household size was measured by summing up the number of people of different age categories (0-3 years; 4-8 years; 9-13 years; 14 years or older) living in households as reported by the participants. For sex, participants reported if they are 'female' or 'male'. Nine levels of education were distinguished: from 1 "no education", 2 "lower education (primary school, special primary school)", 3 "primary or pre-vocational education", 4 "general secondary education", 5 "secondary vocational education and apprenticeship training", 6 "higher general secondary education and pre-university education (class 1-3)", 7 "higher general secondary education and pre-university education (class 4-6)", 8 "higher professional education", and 9 "university education". For the analyses, these educational levels were collapsed into three categories: 1 "low educational level" (answers: 1-4, and 6), 2 "moderate educational level" (answers: 5 and 7), and 3 "high educational level" (answer 8 and 9) (39), which were dummy coded, with "low educational level" as the reference category. BMI was calculated using self-reported weight and height by participants (kg/m^2). A BMI of <25 was considered a healthy weight, a BMI of $25 \leq 30$ as overweight, and a BMI of ≥ 30 as obese (40). The continuous covariate household size was centered around the median and the continuous covariate BMI was centered around the mean by deducting the median or mean from the original variable.

Statistical analyses

Participants with extreme outliers (more than $3 \times \text{IQR}$ below Q1 or above Q3) in any of the outcomes were excluded from all analyses ($n=2$). Moreover, participants who purchased only ≤ 5 different products in the virtual supermarket were excluded from the analyses ($n=8$), as this was considered implausible for a weekly grocery shop. Furthermore, we checked on missing values for self-reported financial constraints, perceived stress, and the covariates (household size, sex, educational level, BMI). For BMI we identified 8 missing cases. Therefore, the final sample of our study included 386 participants. Descriptive statistics were reported using numbers, percentages, means and standard deviations (SD), or medians and interquartile ranges (IQR) in case there was no normal distribution.

For the healthiness and energy content of food purchases, linear regression analyses were used to investigate whether effects of the SSBs tax and nutrient profiling tax were different for individuals experiencing high or low levels of financial constraint or perceived stress. For SSB purchases ordinal regression analysis was used.

We used the fully adjusted models as starting point of our analysis (8). Separate models were ran for each of the two effect modifiers (financial constraints and perceived stress) and for each of the three outcomes (overall healthiness, energy content, SSB purchases).

We decided a priori to test for effect modification as well as visualize the outcomes for each combination of condition and level of effect modifier, regardless of the statistical significance of the overall interaction term, since the sample size was relatively small and not powered for testing effect modification of our two potential modifiers. We first tested main effects, by adding experimental conditions and the effect modifier to the adjusted model (i.e. with covariates household size, sex, educational level, BMI). Subsequently, effect modification was tested by adding the interaction terms between the conditions and the effect modifier to this model. We used the Generalized Linear Model function for the analysis of the overall interactions between the condition and the effect modifier on the three outcome measures and based assessment of significant interactions on the Wald Chi Square test. We also assessed the separate interaction terms between the experimental conditions and three levels of financial constraint and between the experimental conditions and perceived stress for the three outcome measures, using linear regression models for the healthiness and energy content of food purchases and ordinal regression models for SSB purchases. All statistical tests were two-sided. For each model, the effect sizes with corresponding 95% confidence interval (CI), and p-values were computed. As the sample was relatively small and not powered on stratification, a significance level of $p < 0.10$ was chosen for effect modification (41, 42). Statistical analyses were performed using the software IBM SPSS Statistics 26.0. We also visualized the outcomes for each combination of condition and effect modifier, by summing up the constant value, effect of the condition and effect modifier, and the statistical interaction effect. For perceived stress we used the standard deviation (-0,7 SD, Mean=0, +0,7 SD) in the regression analyses. To visualize the outcomes for SSB purchases, we used the regression coefficients (B) for the calculations, and converted the final outcomes to OR's again.

RESULTS

Participants

A slight majority of the participants was female (54.4%), mean aged 48.4 years (SD 15.7) with a mean BMI of 26.7 (kg/m²) (SD 5.8) (Table 1). The mean household size was 2.3 persons (median 2). 64 participants had a low educational level (16.6%) and 80 (20.7%) participants experienced a moderate/high level of financial constraint (Table 1). Participants had on average a score of 2.1 (SD 0.7) on the 5 point perceived stress scale, indicating almost never experiencing stress (Table 1).

Participants bought on average 71.5% healthy foods, 32,080 kilocalories and 1.0 liters (median) of SSBs in their total weekly shopping basket (Table 1). Less than half of the participants (44.3%) purchased no SSBs, and 7.5% of the participants purchased 6 liters of SSBs or more (Table 1). In Supplementary file 1 more details can be found on the characteristics of the participants, their perceived stress, experienced financial constraints and consumer food purchases.

Table 1. Descriptive statistics of the study participants, the potential modifying variables and consumer food purchases in the virtual supermarket.

	Total (n 386)		Control condition (n 151)		SSBs tax condition (n 126)		Nutrient profiling tax condition (n 109)	
	n or mean	% or SD	n or mean	% or SD	n or mean	% or SD	n or mean	% or SD
Age (years), mean and SD	48.4	15.7	48.5	16.3	48.6	15.3	48.2	15.5
Sex, n and %								
Female	210	54.4	78	51.7	77	61.1	55	50.5
Male	176	45.6	73	48.3	49	38.9	54	49.5
Educational level, n and %								
Low	64	16.6	20	13.2	19	15.1	25	22.9
Moderate	141	36.5	44	29.1	56	44.4	41	37.6
High	181	46.9	87	57.6	51	40.5	43	39.4
BMI (kg/m ²), mean and SD	26.7	5.8	27.5	6.0	26.5	5.7	26.0	5.4
Weight status, n and %								
Healthy weight (BMI <25)	178	46.1	65	43.0	61	48.4	52	47.7
Overweight (BMI 25≤30)	128	33.2	49	32.5	38	30.2	41	37.6
Obese (BMI ≥30)	80	20.7	37	24.5	27	21.4	16	14.7
Household size, mean and SD	2.3	1.2	2.3	1.2	2.4	1.3	2.4	1.2
Household composition, mean and SD								
% of household 14 years or older	91.7	17.9	91.4	18.6	91.2	18.3	92.7	16.6
Potential modifying variables								
STRESS								
Perceived stress ^a , mean and SD	2.1	0.7	2.1	0.7	2.2	0.8	2.1	0.8
FINANCIAL CONSTRAINTS								
Financial constraints ^b , n and %								
No financial constraints	159	41.2	61	40.4	59	46.8	39	35.8
Low level of financial constraint	147	38.1	58	38.4	42	33.3	47	43.1
Moderate/high level of financial constraint	80	20.7	32	21.2	25	19.8	23	21.1
Consumer food purchases								
SSB (litres), median and IQR	1.0	3.0	1.5	3.0	0.8	3.0	0.8	2.4
SSB, n and %								
0 litres	171	44.3	58	38.4	60	47.6	53	48.6
0.75-1.5 litres	29	7.5	10	6.6	9	7.1	10	9.2
1.5-3 litres	83	21.5	39	25.8	23	18.3	21	19.3
3-6 litres	74	19.2	30	19.9	26	20.6	18	16.5
6 litres or more	29	7.5	14	9.3	8	6.3	7	6.4

Proportion healthy (%), mean and SD	71.5	10.9	70.8	10.2	71.6	11.1	72.4	11.6
Total energy (kcal), mean and SD	32,080	17,074	32,422	16,540	32,926	18,665	30,630	15,905

^aMeasured by four items: (1) "In the last four weeks, how often have you felt that you were unable to control the important things in your life?"; (2) "In the last four weeks, how often have you felt confident about your ability to handle your personal problems?"; (3) "In the last four weeks, how often have you felt that things were going your way?" and (4) "In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?", indicated on a five-point Likert scale from 1 "always" to 5 "never". The items (1) and (4) were reverse coded, and based on the four items, a mean score was calculated, resulting in a total continuous score that ranged from one to five, with higher scores representing higher experienced stress.

^bMeasured by one item "In the last 12 months, did you have difficulties making end meets on your household income?" indicated on a four-point Likert scale: 1 "No, no difficulties at all", 2 "No, no difficulties, but I have to pay attention to my expenses", 3 "Yes, a bit difficult, and 4 "Yes, very difficult". These last two categories were recoded into one category, resulting in 3 levels of financial constraint: 1 "No financial constraints", 2 "Low level of financial constraint" and 3 "Moderate/high level of financial constraint".

Effect modification

Overall, we did not find statistically significant interactions between experiencing financial constraints and the experimental conditions for any of the three outcomes (overall healthiness of food purchases, Wald $X^2=4,54$, $P=0,34$; energy content, Wald $X^2=3,05$, $P=0,55$; SSB purchases, Wald $X^2=3,30$, $P=0,51$) (Model 2), nor between perceived stress and the experimental conditions for any of the outcomes (healthy food purchases, Wald $X^2=0,10$, $P=0,95$; energy content, Wald $X^2=0,70$, $P=0,71$; SSB purchases, Wald $X^2=0,07$, $P=0,97$) (Model 4). Further, no statistically significant interaction terms were found for the different combinations between the levels of financial constraint and the separate experimental conditions (Table 2). Similarly, there were no statistically significant interaction terms between perceived stress and the separate experimental conditions (Table 3).

The percentage of healthy food purchases, energy content, and likelihood of being in a lower-level of SSB purchases have been visualized for each combination of level of financial constraint and condition in Figure 1. In this figure we observed differential patterns on the percentage of healthy food purchases and the likelihood of being in a lower-level category of SSB purchases for people experiencing different levels of financial constraint. So can be observed that in the control condition, the percentage of healthy food purchases and the likelihood of being in a lower-level category of SSB purchases is lower among people experiencing low or moderate/high levels of financial constraint compared to people experiencing no financial constraints. Compared to the control condition, the percentage of healthy food purchases and the likelihood of being in a lower-level category of SSB purchases is higher in the nutrient profiling tax condition, especially among people with moderate to high levels of financial constraint. Also, we observe a higher percentage of healthy food purchases and a higher likelihood of being in a lower-level category of SSB purchases among people experiencing moderate/high levels of financial constraint compared to people experiencing no financial constraints in the nutrient profiling condition. For the SSBs tax we observe similar patterns among

people experiencing low levels of financial constraint, although effects are smaller than in the nutrient profiling tax condition in the highest financial constraint group. We did not observe any differential patterns for the third outcome (energy content of food purchases) (Figure 1). For perceived stress we observed a higher percentage of healthy food purchases, a higher likelihood of being in a lower-level category of SSB purchases and less energy content among all subgroups in the nutrient profiling tax condition as well as the SSBs tax condition compared to the control condition. However, we did not observe any differential effects of these taxes, but similar patterns on food purchases for people with lower and higher levels of perceived stress (Figure 2).

Table 2. Effects of the experimental conditions, financial constraints and the experimental conditions*financial constraints on the three outcomes: the overall healthiness and energy content of the total weekly food shopping basket (linear regression analyses), and the likelihood of being in a lower level category of sugar-sweetened beverage purchases (ordinal regression analyses).

Overall healthiness (proportion healthy (%))										Energy content (kcal)			Likelihood of being in lower-level category of SSB purchases							
Model 1a ¹			Model 2a ²			Model 1b ¹			Model 2b ²			Model 1c ¹			Model 2c ²					
B	95% CI	P	B	95% CI	P	B	95% CI	P	B	95% CI	P	OR	95% CI	P	B	OR	95% CI	P		
Constant/ Threshold values	62.86	58.33; 67.39	<0.001	64.23	59.40; 69.05	<0.001	28540.92	23181.50; 33900.34	<0.001	27986.74	22267.22; 33706.25	<0.001	2.31 (0.75-1.49)	1.24; 4.33	0.009	0.76 (0.75-1.49)	2.13 (0.75-1.49)	1.08; 4.21	0.030	
												1.64 (1.52-2.99)	0.88; 3.07	0.120	0.41 (1.52-2.99)	1.51 (1.52-2.99)	0.77; 2.98	0.234		
												0.56 (3-5.9)	0.30; 1.04	0.070	-0.67 (3-5.9)	0.51 (3-5.9)	0.26; 1.01	0.055		
												0.11 (≥ 6)	0.05; 0.21	<0.001	-2.33 (≥ 6)	0.10 (≥ 6)	0.05; 0.20	<0.001		
Control condition	Reference			Reference			Reference			Reference			Reference			Reference				
SSB tax condition	1.26	-1.27; 3.80	0.328	-1.10	-4.88; 2.68	0.567	-1350.36	-4347.25; 1646.53	0.376	630.94	-3853.28; 5115.15	0.782	1.62	1.16; 3.02	0.037	0.33	1.39	0.71; 2.74	0.342	
Nutrient profiling condition	2.74	0.10; 5.38	0.042	0.11	-4.15; 4.37	0.960	-3396.59	-6517.77; -275.40	0.033	-3055.41	-8103.04; 1992.22	0.235	1.87	1.03; 2.55	0.010	0.41	1.51	0.71; 3.22	0.288	
No financial constraints	Reference			Reference			Reference			Reference			Reference			Reference				
Low level of financial constraint	-0.78	-3.16; 1.59	0.517	-3.28	-7.07; 0.50	0.088	2215.77	-591.34; 5022.87	0.121	4507.75	25.24; 8990.26	0.049	1.04	0.68; 1.60	0.856	-0.13	0.88	0.45; 1.71	0.700	
Moderate/ high level of financial constraint	-1.83	-4.68; 1.03	0.209	-4.56	-9.08; -0.05	0.047	-371.04	-3744.84; 3002.76	0.829	-578.40	-5927.80; 4771.00	0.832	1.02	0.62; 1.70	0.929	-0.19	0.83	0.38; 1.82	0.635	
Control condition x no financial constraints	Reference			Reference			Reference			Reference			Reference			Reference				

Overall healthiness (proportion healthy (%))										Energy content (kcal)					Likelihood of being in lower-level category of SSB purchases														
Model 1a ¹					Model 2a ²					Model 1b ¹					Model 2b ²					Model 1c ¹					Model 2c ²				
B	95% CI	P	B	95% CI	P	B	95% CI	P	B	95% CI	P	B	95% CI	P	OR	95% CI	P	B	95% CI	P	OR	95% CI	P						
Low level of financial constraint*	-	-	3.67	-2.20; 9.54	0.220	-	-	-	-	-	-	-2201.76	-9160.36; 4756.84	0.534	-	-	-	0.15	1.16	0.40, 0.787	1.16	0.40, 0.787	3.31						
Nutrient-profiling tax condition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Moderate/high level of financial constraint*	-	-	5.69	-1.36; 12.74	0.113	-	-	-	-	-	-	2088.50	-6266.77; 10443.76	0.623	-	-	-	0.85	2.33	0.62, 0.205	2.33	0.62, 0.205	8.63						
Nutrient-profiling tax condition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Low level of financial constraint	-	-	4.60	-1.04; 10.24	0.110	-	-	-	-	-	-	-5124.00	-11808.01; 1560.01	0.133	-	-	-	0.45	1.57	0.56, 0.387	1.57	0.56, 0.387	4.39						
condition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Moderate/high level of financial constraint	-	-	3.43	-3.24; 10.09	0.313	-	-	-	-	-	-	-1045.59	-8948.22; 6857.04	0.795	-	-	-	-0.02	0.98	0.30, 0.977	0.98	0.30, 0.977	3.18						
condition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						

¹ Main effects of experimental conditions and financial constraints, controlled/adjusted for household size, sex (**male** is reference), educational level (**low educational level** is reference), BMI.

² Effects of experimental conditions (in the group with no financial constraints), and effects of financial constraints (in the control condition), controlled/adjusted for household size, sex (**male** is reference), educational level (**low educational level** is reference), BMI, with interaction terms between the experimental conditions and financial constraints.

¹ Main effects of experimental conditions and financial constraints, controlled/adjusted for household size, sex (**male** is reference), educational level (**low educational level** is reference), BMI.

² Effects of experimental conditions (in the group with no financial constraints), and effects of financial constraints (in the control condition), controlled/adjusted for household size, sex (**male** is reference), educational level (**low educational level** is reference), BMI, with interaction terms between the experimental conditions and financial constraints.

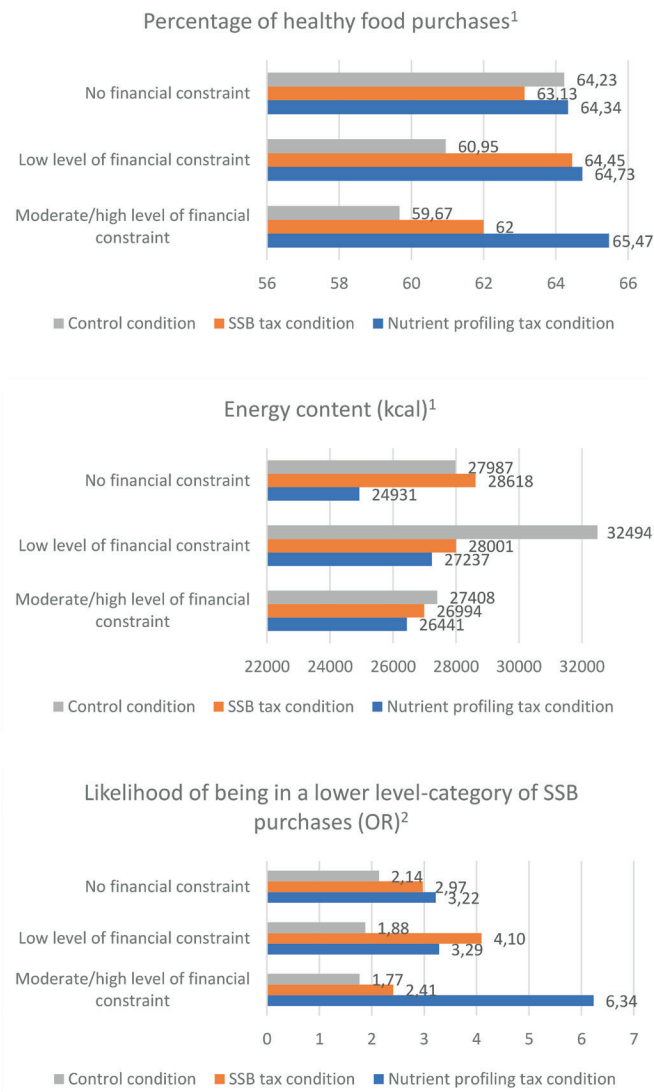
Table 3. Effects of the experimental conditions, perceived stress and the experimental conditions*perceived stress on the three outcomes: the overall healthiness and energy content of the total weekly food shopping basket (linear regression analyses) and on the likelihood of being in a lower level category of sugar-sweetened beverage purchases using ordinal regression analyses (ordinal regression analyses).

	Overall healthiness (Proportion healthy (%))					Energy content (kcal)					Being in a lower-level category of SSB purchases				
	Model 3a ¹					Model 3b ¹					Model 3c ¹				
	B	95% CI	P	B	95% CI	P	B	95% CI	P	OR	95% CI	P	B	95% CI	P
Constant/ Threshold values	61.98 57.62; 66.35	<0.001		62.02 57.64; 66.41	<0.001		29279.12 24085.58; 34472.67	95% CI 24085.58; 34472.67	<0.001		29401.22 24189.80; 34612.65	<0.001	0.88 0.75-1.09 1.49	1.34; 4.35	0.003
Control condition	Reference			Reference			Reference			Reference			0.54 (1.5-2.99)	0.95; 3.07	0.074
SSBs tax	1.37	-1.15;	0.285	1.71	-6.11;	0.667	-1438.77	-4433.07;	0.345		-374.33	0.937	1.65	0.45	1.56
condition	3.89	3.89		9.54	9.54		22449.23	22449.23			8922.69	2.59	0.57 (3-5.9)	0.32; 1.03	0.064
Nutrient	2.73	0.10;	0.042	1.95	-5.91;	0.626	-3288.30	-6412.35;	0.039		-5836.42	0.219	1.86	0.74	2.11
profiling	5.36	5.36		9.80	9.80		-164.25	-164.25			3492.09	2.30	0.11 (2-6)	0.06; 0.21	<0.001
tax	Reference			Reference			Reference			Reference			Reference		
condition x perceived stress	-1.20	-2.60;	0.095	-1.26	-3.68;	0.305	-870.44	-2536.82;	0.305		-1099.29	0.452	0.75	-0.28	0.76
Perceived	0.21	0.21		1.16	1.16		795.94	795.94			1772.98	0.97	0.59;	0.50; 1.16	0.200
Control	Reference			Reference			Reference			Reference			Reference		
condition x perceived stress	-	-		0.36	-3.08,	0.835	-	-	-		1186.84	0.568	-	-0.06	0.95
Perceived	3.81	3.81		3.81	3.81		5273.95	5273.95			5273.95		-	0.51, 1.74	0.856
stress *															
Nutrient															
profiling															
tax															
condition															
Perceived	-	-		-0.16	-3.59,	0.928	-	-	-		-493.40	0.812	-	0.02	1.02
stress *	3.27	3.27		3.27	3.27		3581.27	3581.27			3581.27		-	0.56, 1.87	0.938
SSBs tax															
condition															

¹ Main effects of experimental conditions and perceived stress, controlled/adjusted for household size, sex (**male** is reference), educational level (**low educational level** is reference), BMI.

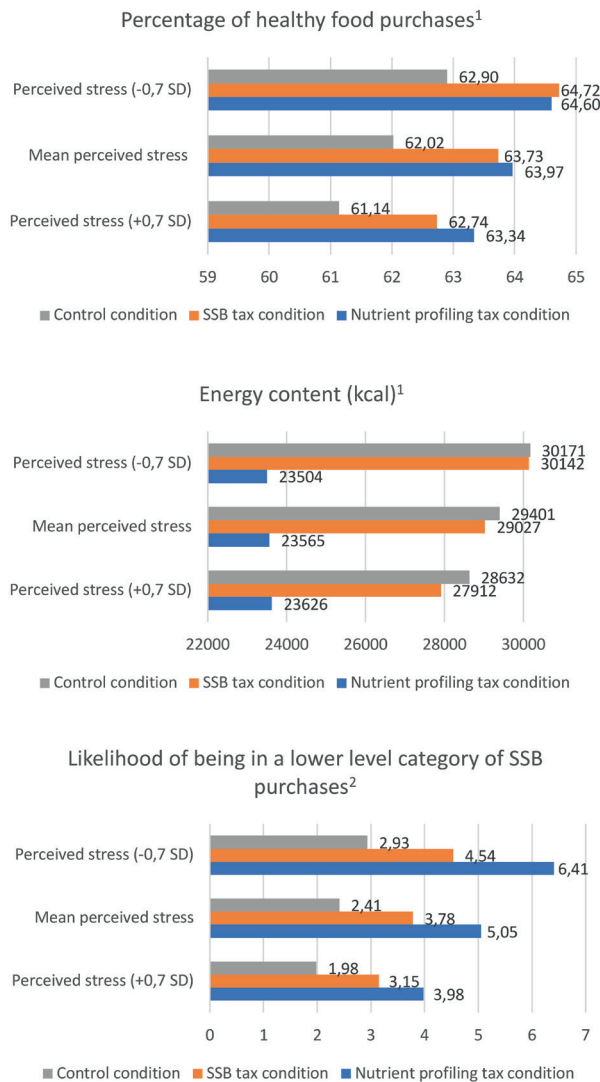
² Effects of experimental conditions (in the group with no financial constraints), and perceived stress (in the control condition), controlled/adjusted for household size, sex (**male** is reference), educational level (**low educational level** is reference), BMI, with interaction terms between the experimental conditions and perceived stress.

Figure 1. The percentage of healthy food purchases, energy content, and likelihood of being in a lower level of SSB purchases visualized for each combination of level of financial constraint and condition, for men, with a low educational level, median household size, and mean BMI.



- 1. Calculated by summing up the constant value (B), effect of the condition, effect of the level of financial constraint, and the interaction term of condition*level of financial constraint.
- 2. Calculated by summing up the constant value (B), effect of the condition, effect of the level of financial constraint, and the interaction term of condition*level of financial constraint. Final outcomes were converted to OR's again. Calculations in this figure are based on the constant value (B) of the category 0.75- 1.49 litres SSB purchases.

Figure 2. The percentage of healthy food purchases, energy content, and likelihood of being in a lower level of SSB purchases visualized for each combination of perceived stress (-0,7 SD, Mean=0, +0,7 SD) and condition, for men, with a low educational level, median household size, and mean BMI.



1. Calculated by summing up the constant value (B), effect of the condition, effect of perceived stress, and the interaction term of condition*perceived stress.

2. Calculated by summing up the constant value (B), effect of the condition, effect of perceived stress, and the interaction term of condition*perceived stress. Final outcomes were converted to OR's again. Calculations in this figure are based on the constant value (B) of the category 0.75- 1.49 litres SSB purchases.

* For perceived stress we used the standard deviation (-0,7 SD, Mean=0, +0,7 SD) in the regression analyses.

DISCUSSION

We did not find evidence for a modifying role of financial constraints or perceived stress on the effect of any of the experimental conditions on the healthfulness of food purchases. Therefore, the results did not confirm our hypotheses that people experiencing financial constraints are more likely to act upon price increases of unhealthy foods as a result of food-related taxes, nor that people experiencing higher levels of perceived stress are less likely to act upon price increases as a result of food-related taxes compared to people with no financial constraints or perceived stress.

We did not come across other studies which investigated the modifying effect of experiencing financial constraints or perceived stress on the relation between food-related taxes and food purchases. However, several studies showed that price increases and taxes on specific (e.g. sugar-sweetened beverages, high energy-dense) foods have a greater impact on people with a lower socioeconomic position (9), as they are more price-sensitive and as a result reduce purchases of these foods more than people with a higher socioeconomic position (9, 43, 44). This is also in line with findings of a qualitative study in the Netherlands, in which stakeholders of various organizations (e.g. health professional and health consumer organizations, academia, trade associations, ministries, parliamentary parties) expected an SSBs tax to have a financially regressive effect, but would therefore also have the potential to especially reduce the SSB consumption among people with lower incomes (15), which could reduce income inequalities in diet and health. However, another study found that the effects of a 25% price increase on unhealthy products alone on the percentage of healthy food purchases were not modified by income level, but that if these price changes were also communicated and combined with nudging strategies, there was a small significant increase in healthy food purchases in low income groups, while for high income participants no statistically significant increase was found (11).

That we found no statistical evidence for a modifying role of financial constraints or perceived stress on the effect of any of the experimental conditions on the healthfulness of food purchases might be explained by a lack of power in our study sample to detect statistical interactions. A total of 81 study participants experienced a moderate/high level of financial constraint and the mean score on perceived stress in this study was 2.1, which is corresponding with the answer category 'almost never' perceiving stress. It might be that this sample included relatively few people experiencing higher levels of stress compared to people experiencing no perceived stress, also because the odds of participating in an experiment may be higher for those not experiencing stress (25). Although often a sample is not powered for a secondary analysis into effect modification (like in our case), it is still important to carry out such theory-based, modification

analyses in order to gain insight in potentially differential effects of interventions among population subgroups and thereby uncover potential pro-equity effects of interventions (45).

However, based on the visualizations of the effects of financial constraints and the conditions on the overall healthiness of food purchases and SSB purchases, we did make some noteworthy observations. These observations suggest that in a situation without taxes, people experiencing moderate to high levels financial constraint, purchase less healthy food purchases compared to people experiencing no financial constraints. The observations also suggest that compared to the control condition, in a nutrient profiling tax condition the overall healthiness of food purchases was higher and SSB purchases were lower especially among people experiencing moderate/high levels of financial constraint, more than among people with no financial constraints, which would be in line with our first hypothesis. We did not find the same pattern for the third outcome, nor did we find clear differential patterns between those with lower or higher levels of perceived stress for any of the three outcomes. Further research is needed to investigate whether effects of food taxation are more pronounced among those experiencing higher levels of financial constraint or perceived stress.

Strengths and limitations

An important strength of this study is that this is, as far as we are aware, the first study that investigated the modifying effects of experiencing financial constraints and perceived stress on the effects of food-related taxes on food purchases. Another strength is that next to the effects of an SSBs tax, this study also included the taxation of a wider range of unhealthy foods by using the nutrient profiling tax, which even seem to have more beneficial effects on overall diet quality and health (7, 8). The main limitation, as discussed earlier, is the small sample and the lack of statistical power to conduct the moderation analyses. Another limitation is the use of a virtual supermarket that is not identical to a real-life supermarket (29). For instance, participants do not spend real money and the allocated shopping budget was based on household composition and size but not on actual income levels, which may have influenced their shopping behavior, especially of participants experiencing financial constraints, by paying less attention to prices than they do in real life. Although studies have shown that in general shopping patterns in a virtual supermarket resemble those in real life (11), it is unknown how shopping patterns would differ for subgroups experiencing different levels of financial constraint or perceived stress. Also, in this study experiencing financial constraints and perceived stress were only weakly correlated ($r=0.30$) [data not reported], but from the literature it appears that they can mutually reinforce each other; perceived stress can increase the risk of experiencing poverty (e.g. through reduced productivity, stigma related to mental health), and experiencing financial constraints may affect an

individual's exposure to stress and stressful life events as well as someone's ability to cope with stress (22, 27). Furthermore, limitations might be that financial constraints were measured by one time and that different time periods were taken into account for measuring financial constraints (12 months) and perceived stress (1 month). However, the Perceived Stress Scale is one of the most widely disseminated methods of assessing psychological stress and the four item Perceived Stress Scale has also proven to be a useful instrument for assessing stress perception levels in the general population in different countries (46).

Implications for practice and suggestions for future research

We believe there are reasons warranting further investigations to assess whether food-related taxes differentially affect subgroups with different material and psychosocial circumstances, such as financial constraints and perceived stress. This is especially relevant in current insecure times with high inflation rates and high energy prices (47), with as a result an increasing number of people having difficulties making ends meet and experiencing stress. Studies could assess whether the overall health benefits of food-related taxes will exceed the financially regressive effects of taxation (14), or which other potential negative side effects could be caused by taxation (e.g. financial stress). We recommend using hypotheses in these studies based on theories that take elements of broader daily living conditions into account, as dietary and health inequalities are caused by a complex set of interrelated factors (e.g. food environment exposures, living conditions, individual-level factors) (17, 48).

These studies could be used to strengthen the evidence base and inform policy-makers on how to effectively implement food-related taxes, aiming to improve population diet in general but also specifically targeting the most vulnerable (e.g. lower socioeconomic, lower income) groups, without posing unnecessary burdens on them. In order to be effective and prevent food-related taxes from increasing dietary and budgetary inequalities, it is recommended to combine these kinds of price interventions with other food environment policies (15) (e.g. decreasing the price of healthy foods, providing fruit and vegetable subsidies targeting lower income populations (49)), but also with policies tackling more distal determinants of unhealthy diets (e.g. financial debts, deprived housing conditions, social problems) (48). The application of a systems perspective (a system of multiple, interconnected factors exerting non-linear influence on dietary intakes), can enhance the development of effective policies tackling dietary and health inequalities, while also shining a light on the potential unintended consequences (50).

CONCLUSIONS

Our study did not provide evidence that the effects of an SSBs tax or nutrient profiling tax on the healthfulness of food purchases were modified by experiencing different levels of financial constraint or perceived stress. Future studies with larger samples, using theory-based hypotheses that take elements of broader daily living conditions into account, are recommended to assess whether food-related taxes differentially affect the healthfulness of dietary intakes of subgroups of the population. These studies could be used to strengthen the evidence base and inform policy-makers on how to effectively implement food-related taxes, aimed at improving dietary intake in populations and specifically targeting the most vulnerable groups, without posing unnecessary burdens on them.

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6

Stakeholder views on the potential impact of a sugar-sweetened beverages tax on the budgets, dietary intake, and health of lower and higher socioeconomic groups in the Netherlands

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ABSTRACT

Background

Socioeconomic inequalities in overweight and obesity exist in many European countries. A sugar-sweetened beverages (SSB) tax may contribute to a reduction of these inequalities. However, in the Netherlands, the government decided to not (yet) introduce an SSB tax, although the government has acknowledged its potential to be pro-equity. Understanding how various stakeholder groups perceive the potential effects of an SSB tax on different socioeconomic groups may provide useful insights into equity-related considerations in the debate whether or not to implement an SSB tax. This study aims to gain insight into the perceptions of stakeholder groups in the Netherlands on (1) the effects of an SSB tax on the budgets of lower and higher socioeconomic groups and (2) the impact of an SSB tax on socioeconomic inequalities in dietary intake and health.

Methods

Semi-structured interviews were conducted in 2019 with 27 participants from various stakeholder groups in the Netherlands (i.e. health and consumer organizations, health professional associations, trade associations, academia, advisory bodies, ministries and parliamentary parties). Data were analyzed using a thematic content approach.

Results

Participants from all stakeholder groups indicated that an SSB tax would have a larger impact on the budgets of people in lower socioeconomic groups. Participants from nearly all stakeholder groups (except trade associations) mentioned that an SSB tax could have greater health benefits among lower socioeconomic groups as people in lower socioeconomic groups often have a higher SSB consumption and are more likely to be overweight or obese. Some participants mentioned that an SSB tax may have no or adverse health effects among lower socioeconomic groups (e.g. compensation of lower SSB consumption with other unhealthy behaviors). Some participants emphasized that an SSB tax should only be introduced when accompanied by other interventions (e.g. offering healthy alternatives), to make it easier for people in lower socioeconomic groups to lower their SSB consumption in response to an SSB tax, and to prevent adverse health effects.

Conclusions

Participants believed an SSB tax could contribute to a reduction in socioeconomic inequalities in dietary intake and health. However, additional interventions facilitating the reduction of SSB consumption in lower socioeconomic groups were recommended.

BACKGROUND

According to the World Health Organization (WHO), obesity has nearly tripled since 1975 worldwide (1). In 2016, more than 1.9 billion adults (39% of the global population) were overweight, over 650 million of whom (13% of the global population) were obese (1). In the WHO European Region, 58% of the adult population was overweight in 2014 (2). People with a lower educational level are more likely to be overweight and obese than those with a higher educational level in most European countries (3), and a widening of absolute socioeconomic inequalities in obesity prevalence has been observed in 15 European countries (4).

Unhealthy diets are a leading risk factor for overweight and obesity, as well as for other diet-related non-communicable diseases, such as cardiovascular diseases, type 2 diabetes, musculoskeletal disorders (especially osteoarthritis) and some cancers (1, 2, 5). Unhealthy diets are characterized by excessive intake of saturated fats, trans fats, sugar, and salt, largely due to increased consumption of highly processed, energy-dense manufactured foods, like sugar-sweetened beverages (SSBs) (1, 2). Previous studies have shown that unhealthy diets are more common among people with a lower socioeconomic position (SEP) (6), and that lower socioeconomic groups consume more SSBs than higher socioeconomic groups (7, 8, 9, 10). A study of 11-year old children revealed that children with a low SEP consumed 0,63 l of SSBs more per week than children with a high SEP (10).

The WHO Commission on Ending Childhood Obesity noted that fiscal policies may encourage consumers – and especially those on low income – to make healthier choices (11). The WHO sees taxation of SSBs as the most feasible fiscal policy tool to implement on a large scale. SSBs are an easy-to-define category of products that are dense in energy and poor in nutrients, which have healthier and less expensive substitutes (e.g. water) (12). Furthermore, SSBs are a major driver of increased weight gain and type 2 diabetes which provides a rationale for government action (13, 14).

As lower socioeconomic groups are more sensitive to price increases (15) and consume more SSBs than higher socioeconomic groups, an SSB tax may have larger positive effects on the healthfulness of diets of lower socioeconomic groups (12, 15). Evidence from countries in which an SSB tax already has been implemented shows a decrease in SSB consumption (13, 16, 17), with a greater reduction among those with a lower SEP (8). As a result, an SSB tax, as a component of a comprehensive approach, could contribute to reduced dietary inequalities, and ultimately, improved health equity (6, 12, 18, 19).

Although an increasing number of countries worldwide and in Europe have introduced an SSB tax (20), the Netherlands has not (yet) implemented such a tax. In the Netherlands a value-added tax (VAT) rate of 9% is applied to all food and beverages (21) and an additional consumption tax of 8,83 eurocent per liter is applied to non-alcoholic drinks (i.e. fruit and vegetable juices, soft drinks and mineral water), with no distinction made between SSBs and sugar-free beverages (22). In 2020, the Dutch National Institute for Public Health and the Environment (RIVM), commissioned by the Ministry of Health, compared the characteristics and effects of an SSB tax in the United Kingdom, France and Norway (23). Results from this study showed a reduction in SSB purchases and an increase in purchases of healthy alternatives after implementation of an SSB tax. However, the RIVM notes that it is unclear to what extent these changes in purchases are a direct consequence of the SSB taxes. In addition, the study showed that there is evidence from the United Kingdom that an SSB tax may encourage manufacturers to reduce sugar levels in soft drinks.

In a written response to the RIVM study, the Dutch government recognized the potential of an SSB tax (in addition to the efforts made by the industry) to reduce sugar consumption and its potential to stimulate product reformulation (24). The government specifically mentioned that an SSB tax could reduce sugar consumption among people with a lower SEP as they will be more sensitive to price increases. However, the government has decided to not (yet) introduce an SSB tax and refers to the agreement with the food industry on self-regulated measures to reduce sugar levels in soft drinks. These self-regulated measures have been included in the 'National Prevention Agreement', an agreement of the Dutch government with more than seventy public and private organizations to reduce the prevalence of overweight and obesity, smoking and alcohol consumption (25).

Thus, although evidence suggests an SSB tax may have the potential to reduce SSB consumption and be pro-equity, this does not imply that stakeholders involved in the debate whether or not to implement an SSB tax are sensitive to this argument. The views of ministers and other governmental officials are likely influenced by the opinions and lobbying of other stakeholder groups in the SSB-tax-debate, which could slow down or even block the decision-making process (26, 27). Various studies reported concerns among stakeholders about the regressive effect of an SSB tax; the tax would have a larger impact on the (often) smaller budgets of lower socioeconomic groups, which is considered unfair (28).

It is important to understand how different stakeholder groups (e.g. health professional associations, academics, policy makers) perceive the equity effects of an SSB tax, and which different equity-related arguments may influence the decision-making process of

an SSB tax. These perspectives would lead to a greater understanding on how different stakeholders believe an SSB tax could contribute to socioeconomic inequalities in dietary intake and health and may address issues where contradictory views exist. Furthermore, a better understanding of the views of different stakeholder groups may also provide useful information on how the pro-equity effect of an SSB tax could be increased.

These insights are especially relevant for governments considering to implement an SSB tax, given the persistence of health inequalities in many European countries. This study therefore aims to gain insight into the perceptions of different stakeholder groups in the Netherlands on (1) the differential effects of an SSB tax on the budgets of lower and higher socioeconomic groups and (2) the impact of an SSB tax on socioeconomic inequalities in dietary intake and health.

METHODS

Study design and participant recruitment

Semi-structured interviews were conducted with Dutch stakeholders from various professional backgrounds and a wide range of sectors who have an interest in the potential implementation of an SSB tax in the Netherlands: ministries and parliamentary parties, advisory bodies, academia, trade associations, health professional associations, health and consumer organizations (Table 1). These stakeholder groups, their role and their potential interest in the SSB tax decision-making process are further described below.

Table 1. Study participants.

Stakeholder Group	Participants approached (n = 46)	Participants declined (n = 19)	Participants included (n = 27)
Parliamentary parties	10	No response (n = 2) No time (n = 1) No reason (n = 4)	Members of the Dutch parliament/ politicians (n = 3)
Ministries	8	No response (n = 2) Insufficient knowledge on taxation of SSBs according to the stakeholder (n = 1) No reason (n = 2)	Policymakers from various ministries (n = 3)
Advisory bodies	4	No response (n = 1) Insufficient knowledge on taxation of SSBs according to the stakeholder (n = 1)	Representatives of a governmental, non- profit advisory body (n = 2)
Academia	10	No time (=1)	Academics in the field of obesity prevention, nutrition and health, preventive dentistry, behavioral science, health economics, tax law, political science, medical ethics or social epidemiology (n = 9)
Trade associations	5	No response (n = 1)	Representatives of trade associations for food and beverages manufacturers, hospitality businesses or the catering industry (n = 4)
Health professional associations	3	NA	Representatives of non-governmental, non-profit professional associations of physicians or dentists (n = 3)
Health and consumer organizations	6	No response (n = 2) Insufficient knowledge on taxation of SSBs according to the stakeholder (n = 1)	Representatives of governmental or non-governmental, non-profit consumer organizations and health organizations in the field of nutrition and health promotion (n = 3)

The Dutch Ministry of Health, Welfare and Sport develops national policies to reduce the prevalence of overweight and obesity among children and adults in the Netherlands, which could include an SSB tax. However, an SSB tax is not included in the 'National Prevention Agreement', a package of measures to reduce the prevalence of overweight and obesity (25).

The Dutch Ministry of Finance has an important role in adjusting the tax regulations when the decision to implement an SSB tax has been taken and is responsible for the implementation of the SSB tax (29).

Parliamentary parties have three key responsibilities: 1) to propose, review and pass laws in collaboration with the government, 2) to review the Cabinet's (i.e. the Prime Minister, the other ministers and the State Secretaries) implementation of legislation and all other government actions and 3) to represent the Dutch voters (30). In the Netherlands various parliamentary parties exist (from left-wing to right-wing parties). These parties participate in the House of Representatives (Second Chamber), elected directly by Dutch citizens and the Senate (First Chamber), chosen by the members of the State-Provincial.

Advisory bodies (representatives of a governmental, non-profit advisory body) conduct health-related research and monitoring studies commissioned by the government (31, 32). They provide the government with independent advice on how to promote health and safeguard a healthy environment.

Academia have expertise in certain fields, such as obesity prevention and nutrition and health. Academia conduct independent scientific research on for example the effects or acceptability of an SSB tax. These results can be used in the development of policies (32). Academia were also involved in the development and negotiations of the National Prevention Agreement (25).

Trade associations (representatives of food and beverages manufacturers, hospitality businesses or the catering industry) influence government decisions such as the implementation of an SSB tax through their lobby activities (28). They are involved in the development and negotiations of several government policies, such as the National Prevention Agreement (25) and the Agreement on Product Improvement which has been signed in 2014 (33). When the decision to implement an SSB tax has been taken, food and beverages manufacturers, hospitality businesses and the catering industry have to implement the tax.

Health professional associations (representatives of non-governmental, non-profit professional associations of physicians or dentists) and *health and consumer organizations* (representatives of governmental or non-governmental, non-profit consumer organizations and health organizations in the field of nutrition and health promotion) may influence the decision-making process of implementing an SSB tax by lobbying to the government and promoting the importance of healthy dietary lifestyles to prevent diseases (32, 34). They are also involved in diverse platforms of interaction with the government and many of these organizations were involved in the development and negotiations of the National Prevention Agreement (25).

To recruit participants, we used purposive sampling combined with snowball sampling, asking each participant if certain stakeholders or stakeholder groups were lacking

from the initial anonymized list of stakeholders developed by the research team. We approached a total of 46 stakeholders, of whom 11 declined to participate and 8 did not return phone calls or reply to reminder e-mails (see Table 1 for reasons for non-participation). A total of 25 semi-structured interviews were held with 27 participants. One interview was held with two participants that represented two trade associations and one interview was held with two participants that represented one advisory body.

Interview procedure

Data were collected in March, April and May 2019. Interviews were held in person, by (one of the) two members of the research team (ME and SD). Most interviews were held at the participants workplace. Three interviews were held at a neutral and for the participant easy accessible location and one interview was held at the interviewers' workplace, at the request of the participant. The interviews were held in Dutch, using a semi-structured interview guide, with questions developed based on topics as identified in the literature (28, 35, 36). The interviewers provided the participants with a definition of an SSB tax: a tax of at least 20% on regular soft drinks, fruit juices with added sugars, sport drinks, energy drinks and flavored water with added sugars. The interview guide included questions about barriers and facilitators to the potential future introduction of an SSB tax in the Netherlands and advantages and disadvantages of an SSB tax, including questions about potential differential effects of an SSB tax on different socioeconomic groups. This manuscript focuses on the latter: stakeholder views on differential effects of an SSB tax on the budgets, dietary intake, and health of lower and higher socioeconomic groups. Results about perceived advantages and disadvantages of an SSB tax and barriers and facilitators to its potential introduction have been described elsewhere (37).

The interviews lasted 25 to 90 min, were audio-recorded, and transcribed verbatim by two researchers (ME and SD). A summary of the interview was sent to every participant to check for accuracy. Anonymity of the participants was assured by using identification numbers instead of names.

Data analysis

Full interview transcripts were analyzed; that is including the part on advantages and disadvantages of an SSB tax, since equity aspects were mentioned here by participants. Two researchers (ME and SD) analyzed the interview transcripts with MAXQDA Qualitative Data Analysis Software (version 2018.2), using a thematic content approach (38). ME and SD coded the first four interview transcripts of interviews with participants from four different stakeholder groups inductively line-by-line and independent of each other. Subsequently, ME and SD discussed the emergent subthemes until consensus was reached. These subthemes were then aggregated into overarching themes, which

led to the development of an initial thematic map which was used for coding the next interview transcripts by either ME or SD. During the coding, ME and SD discussed the subthemes and overarching themes repetitively with each other to review themes for coherence, refine existing themes, identify and add new themes, and recode some data extracts.

All interview fragments that were coded with either '*health inequalities*' or '*budgetary inequalities*' were further analyzed for this manuscript. Fragments in which participants talked about specific views/topics in relation to these two themes have been copied from the transcripts and pasted into a separate document, including the ID-number of the participant who brought this up. The researchers checked which stakeholder group the participant belonged to. This document was used to create Table 2, which shows the specific views and topics that have been mentioned. If one or more participants from a certain stakeholder group mentioned a specific topic, this has been indicated with an 'X' in Table 2. All quotes in this manuscript have been translated from Dutch into English.

Table 2. Views on the effects of an SSB tax on higher and lower socioeconomic groups.

Stakeholder groups						
	Health and Consumer organizations	Health professional associations	Advisory bodies	Academia	Trade associations	Ministries
						Parliamentary parties
The differential effects of an SSB tax on the budgets of lower and higher socioeconomic groups						
An SSB tax is financially regressive	X		X	X	X	X
People with a lower socioeconomic position spend a bigger proportion of their income on food purchases				X		X
People with a lower socioeconomic position consume more unhealthy foods/drinks like SSBs		X	X	X		X
People of lower socioeconomic groups cannot easily change their routines				X		
The regressive effect of an SSB tax is likely very marginal						X
The regressive effect of an SSB tax does not need to occur when people eat healthy and consequently do not buy SSBs						X
The impact of an SSB tax on socioeconomic inequalities in dietary intake and health						
An SSB tax is progressive in terms of health benefits	X		X	X		X
People with a lower socioeconomic position have more health problems (overweight, non-communicable diseases)	X			X		X
People with a lower socioeconomic position consume more unhealthy foods/drinks like SSBs		X	X	X		X
An SSB tax could lead to alternative, healthier choices of lower socioeconomic groups	X			X		X
An SSB tax could be especially effective for the health of people with a lower SEP who are more difficult to reach by other interventions				X		
People of lower socioeconomic groups cannot easily change their routines				X		
An SSB tax could lead to compensation with other unhealthy behavior	X					
An SSB tax could lead to a widening of socioeconomic inequalities in dietary intake and health		X		X		

1. X denotes: one or more participants in this stakeholder group mentioned the specific topic in an interview

RESULTS

Table 2 gives an overview of the views of different stakeholder groups on how an SSB tax would affect the budgets of lower and higher socioeconomic groups differently, and impact on inequalities in dietary intake and health. Below we elaborate on these different views.

Differential effects of an SSB tax on the budgets of lower and higher socioeconomic groups

Participants from all stakeholder groups mentioned that an SSB tax will have a financially regressive effect. Participants (from academia and the ministries) reasoned that people with a lower SEP often have a lower income and spend a larger proportion of their income on food purchases. Consequently, an SSB tax will have a larger effect on the budgets of people with a lower SEP. Furthermore, participants (from health professional associations, advisory bodies, academia, a ministry, and parliamentary parties) reasoned that people with a lower SEP in general consume more unhealthy foods and drinks like SSBs than people with a higher SEP, which could further increase the effect of an SSB tax on their financial situation if they would maintain their usual levels of SSB consumption. There could be a chance that people with a lower SEP will stick to their usual SSB consumption levels, because they can be less capable of and/or willing to change their routines regarding consuming SSBs than people with a higher SEP, as was mentioned by two academics. An academic noted '... *it is financially unbearable for people when they are not capable to make alternative choices. That is a potential problem.*' Another academic reasoned that when an SSB tax will disproportionately affect the financial situation of people with a lower SEP, this could thus lead to a widening of budgetary inequalities.

However, a few participants, although acknowledging the regressive effect of an SSB tax, were less concerned about possible adverse financial effects. One policy maker referred to evidence which showed that the regressive effect is likely to be marginal for this specific tax, because the absolute price increase is quite low for these relatively inexpensive drinks. A politician mentioned '*if the [SSB] tax increases [the price of SSBs], it works regressive. And that is of course ... not the intention. On the other hand, there is the discussion about if healthy eating is more expensive ... and that is not the case. Thus ... if you eat according to the Dutch Wheel of Five [dietary guidelines] [39] (and then you do not buy cola and chips because they are not included) ... you can eat healthy for 5 or 6 euros per day per person. Yes, that includes less [treats] and less cookies but those are also the products you do not need.*'

The contribution of an SSB tax to socioeconomic inequalities in dietary intake and health

Participants from all stakeholder groups, except those from trade associations, mentioned the progressive health benefits of an SSB tax. They see it as an advantage rather than a disadvantage that an SSB tax will probably disproportionately affect the budgets and SSB consumption of people with a lower SEP.

Participants (from health professional associations, advisory bodies, academia, a ministry, and parliamentary parties) mentioned that people with a lower SEP often have unhealthier dietary behavior, including a higher consumption of SSBs. According to a few participants (from academia) unhealthier lifestyles among people with a lower SEP may be caused by, for example, less knowledge about healthy behavior, and by being more vulnerable to *and* more exposed to an environment that stimulates unhealthy behavior. Consequently, the prevalence of overweight and obesity is higher among people with a lower SEP and they have a greater risk of experiencing health problems (e.g. type 2 diabetes, cardiovascular disease) than people with a higher SEP according to participants (from health and consumer organizations, a health professional association, academia, a ministry, and a parliamentary party). Participants (from health and consumer organizations, academia, and a parliamentary party) reasoned that an SSB tax will increase the price of SSBs and will therefore stimulate people, especially people with a lower SEP, to buy and consume fewer SSBs and make more alternative, healthier choices, which will thus positively contribute to their health. A politician noted *'from a lot of research, it appears that people with a lower socioeconomic position ... live unhealthier lives. Thus, if ... people with less money to spend purchase and consume more inexpensive drinks which also contain less sugar, that is, I think what we would want.'*

Academics mentioned that an SSB tax could be especially effective for the health of people with a lower SEP, who are more difficult to reach by other interventions. One of these academics noted *'The whole environment we are living in promotes unhealthy behaviorfor which [lower socioeconomic] groups are more vulnerable. If they would like to improve the health of all people, and especially of these [lower socioeconomic] groups, this [an SSB tax] is an intervention that could be potentially effective. More than an intervention that depends on individual behavioral change or motivation.'*

Thus, according to a number of participants, an SSB tax stimulating people to buy fewer SSBs will contribute positively to the health of people in general, but even more to the health of people with a lower SEP. Consequently, SSB taxation may contribute to a decrease in socioeconomic inequalities in health, like a participant from an advisory body noted *'prevention aims to decrease socioeconomic health inequalities ... this is an advantage [of an SSB tax], as this is just what it does.'* A participant from a health professional

association mentioned *'unhealthy [foods] should be made unattractive for everybody. And the rich people will continue buying it, I can believe that. However, especially in the lower socioeconomic groups, that [unhealthy eating] is a big problem in the Netherlands. In the lower socioeconomic groups differences will be made and that is I think what is needed.'*

In contrast to the arguments above, some participants mentioned an SSB tax could also have no or adverse health effects. As was also noted in the paragraph about the financial effects of an SSB tax, two academics mentioned that people with a lower SEP can be less capable of and/or willing to change their routines regarding consuming SSBs than those with a higher SEP. One of these academics argued that *'if people are stuck in certain behavioral routines, they can't adjust these very easily'. And then the point is, how strong is the incentive? Is the incentive strong enough to break through a habit?* These academics also mentioned that some of the additional barriers to reducing SSB consumption that may be encountered by people with a lower SEP include a fear of negatively impacting their children's happiness or the feeling that drinking less SSBs would lower their quality of life. As an academic mentioned: *'A cola is just one of the last things they [people with a lower SEP] could award themselves with'. Thus, [the implementation of an SSB tax] is not contributing to their quality of life, because it is a larger proportion of their income and it could increase the socioeconomic differences'.*

A possible adverse effect of an SSB tax that was raised by a few participants is the possibility that a reduced SSB consumption will be compensated by an increased consumption of other unhealthy products. One participant from a health professional association mentioned: *'People who cannot afford it [their usual level of SSB consumption] will maybe start doing [other] things which are 'bad' [for their health].* One participant from a health/consumer organization mentioned that *'stop drinking SSBs is, I think, for everybody a very good step for health, but on the other hand, if you compensate that with other unhealthy behavior, that is of course not desirable'.*

If lower socioeconomic groups do not decrease their SSB consumption, or compensate a reduced SSB consumption with eating other unhealthy treats (e.g. more sweets or chocolate bars), and higher socioeconomic groups do reduce their SSB consumption in response to an SSB tax, two participants (an academic and a professional affiliated with a health professional association) reasoned this could lead to a widening of socioeconomic inequalities in dietary intake and health.

The implementation of an SSB tax should be accompanied by other interventions targeting lower socioeconomic groups

To make it easier for lower socioeconomic groups to lower their SSB consumption in response to an SSB tax, and to prevent adverse effects, some participants emphasized

that the implementation of an SSB tax should be accompanied by other interventions. According to a participant from a health/consumer organization, informing people, creating support for an SSB tax, and offering healthier alternatives that are affordable would be essential conditions for its success. One academic mentioned further: '*... if you don't ensure at the same time a decrease in prices of healthy products, then you are disproportionally affecting [lower socioeconomic] groups, because they cannot even afford themselvesa cola. Thus, you have to make sure there are attractive [healthy] alternatives [...] which are festive and cheerful!*' Another academic mentioned some form of compensation for people with a lower SEP as an additional measure accompanying the implementation of an SSB tax. The academic added that this could be done by investing the revenues of the SSB tax in a fund from which supplementary interventions that benefit the health of people with a lower SEP can be financed.

DISCUSSION

In this study, we aimed to gain insight into the perceptions of different stakeholder groups in the Netherlands on (1) the differential effects of an SSB tax on the budgets of lower and higher socioeconomic groups and (2) the impact of an SSB tax on socioeconomic inequalities in dietary intake and health.

Participants, from all stakeholder groups, mentioned that an SSB tax would have a regressive financial effect, i.e. a larger impact on the budgets of lower socioeconomic groups. As a result of cutting down on SSBs, participants, from all stakeholder groups except trade associations, indicated an SSB tax could have greater health benefits among lower socioeconomic groups, who often have unhealthier diets (including a higher SSB consumption) and are more likely to be overweight or obese. Some participants (from academia, a health/consumer organization, and a health professional association) indicated that an SSB tax could have no effect or adverse health effects for lower socioeconomic groups (e.g. compensation of lower SSB consumption with other unhealthy behaviors). Some participants (from academia and a health/consumer organization) emphasized that an SSB tax should only be introduced when accompanied by other interventions, to make it easier for lower socioeconomic groups to lower their SSB consumption in response to an SSB tax, and to prevent adverse health effects. Examples of these interventions are educational efforts, offering healthy alternatives, decreasing the price of healthy products, and investing the revenue of the tax in favor of people with a lower SEP.

The regressive financial effect as perceived by participants from all stakeholder groups in our study is in line with the literature. The regressive burden of taxes on food and beverage products was highlighted in 27 studies of a systematic review of empirical

studies on health taxes (40). In another systematic review on the impact of an SSB tax according to SEP (8), five studies also reported that an SSB tax is consistently financially regressive but, like a policy maker in our study noted, only to a small degree because the absolute price increase is quite low. A politician in our study mentioned that this regressive effect does not need to occur when people eat healthy according to the Dutch dietary guidelines and consequently do not buy SSBs. However, a study in the Netherlands revealed energy density was inversely related with energy costs, implying that healthier diets cost more (41).

The progressive health effect of an SSB tax as perceived by participants in our study is also corresponding with the literature. Seven modelling studies in a review on the impact of an SSB tax according to SEP (8) reported either similar reductions in body weight across socioeconomic groups or greater reductions for lower socioeconomic groups. Another systematic review of empirical studies on health taxes (40) included 15 studies which found that public health impacts are likely to be the largest for lower socioeconomic groups. In contrast, two studies in this review did not find significant differences in health impacts between socioeconomic groups. Therefore, the authors concluded that taxes on unhealthy food and beverages may contribute to a reduction in socioeconomic health inequalities, but that more research is needed.

Several authors in the literature have addressed the question whether the regressive burden of an SSB tax would be exceeded by the benefits of an SSB tax in terms of health (40, 42, 43, 44, 45). The outcome of this question depends on the behavior of consumers: if people with a lower SEP substantially reduce their SSB consumption in response to an SSB tax, then the health benefits compared to the financial burden are relatively larger, making the tax less regressive. On the other hand, if a tax does *not* lead to a considerable reduction of SSB consumption among people with a lower SEP, then the benefits compared to the financial burden are relatively small (44, 45). The review of empirical studies by Wright et al. (40) states that available research does not sufficiently address the question whether the overall benefits of food and beverage taxes (i.e. reducing consumption of unhealthy products) exceed the financial burden for people who do not reduce their consumption.

Regarding the possibility that an SSB tax has no effect, participants in our study noted that people may not be able/willing to change their SSB consumption patterns. A participant in our study emphasized that the incentive has to be strong to make people change their SSB consumption routines, especially among people with a lower SEP. This corresponds with results in the systematic review of Wright et al. (40), which states that lower and incremental taxes are less likely to achieve behavior changes and that evidence shows a tax of at least 20% is needed to reduce the consumption of unhealthy

products (40). Participants in our study also generally recommended to implement a tax of at least 20% on all beverages with sugar (37).

A possible adverse health effect of an SSB tax noted by participants in our study is the substitution between SSBs and other unhealthy food and beverages, which is mentioned in the literature as well (40, 44, 46, 47, 48, 49, 50). Various authors have highlighted the difficulties in monitoring these behavioral responses (44, 46), but we have also found some studies which examined these substitution patterns. Studies in the United States showed that the reduction in soda consumption is completely offset by increases in consumption of other high calorie drinks and therefore did not lead to significant reductions in people's body weight (40, 47, 48). However, Fletcher et.al (48) also mentioned that this substitution does not necessarily have to be negative in terms of health outcomes, when people substitute the SSBs for example with whole milk (which is also high in calories, but more nutritious and does not contain added sugar). Thus, even if taxation does not lower obesity rates, SSB taxes could combat poor health outcomes (e.g. type 2 diabetes, cardiovascular risk, poor dental health) associated with high levels of added sugar consumption. Studies using simulation models showed that an SSB tax could result in a decrease in energy (calories) purchases (49) and consumption (50) but would not result in substitution to sugary foods (49). One study showed that the predicted decline in calorie intake was larger for lower socioeconomic groups than for higher socioeconomic groups (50). In contrast, this study found that an increase in SSB prices (half-cent per ounce) would lead to an increase in sodium and fat intake as a result of product substitution (50). Given the few and diverse studies that examined SSB substitution patterns and the difficulty of monitoring these patterns, more empirical research is needed to be able to substantiate the substitution patterns described by the participants in our study.

Participants in our study indicated that when an SSB tax has no effect or adverse health effects (i.e. people not being able to change their SSB consumption routines and/or substituting SSBs for other unhealthy foods and beverages) this could lead to an increase in health inequalities. However, evidence showing that an SSB tax increases health inequalities is scarce. A study in Chile showed a greater decline in consumption of SSBs among people with a higher SEP compared to people with a lower SEP after the introduction of a tax (16). This may suggest a signaling pathway, where public health messaging discourages SSB consumption, may work more effectively for high socioeconomic groups than low socioeconomic groups (16). Such a signaling pathway could thus lead to a widening of health inequalities. The systematic review of empirical studies by Wright et.al (40) included two studies which did not find significant differences in public health impacts between socioeconomic groups, but this would not cause an increase in health inequalities (nor a decrease in health inequalities). Considering the

few studies and diverse outcomes, more studies are needed to generate evidence about the contribution of an SSB tax to health inequalities.

To simultaneously increase the effect of an SSB tax on the health of people with a lower SEP and prevent an SSB tax from increasing socioeconomic inequalities in dietary intake and health, some stakeholders in our study suggested to implement additional interventions accompanying the SSB tax. Implementing an SSB tax as part of a comprehensive policy framework has also been recommended in the literature. Previous studies emphasized that additional measures could reduce the regressive nature of health taxes (40), limit the possibility for substitution to unhealthful alternatives (47, 48), or are necessary to achieve sustained reductions in SSB consumption (42). For example, a tax combined with a subsidy for fruit and vegetables (40) and an extension of an SSB tax to a tax that taxes all caloric sweeteners could be more effective than a tax in isolation (48). The WHO recommends comprehensive action plans at the country level that combine taxation, restriction of marketing of sugary products to children, and education (51). Using revenue to fund initiatives benefiting people with greater disadvantage was recommended by a study conducted in Australia on modelled health benefits of an SSB tax across socioeconomic groups (43). In a study exploring public acceptability of an SSB tax in the Netherlands, less than half of the Dutch adults ($n = 500$) were in favor of an SSB tax in general, but if the revenue is used for health initiatives more than half of the Dutch adults were in favor of an SSB tax (52). Support for an SSB tax was significantly lower among people with a lower educational level than people with a higher educational level.

Furthermore, the World Cancer Research Fund International (WCRF) recommends modelling the impact of SSB taxes on different socioeconomic groups, to design an SSB tax that is fit-for-purpose and context appropriate, and to increase public and political support for the tax (53). The Dutch Scientific Council for Government Policy proposes a perspective in which policymakers should not focus on decreasing health inequalities, but on where the greatest possible health gains lie, and how to keep health losses to a minimum (54). This means a greater focus on people with the greatest health disadvantage.

Strengths and limitations

The main strength of this study is that it is one of the first studies to provide insights into the views of various stakeholder groups (parliamentary parties, ministries, academia, health and consumer organizations, health professional associations, advisory bodies, trade associations) regarding the effects of an SSB tax on different socioeconomic groups. To ensure that all relevant stakeholder groups were included in our study, we

asked each participant if stakeholders were lacking from the initial anonymized list of stakeholders developed by the research team.

Another strength of this study is the use of a qualitative design, as the interviews provided in-depth and rich information that could not have been gained through quantitative methods, or a systematic review of the available evidence of the effectiveness of an SSB tax on SSB consumption or health outcomes of different socioeconomic groups (55). Insights into the stakeholder views via in-depth interviews lead to a greater understanding on how different stakeholders believe an SSB tax could contribute to socioeconomic inequalities in dietary intake and health and address arguments which may hinder the decision to implement an SSB tax. Furthermore, these perspectives provide useful suggestions how to increase the pro-equity effect of an SSB tax.

Our study also has some limitations. Firstly a considerable number of potential participants did not respond to our interview invitation ($n = 8$) or declined ($n = 10$), despite the reminder e-mails and calls made by the researchers. In particular, policymakers and politicians from whom we would expect opposition to the implementation of an SSB tax, stated that they did not want to participate or were too busy. This might be related to the politically sensitive nature of an SSB tax. A second limitation could be that the interviews were held by two different researchers (ME and SD). ME conducted interviews with stakeholders from academia, advisory bodies, trade associations, health professional associations, and health and consumer organizations. SD conducted interviews with stakeholders from parliamentary parties, ministries, and trade associations. We attempted to prevent interviewer bias by using the same interview guide and by close communication between the researchers during the data collection. Also, both researchers were trained in qualitative research. Lastly, it should be kept in mind that the findings of this study were restricted to the opinions of 27 stakeholders in the Netherlands and a substantial number of invited stakeholders ($n = 19$) declined to participate. Therefore, we are not certain if all opinions have been included in this study.

CONCLUSIONS

Participants, from all stakeholder groups, mentioned that an SSB tax would have a larger impact on the budgets of people with a lower SEP. As a result, people in lower socioeconomic groups who often have unhealthier diets (including a higher SSB consumption) and are more likely to be overweight and obese, may be more likely of cutting down on SSBs. Therefore, participants, from all stakeholder groups except trade associations, indicated an SSB tax could have greater health benefits among lower socioeconomic groups than higher socioeconomic groups and has the potential to be pro-equity. However, some participants (from academia, a health/consumer

organization, and a health professional association) did not agree on this pro-equity effect, as they believed that an SSB tax could also have no or adverse health effects (e.g. compensation with other unhealthy behavior). These counterarguments may hinder the decision-making process to implement an SSB tax. To be effective and to prevent potential adverse health effects, some participants (from academia and a health/consumer organization) stressed the importance of additional interventions facilitating the reduction of SSB consumption in lower socioeconomic groups. These interventions would support the appropriate, effective and equitable development and implementation of an SSB tax. These interventions could also increase support for an SSB tax from several stakeholder groups (52, 53) and with that facilitate the decision-making process.

Further research is required to gain more insights into the opinions of certain stakeholder groups regarding the effects of an SSB tax on different socioeconomic groups. It would also be interesting to have more studies that statistically test differences in outcomes following an SSB tax between different socioeconomic groups, to substantiate the arguments and generate more evidence.

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The image features a large, stylized number '7' in a dark teal color, positioned in the center-right area. The background is composed of several overlapping geometric shapes in shades of light blue and white, creating a modern, abstract design. The number '7' is rendered in a bold, sans-serif font with a slight slant.

7

General discussion

7. General discussion

This thesis aimed to evaluate the extent to which government policies influencing food environments have been implemented by the European Union (EU) and the Dutch national government, and to gain insight into how governmental food environment policies may impact on socioeconomic inequalities in diet. In this chapter, the main findings of these studies are summarized and reflected upon in relation to these two aims. Moreover, methodological considerations, implications for future research, and implications for policy and practice are discussed.

7.1 MAIN FINDINGS

7.1.1 Large potential for the European Union and the Dutch national government to strengthen food environment policies

Applying the Healthy Food Environment Policy Index (Food-EPI) in the period 2019–2020, the study in Chapter 2 aimed to get insight into the strength of food environment policies at EU level and the actions needed to improve food environments in EU member states. The study showed that there is a large potential for the EU to strengthen its policies and infrastructure support in order to improve member states' food environments. Independent food and health experts who took part in this study rated existing policies regarding a number policy and infrastructure support indicators as specified in the Food-EPI tool. Regarding the policy indicators, most EU-level policies were rated as weak (65%) or very weak (23%). The strength of infrastructure support indicators was rated higher: 63% of the infrastructure support indicators were rated as of moderate strength, whereas 33% were rated as weak. Further, experts recommended 18 policy actions and 19 infrastructure support actions to the EU and prioritized these actions on importance, achievability, and potential to reduce socioeconomic inequalities in diet. The top five prioritized EU policy actions included: (i) set mandatory, ambitious food composition targets for all food categories and (ii) for processed foods and meals at quick-service restaurants specifically; (iii) adopt a legislated ban for trans fats; (iv) allow member states to implement a 0% VAT exemption on fruit and vegetables; and (v) ban the marketing of unhealthy foods to children <19 years. The top five prioritized EU infrastructure support actions were: (i) develop a high-level non-communicable diseases (NCDs) prevention strategy; (ii) in EU work programs, include clear priorities to reduce health inequalities; (iii) harmonize the promotion of healthy foods with other issues of concern; (iv) benchmark food environment policies and coordinate good practices among member states; and (v) support member states to monitor the status of national food environments.

In Chapter 3, the Food-EPI was applied at national level in the Netherlands in the period 2019–2020. Dutch experts rated the extent to which policies, as specified in the Food-EPI indicators, were implemented compared with international best practices, and formulated and prioritized policy and infrastructure support actions for the Dutch government to improve food environments. Like for the EU, there appeared to be a large potential for the Dutch national government to strengthen its food environment policies; policies for 50% of the policy indicators were rated as having a low level of implementation and for 41% of the policy indicators as having a very low level of implementation. The implementation of infrastructure support was, again similar to that found at EU level, rated higher: it appeared that 42% of the infrastructure support indicators were rated as having a fair level of implementation and another 42% as having a medium level of implementation. Experts recommended a total of 18 policy actions and 11 infrastructure support actions to improve food environments in the Netherlands. The six policy actions that experts considered most important, achievable, and equitable were: (i) develop more ambitious annual food composition targets, a clear timeline with independent monitoring, and proven effective incentives; (ii) ban all forms of marketing of unhealthy foods to children <18 years; (iii) increase the price of unhealthy foods; (iv) formulate clear rules and regulations for caterers, quick-service restaurants, supermarkets, and shops to increase the relative availability of healthy foods compared with total food product availability; (v) decrease the price of healthy foods; and (vi) finance food-related income support. The top five prioritized infrastructure support actions based on importance and achievability were: (i) develop a government-wide national prevention policy and implementation plan containing universal, selective, indicated, and care-related prevention measures; (ii) support local governments to develop and implement prevention measures; (iii) develop concrete, measurable targets with regard to prevention measures and make a comprehensive overview of the achieved and unachieved results on these targets publicly available; (iv) increase the budget for universal, selective, indicated, and care-related prevention in the national budget; and (v) develop an instrument for reporting about food availability in supermarkets, shops, quick-service restaurants, and catering that shows the proportion of healthy foods in relation to the total food product range.

7.1.2 The impact of food environment policies on socioeconomic inequalities in diet

In Chapters 4 to 6, several mechanisms via which governmental food environment policies could lead to differential benefits for the diet of people in lower and higher socioeconomic groups were studied.

In Chapter 4, two contemporary theories that take specific elements of broader daily living conditions into account (Bourdieu's capital theory and the scarcity theory) were used to reason how food environment policies may impact persons in lower and higher

socioeconomic groups differently. This chapter outlined that food environment policies that require higher levels of individual agency (e.g., food labeling) may lead to a widening of socioeconomic inequalities in diet, because the generally less favorable daily living conditions of individuals in lower socioeconomic groups (e.g., higher levels of financial poverty) may constrain individual agency to make healthy food choices. Conversely, this chapter indicated that more structural food environment policies (e.g., restricting unhealthy food promotion) are more likely to decrease socioeconomic inequalities in diet. The explanation for this is that these structural policies require little individual agency and lead to an improvement in unfavorable food environmental features to which individuals in lower socioeconomic groups are more often exposed as a result of specific elements in daily living conditions (e.g., social practices, media use). Moreover, the chapter showed that the application of theories that take specific elements of broader daily living conditions into account could guide future empirical studies and thereby enhance the development of effective policies tackling socioeconomic inequalities in diet.

The study in Chapter 5 aimed to investigate whether financial constraints and perceived stress modify the effects of food-related taxes on the healthiness of food purchases in a virtual supermarket. Data from a randomized controlled trial among Dutch participants (n=386) were used. Financial constraints and perceived stress did not significantly modify the effects of food-related taxes on the healthiness of food purchases. However, visualizations suggested that, compared with the control condition, in a nutrient profiling tax condition the overall healthiness of food purchases was higher and sugar-sweetened beverages (SSBs) purchases were lower, especially among people with moderate/high levels of financial constraint. Such patterns were not observed for perceived stress. Further studies with a larger sample size are recommended to assess whether, and, if yes, why, food-related taxes differentially affect subgroups' food purchases.

Finally, the study in Chapter 6 aimed to understand how various stakeholder groups from a wide range of sectors (i.e., ministries, parliamentary parties, advisory bodies, academia, health and consumer organizations, trade associations, and health professional associations) perceive the potential effects of an SSBs tax on different socioeconomic groups. We therefore conducted 25 in-depth interviews with 27 participants. The results showed that, in general, the majority of participants believed an SSBs tax could contribute to a reduction in socioeconomic inequalities in dietary intake and health. However, additional interventions (e.g., decreasing the price of fruit and vegetables or investing SSBs tax revenues in a fund from which supplementary interventions that benefit the health of people with a lower socioeconomic position can be financed) were recommended. It was thought that these additional interventions

would facilitate a reduction in SSBs consumption among lower socioeconomic groups and prevent adverse health effects.

7.2 REFLECTION ON MAIN FINDINGS

7.2.1 Explanations for the EU's and the Dutch national government's weak and low implementation of food environment policies

Both the EU and the Dutch national government have an important responsibility with regard to maintaining or improving population health, for which a healthy diet is considered a vital element. Article 168 of the Treaty on the Functioning of the European Union (TFEU) addresses a clear responsibility for the EU in human health protection (1). Although Article 168 prescribes that a high level of human health protection shall be ensured in the definition and implementation of all EU policies and activities (1), the study in Chapter 2 has shown that policies to create healthy food environments are predominantly (very) weak at EU level. The EU's implementation of infrastructure support appears a little stronger. These findings are in line with the literature, which states that EU-level public health policies have hardly impacted national policymaking and that EU influence on member states' food environment policies has been limited mainly to policies such as the adoption of legislation on labeling and health claims, and the requirements of the school milk scheme (2). In the Netherlands, Article 22 of the Dutch Constitution explicitly states that the government should take measures to promote public health (3). However, the study in Chapter 3 has shown that the implementation of policies that create healthy food environments is predominantly (very) low. Similar to the results at EU level, the implementation of infrastructure support indicators (e.g., providing food-based dietary guidelines, public access to nutrition information, having a statutory health promotion agency, and monitoring overweight and obesity) was higher than policy implementation in the Netherlands. This implicates that actions have been taken that could be supportive for developing and implementing food environment policies, but that, in practice, this has not yet resulted in the actual implementation of these policies.

In other countries also where the Food-EPI was applied, the implementation of infrastructure support was better than the implementation of structural policies to create healthy food environments (4, 5). In Europe, the Food-EPI was applied in 11 countries, including Estonia, Finland, Germany, Ireland, Italy, the Netherlands, Norway, Poland, Portugal, Slovenia, and Spain (4). All of these countries, except Finland, Norway, and Portugal, had predominantly low to very low implementation scores for policies that directly shape food environments (4). The proportion of policies with a low level of implementation was highest in the Netherlands, Spain, and Germany, whereas Slovenia and Poland had the highest proportion of policies with a very low, if any,

implementation (4). Compared with the Netherlands, a few European countries did better and implemented some structural policies that create healthy food environments (Box 1). Outside Europe also, examples exist of more regulatory approaches to create healthy food environments (Box 1).

Box 1. Examples of regulatory approaches to create healthy food environments

- In Finland, the Decree of the Ministry of Agriculture and Forestry on declaring certain foods high-salt (10/2014) prescribes that food packaging must be labeled as 'high salt' or 'high in salt' if the salt content of the food exceeds a specified threshold (4).
 - The Finnish Government Decree (54/2012) on the criteria for supporting the meals of university students provides subsidies for student meals, with the prerequisite that these student meals meet general health and nutritional requirements (4).
 - In Portugal, Law No. 30/ 2019 of 23 April restricts the advertising of unhealthy foods to children under 16 years old (4).
 - Portugal's legislation on food provision in schools and on food supply for healthcare institutions limits the availability of unhealthy foods in (school) buffets, vending machines, bars, and cafeterias (4).
 - Chile has, among other food and nutrition policies, implemented an SSBs tax, a law that restricts the advertising of unhealthy foods, a law that bans the sale of unhealthy foods in schools, and has mandatory nutritional labeling updated to front-of-package warning labels about critical nutrients (6, 7).
 - In Brazil, Law No. 11.947 established a national school feeding program that mandates a weekly minimum of fruit and vegetables in school meals and prohibits drinks of low nutritional value (e.g., soda), canned meats, confectionary, and processed foods with a sodium and saturated fat content higher than a specified threshold (8).
-

Potential explanations for the lack and weakness of policies that create healthy food environments include the power of the food industry lobby, the lack of public pressure for policy change, and a dominant political ideology inhibiting the implementation of interventions deemed to infringe on the free market or personal liberties (9, 10). Kingdon's multiple streams theory (MST) is applied below to reflect on the different potential explanations for the weak and low implementation of food environment policies at EU level and in the Netherlands. The MST is an established policy process theory that provides particular utility to explain both policy stasis and policy change (10-12). This theory makes a distinction between a problem stream, a policy stream, and a politics stream, which flow along different channels until, at a specific juncture, they are coupled together and a window of opportunity for policy change is created (13-15) (Figure 1). The problem stream relates to issues or conditions that require government action, which is affected by factors such as how issues are framed; the policy stream focuses on the solutions to address identified problems, which take time to develop and evolve as numerous policy actors (i.e., *policy entrepreneurs*) shape them; and the politics stream refers to the effect of the broader political discourse, influenced by factors such as political and institutional context, public opinion, and pressure group advocacy (11, 12, 14).

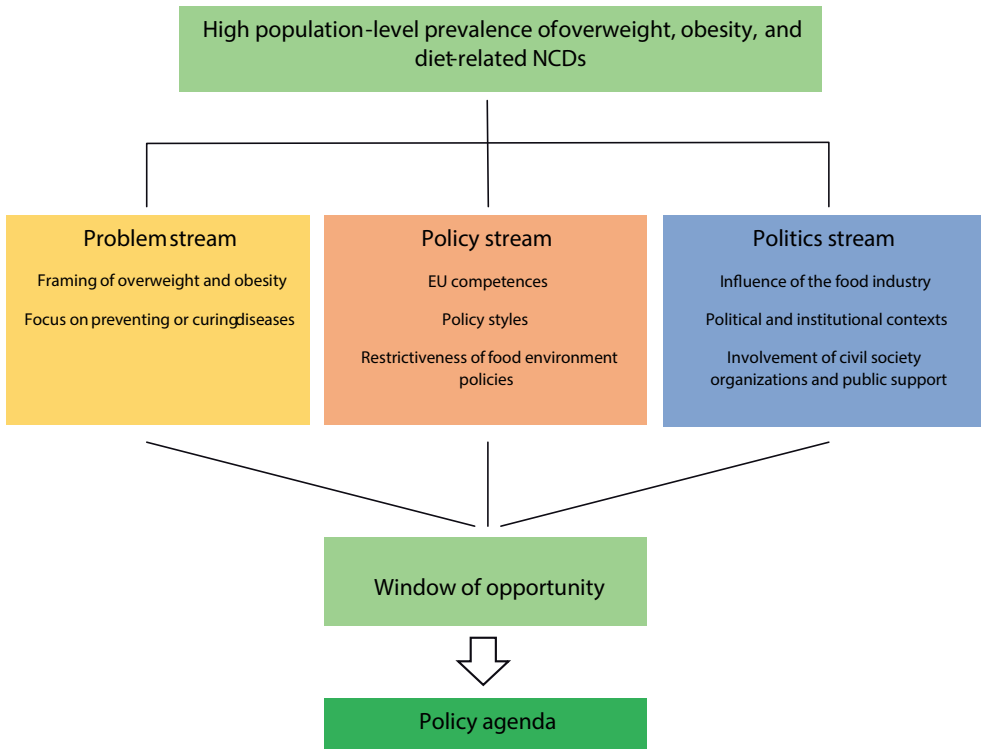


Figure 1. Kingdon's Multiple Streams Framework (16).

7.2.1.1 Problem stream

The predominantly weak or low implementation of governmental food environment policies at EU level and at Dutch national level may be explained by how overweight and obesity have been framed by the EU and the Dutch national government and the larger focus on curing diseases than on preventing them.

Framing: individual responsibility for making healthy food choices

The weak or low implementation of food environment policies (Chapters 2 and 3) may be a result of both the EU and the Dutch national government framing overweight and obesity in the past as a problem of individuals. A systematic review and meta-synthesis on the application of policy process theories (including the MST) to obesity prevention also identified that issue framing around personal choices and responsibility, and the relative importance of treatment compared with prevention responses, are barriers to policy progress for obesity prevention (10).

At EU level, the White Paper *A Strategy on Nutrition, Overweight and Obesity-related Health Issues*, adopted by the European Commission in 2007, acknowledged the dramatic rise in levels of overweight and obesity in the EU population, particularly among children

(17). However, the strategy stated explicitly that public policies should take into account that *individuals are ultimately responsible for their lifestyle, and that of their children*, while recognizing the importance and the influence of the environment on their behavior (17). Moreover, it is stated in this strategy that *only a well-informed consumer is able to make rational decisions* (17). This further emphasizes individuals' own responsibility for making healthy choices when provided with clear, consistent, and evidence-based information related to dietary behavior. Nutrition labeling is proposed as one way that information can be passed on to consumers and used to support healthy decision making in relation to the purchasing of foods (17). Indeed, the study in Chapter 3 showed that EU-level policies relating to ingredient lists and nutrient declarations and to nutrition and health claims were rated strongest among all policy indicators; they were rated as having a moderate strength.

In the Netherlands, the Dutch Ministry of Health in diverse policy notes has addressed the importance of healthy food intake since the early 1980s, and more specifically in relation to the goal to halt the rise in overweight and obesity since the early 2000s (18). Although successive ministers and state secretaries in the Netherlands have acknowledged that making healthy food choices in an unhealthy food environment is difficult, they consistently stressed, until the last decade, that the responsibility for making 'the right choice' lies with individuals themselves (2). Thus, prevention interventions implemented involved mostly the use of information-based instruments requiring a high level of individual agency, such as dietary guidelines (e.g., the Wheel of Five) or mass media health campaigns (e.g., balance day, I choose consciously (19)) (2).

Focus on individual treatment of diseases

Moreover, in the past decades, prevention has received much less priority than curative care in response to health issues (2, 20). Prevention was lost from sight partly because of pharmaceutical developments, and, in our healthcare system, attention has been devoted primarily to the individual treatment of people with complaints or a disease (21). Like governments in other countries, the Dutch government spent and still spends only a small part of its health and care budget on prevention (20). Therefore, the study in Chapter 3 also recommended increasing the budget for universal, selective, indicated, and care-related prevention in the national budget.

Changed framing of overweight and obesity

To facilitate progress on governmental measures to prevent overweight and obesity, reframing the problem of obesity is needed to acknowledge that, although individuals bear some personal responsibility for their dietary behavior, environmental factors exploit people's biological, psychological, social, and economic vulnerabilities, encouraging the overconsumption of unhealthy foods (9). During the last decade, awareness has

grown slightly globally, at EU level, and in European countries such as the Netherlands that unhealthy food environments heavily influence food choices and thereby contribute to current and increasing obesity pandemics (9).

At EU level, the *EU Action Plan on Childhood Obesity 2014-2020* developed by the member states stated that the proportion of the population who were overweight or obese remained worryingly high for adults, children, and young people, despite action at European level to reverse these trends (22). According to the action plan, and based on estimates from the WHO's Childhood Obesity Surveillance Initiative (COSI), around one in three children in the EU aged 6–9 years old was overweight or obese in 2010, whereas in 2008 the comparable estimate was one in four children (22). Importantly, the action plan encouraged the creation of environments in which health and wellbeing were promoted and the healthy option became the easy option (22). In the Netherlands also, the rising levels of overweight and obesity (to 48.7% of adults with overweight or obesity in 2017) increased the awareness that people do not make food choices as consciously and deliberately as previously believed (23). During the cabinet period 2017–2022, the State Secretary for Health acknowledged that obesity is a complex problem in which the environment plays an important role (23).

These changes to framing the problem of overweight and obesity could in theory have facilitated the adoption, development, and implementation of more structural policies that create healthy food environments. However, other factors at play in the policy and politics streams likely have impeded this progression.

7.2.1.2 Policy stream

Solutions to address the identified problems of overweight and obesity, and the contribution of food environments to these problems, take time to develop and evolve, and are shaped by various factors such as competences to implement food environment policies and the application of certain policy styles by governments. At EU level and in the Netherlands, restricted EU competences and pursuing consensus in policymaking resulted in predominantly voluntary and self-regulatory measures to create healthy food environments.

Restricted EU competences to require member states to implement policies creating healthy food environments

Although Article 168 of the TFEU addresses a clear responsibility for the EU in human health protection, the EU's competences to implement policies creating healthy food environment are limited. Article 168 states that the EU shall respect member states' responsibility to define their health policy, that EU action directed towards improving public health and preventing diseases shall complement national policies, and that any

harmonization of member states' laws and regulations is excluded (1). Moreover, Article 5 of the Treaty on the European Union states that the EU shall take action only when objectives can be better achieved by the EU than by member states (24). This implicates that member states take the lead in developing policies in the field of human health (25) and that the EU, by mandate, is active mainly in areas where the functioning of the internal market is concerned (e.g., by harmonizing labeling rules or by authorizing health claims or the Common Agricultural Policy (e.g., on fruit and vegetables or dairy products)) (26). Furthermore, member states themselves may prefer to develop some policies domestically rather than at EU level, such as tax policies (27). As a result of these limited EU competences to develop and implement food environment policies, there is strong heterogeneity across member states with respect to level of policy implementation, choice of policy type, and degree of restrictiveness (26).

Pursuing consensus in policymaking

The lack of regulatory interventions that create healthy food environments might also be explained by the policy styles applied by governments to certain policy domains (2). As a result of the EU's limited competences to implement restrictive legislation in the field of public health, policy efforts undertaken by the EU were focused on building consensus and seeking win-win solutions (27). This was done by developing, supporting, and coordinating partnerships for action at European level, for instance through the EU Platform for Action on Diet, Physical Activity, and Health, consisting of industry organizations, research organizations, and civil society (17), and through the High Level Group on Nutrition and Physical Activity, consisting of EU government representatives and providing guidance to the Platform for Action on Diet, Physical Activity, and Health (22). In the Netherlands, public health policy is also largely characterized by consensual policymaking (2, 28). The process towards the adoption of the National Prevention Agreement provides a good illustration of the pursuit for consensus by including a broad range of stakeholders, including representatives of health organizations, NGOs, municipalities, insurance companies, retailers, and the food industry (2, 28). Another example of this pursuit for consensus with the food industry is the Agreement to Improve Product Composition signed by the food industry and the national government in 2014 (2).

Voluntary and self-regulatory food environment policies

Restricted EU competences to develop and implement food environment policies, and the consensual policymaking style at EU level and in the Netherlands, resulted in the development and implementation of predominantly voluntary and self-regulatory food environment policies. To illustrate, at EU level, the Platform on Diet, Physical Activity, and Health promoted the implementation of more than 300 voluntary commitments in the area of nutrition and physical activity (29) and was seen by some NGOs as a way for the industry to pre-empt real regulation and propose self-regulatory interventions (27). For

instance, in 2007, the EU Pledge, launched as part of a commitment to the platform, is a voluntary initiative by food and beverage companies to change advertising to children under 12 years in the EU (30). Moreover, the Action Plan on Childhood Obesity 2014–2020 proposed predominantly *voluntary and self-regulatory* policies to be implemented by the EU and/or member states, such as ‘continue to *encourage* all food producers to enhance their reformulation actions’, and ‘*encourage* media service providers to set up stricter codes of conduct on audio-visual commercial communications to children regarding less healthy foods’ (22). In the Netherlands, the National Prevention Agreement of 2018 also includes predominantly self-regulatory and voluntary measures, such as ‘*supermarkets, restaurants and the catering industry are working to get people to consume more products that are featured in the Wheel of Five*’, ‘*in the Agreement to Improve Product Composition, additional undertakings will be made to reduce the calorie content for product groups that make a relatively large contribution to energy intake*’ and ‘*a restriction on the use of licensed media characters aimed at children under 13 years of age on product packaging and point-of-sale materials will be included in the self-regulated Advertising Code for Food*’ (23). Having mainly voluntary and self-regulatory policies contributed to the predominantly weak implementation scores of EU-level food environment policies and the predominantly low implementation scores of the Dutch national policies in the studies in Chapters 2 and 3. Only the policy indicators related to food labeling were rated to be of moderate strength at EU level and only the policy indicators ‘support and training systems to provide healthy foods in the public sector’ and ‘support and training systems to provide healthy foods in the private sector’ were rated as having a medium level of implementation in the Netherlands. Nevertheless, the somewhat higher scores on several infrastructure support indicators at EU level (e.g., public access to nutrition information) and at Dutch national government level (e.g., dietary guidelines, public access to nutrition information, monitoring public health and food environments, statutory health promotion agency) indicate that several supportive actions have been undertaken. An example of these infrastructure support actions at EU level is public access to nutrition and health data, with the regulation on nutrition and health claims prescribing the availability of an online register on nutrition and health claims (31). Examples in the Netherlands include the actions by the National Institute for Public Health and the Environment to monitor the reformulation of food products, food consumption, and the measures included in the National Prevention Agreement and the healthy dietary guidelines provided by the Dutch Health Council (*Guidelines Good Food*) and the Netherlands Nutrition Centre (Wheel of Five) (32).

7.2.1.3 Politics stream

The weak or low implementation of governmental food environment policies and the somewhat higher scores on infrastructure support at EU level and at Dutch national level may also be explained by the broader political discourse, which is seen as a very

powerful stream influencing the policy agenda (10). Although more regulations to create healthy food environments are needed, the WHO indicated that, because of a failure of political will, not one single country has managed to turn around the obesity epidemic (33). The will of governments to develop and implement food environment policies can be influenced by opposition from the food industry, political and institutional contexts, a lack of involvement of civil society and absence of public support (34, 35); this is explained in more detail below.

Opposition from the food industry to food environment policies

Strong opposition from the food industry has been identified globally as one of the major barriers to implementing governmental food environment policies, undermining political commitment for action (34, 36, 37). Corporations, including those in the commercial food industry, have a business purpose focused predominantly on short-term economic profit growth, instead of longer-term benefits to society and the environment (6). This results in a situation that represents a clear case of commercial success (wealthy corporations) but failure in terms of negative effects on health and environmental outcomes (6). Therefore, the influence of large commercial interests on the development and implementation of public policies that benefit population and environmental health needs to be reduced (6). Whereas EU-level infrastructure support to restrict commercial influence on policy development was rated as of moderate strength (Chapter 2), this infrastructure support indicator was rated as having a low level of implementation in the Netherlands (Chapter 3). During the policy development process, industry actors apply a diverse range of tactics to soften and weaken commitments, sometimes also referred to as an industry 'playbook' (28, 37, 38). These tactics include, for example, lobbying aimed at policymakers and politicians, making political donations, implementing self-regulatory measures to pre-empt and delay government action (policy substitution), using their privileged position with respect to knowledge about sales figures and market shares, public relations campaigns, and partnerships with community organizations (28, 37). Moreover, a key playbook strategy is framing an issue in a way that is more favorable for the industry in order to influence policies (38). Examples of this framing include efforts to shape how evidence is understood (e.g., portraying research as unreliable or uncertain, describing harmful outcomes as too complex to attribute to one cause or solution), focusing on free choice rather than the social determinants of health (e.g., portraying government action as nanny state-ism undermining free choice), and portraying industry action as well-intentioned steps to manage harms (38). Thus, these diverse tactics applied by the food industry often result in voluntary and self-regulatory measures that harm the market interests of food industries less than legislative or regulatory measures (6, 28).

In the EU, the food manufacturing industry is the largest industry sector in terms of turnover, accounting for €1098 billion annual turnover and 4.24 million employees in 2015 (39). As a result of the food industry's lobbying strategies (40), the EU has had difficulty in leading and making the private sector accountable when it comes to achieving EU health policy goals (41). An example of this is the strong political lobbying by food companies against the implementation of a Nutri-Score by trying to push their own labels and influence public health policies and public opinions about the need for a harmonized nutrition label (42, 43). A frequent argument made against a harmonized nutrition label is that nutritional information provided in back-of-pack nutrition tables is sufficient to guide consumer food choices (42). Another example of this lobby in this context is the opposition of the soft drinks trade association in Europe (UNESDA) to SSBs taxes, asserting that taxes will not solve obesity and have unintended consequences, such as job losses (39). In the Netherlands, the food industry's influence on weakening commitments resulted in mainly voluntary and self-regulatory food environment policies being included in the National Prevention Agreement (28). For instance, throughout the agreement drafting process, the industry lobbied strongly against the introduction of an SSBs tax (28). Arguments made included that the industry's own efforts to reduce the amount of sugar in SSBs had proved much more effective than an SSBs tax, that an SSBs tax would violate competition law, and that the measure did not belong in an agreement, given that it came from the government itself and not the societal stakeholders (28).

Political and institutional contexts may hamper the successful development and implementation of government policies that create healthy food environments

Political parties' background can influence their will to implement policies creating healthy food environments. Political organizations or parties with a liberal ideology seem more reluctant to endorse structural, universal, preventive measures, as they argue that these kinds of interventions impair freedom of choice and that individuals themselves are responsible for their health behavior (15). Conversely, health policies in general, and policies improving health behaviors specifically, are seen as more often advocated by social-democratic parties (44). However, scientific evidence is inconclusive and health policy does not appear to be strongly influenced by aspects of political representation (15, 45). Furthermore, it was concluded that governments implementing an SSBs tax in most cases consisted of liberal or conservative parties (44) and that the implementation of such a tax could follow both left-wing and right-wing political rationales (e.g., public health and raising revenue) (13, 44). Other factors that may play a role in decisions about whether or not to implement food environment policies is the coincidence of political and budget cycles, as political parties are generally in government for a restricted period of time (34, 46).

The study in Chapter 2 revealed that political support for food environment policies was of moderate strength at EU level. The absence of strong political support might be related to the fragmented political context. Both the European Parliament and the Council of the European Union play an important role in this political context, as they can amend legislative proposals developed by the European Commission and must agree on the adoption of legislation (27). However, in the European Parliament, institutional tensions between different parliamentary committees with different political viewpoints (25) (e.g., the lead committee responsible for health issues, namely, the environment, public health, and food safety committee and the committee on agriculture and rural development) may contribute to the absence of strong visible political EU support for adopting food environment policies. Moreover, the approach of the Council of the European Union, comprised of the relevant ministers from each member state (e.g., Health Ministers in the Health Council) may also give rise to particular tensions (27). That is, a council with a specific thematic focus (e.g., employment, social policy, health, and consumer affairs) is not allowed to comment or otherwise engage with the decisions taken by another council (e.g., economic and financial affairs), thus effective coordination at national level must be relied upon to ensure that positions expressed in one council take account of the full range of views domestically (27). Moreover, institutional challenges among the European Commission's Directorates-General (DGs) and their different policy objectives may hamper the successful development of food environment policies (25). Although climate change policy, trade policy, and agricultural policy all affect diet and nutrition (27), health features significantly only in the department dedicated to it – the DG for Health and Food Safety (39). Differential interests, such as receptiveness to farmers' interests (DG for Agriculture and Rural Development) and reluctance to address other sustainability dimensions such as socioeconomic considerations in the revision of the Green Procurement Criteria for food (DG for Environment), may impede the development of food environment policies (25). In addition, EU regulations may constrain the ability of national governments to implement public health regulations; this applies particularly to those measures that would affect free trade between countries (28). For instance, The EU Court of Justice declared a Belgian law that set maximum salt levels in bread at 2% to be in violation of the EU rules on the free movement of goods and rejected the Belgian government's argument that this was justified as a means to protect public health (28).

For the Netherlands, the study in Chapter 3 indicated that political support for implementing food environment policies was at a medium level. This might be explained by the political context in the Netherlands. In the prior election programs (2017–2021) of parties in past governing coalitions, some governing parties still emphasized that the responsibility for healthy dietary behavior lay with individuals themselves and that preventive measures should focus on informing people (CDA) (47), (VVD) (48). The other governing parties proposed a few food environment policies in their election

programs, such as binding regulations for product improvement (ChristenUnie) (49) and protecting children against unhealthy food marketing (D66) (50). However, until the latest coalition agreement (2021–2025) (see further information in section 7.4), these kinds of measures were not included. Moreover, like at EU level, in the Netherlands, the discrepancy between policy objectives may also have delayed the implementation of food environment policies, as critiques pointed to the dominant role of the Ministry of Economic Affairs vis-à-vis other ministries, arguing that economic and productionist interests too often prevailed over concerns about food safety, unhealthy diets, animal welfare, and ecological sustainability (51).

Lack of involvement of civil society organizations and absence of public support and demand for food environment policies

The development and implementation of multiple food environment policies may also have faced challenges because of little civil society support and insufficient demand from an informed public (6, 52). In many countries, the fact that civil society organizations (CSOs) calling for healthy food policies are few in number, weakly coordinated, and minimally resourced to promote governmental food environment policies can result in insufficient public support for government policies (52).

The need to engage civil society in the development and implementation of food environment policies is apparent, and such engagement may provide valuable information to the European Commission (53). CSOs can act as mediators of information or as catalysts to create space for health within policy debates (53). However, in our study in Chapter 2, the infrastructure support indicator on platforms between the EU and civil society was rated as weak. This might be explained by the existence of the EU Platform Diet, Physical Activity, and Health, from which seven CSOs resigned, because in their view this platform is not fit for purpose and cannot adequately contribute to reversing obesity and NCDs (27, 54). According to the CSOs, the continual decrease in resources, time, and attention afforded to the platform and the voluntary approach it embodies pointed to the limited impact that the platform could have (27, 55). Another explanation for the weak infrastructure indicator on platforms with CSOs may be that CSOs are less well-resourced than the lobbyists who oppose public health policies (56). Political leaders can pick and choose the organizations that they fund, shaping the CSOs they want to hear from and excluding those with contrary views from subsidization (27).

Previous studies have shown that, across countries, public support is lowest for policies that impose restrictions and greatest for the less intrusive policies (57). At EU level, there is public support for an EU that improves health, but there is little support for a bigger EU budget or ambitious EU actions that might infringe on member states' responsibility for health policy (27). At national level, studies have shown that the level of support

differs across countries; this may result from differences between these countries regarding individualism (57, 58). In individualist countries, such as the Netherlands, less support exists for rules and regulations imposed by the government, as people typically experience a higher need for personal agency and self-determination (57, 58). Therefore, people in these countries may see government policies as an infringement on personal freedom and frame government policies under the nanny state narrative, thereby potentially further exaggerating individualist beliefs and consequently reducing support (57).

To summarize, applying the MST framework illustrated how various factors relating to the problem, policy, and politics streams (framing overweight and obesity as an individual responsibility, a focus on cure instead of prevention, restricted EU competences, pursuing consensus in policymaking, a strong food-industry lobby, unfavorable political and institutional contexts, a lack of CSO involvement, and the absence of public support) may have reinforced one another and led to the predominantly weak or low implementation of food environment policies and the somewhat higher implementation of infrastructure support at EU level and in the Netherlands. However, the current severe, urgent, and complex obesity pandemic requires more forceful governmental interventions, setting aside some existing policy styles (2).

7.2.1.4 Recommendations for action by the EU and the Dutch national government

Our studies among experts allowed us to make recommendations to the EU (Chapter 2) and to the Dutch national government (Chapter 3) on multiple policy and infrastructure support actions to create healthy food environments. Many of the actions recommended to the Dutch national government, such as increasing the price of unhealthy foods (e.g., an SSBs tax) and restricting unhealthy food marketing to children, are in line with recommendations from international health organizations, including the WHO (59-63), and based on a large body of evidence (34, 64, 65). The actions recommended at EU level were a little different from the actions recommended to the Dutch national government, as they were formulated in light of the EU's facilitating competences with regard to developing public health policies. However, the actions implicate that there is more potential for the EU to create healthy food environments in member states, for instance by setting mandatory food composition targets or introducing a regulation that requires member states to restrict unhealthy food marketing to children. The further acceleration of the adoption of the recommended policy and infrastructure support actions at EU level and Dutch national government level will require an understanding of the above-outlined barriers to policy development and implementation and the successful generation of political commitment (66, 67). The recommended actions to create healthy food environments are further discussed in section 7.4.

7.2.2 The role of daily living conditions in explaining the impact of food environment policies on socioeconomic inequalities in diet

The theoretical study in Chapter 4 explained how broader living conditions (e.g., financial problems, housing insecurity, social practices) may lead to a higher exposure to unhealthy food environments among individuals in lower socioeconomic groups, which in turn may influence food preferences and behaviors. The role of these daily living conditions in socioeconomic inequalities in health and diet has also been explicitly addressed by the WHO Commission on the Social Determinants of Health (68) and in the recently published Nutrition Equity Framework (69). The WHO Commission states that the unequal distribution of intermediary factors – including material (e.g., housing conditions), psychosocial (e.g., stress, lack of social support), behavioral and biological factors associated with differences in exposure and vulnerability to health-compromising conditions – constitutes the primary mechanisms through which socioeconomic position generates health inequalities (68). Specifically related to food environments, the Nutrition Equity Framework illustrates the circular relationship that exists between the intermediate determinants including daily living conditions, food environments, and behavior and practices (Figure 2) (69). This framework proposes that these intermediate determinants of nutrition equity are shaped by sociopolitical contexts and social stratification (i.e., socioeconomic position, capital, and potential), which interact through processes of unfairness, injustice, and exclusion (69). Although the impact of associations between socioeconomic position and the intermediate determinants of health on health inequalities have been increasingly addressed by frameworks, attention on these associations in studies on the impact of policies on socioeconomic inequalities in diet is still limited.

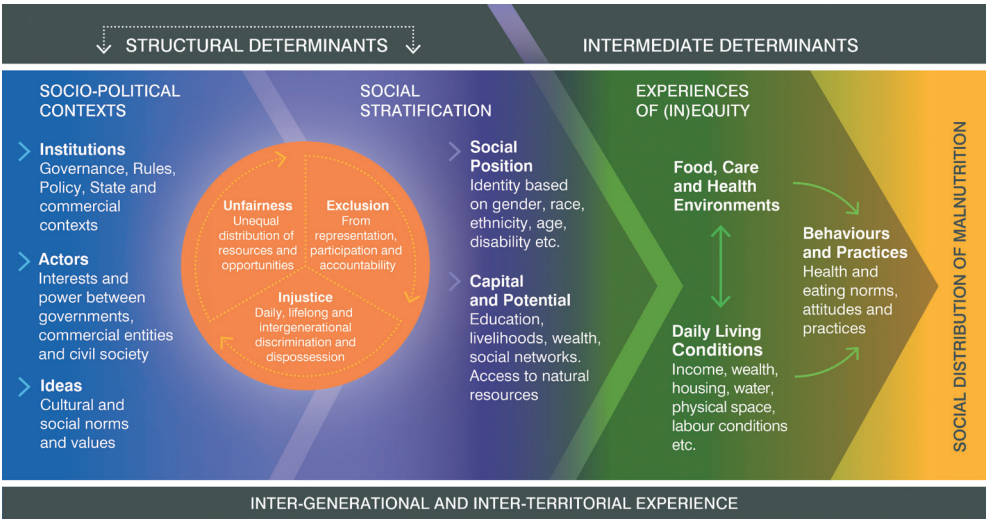


Figure 2. The Nutrition Equity Framework (69).

The theoretical study in Chapter 4 aimed to contribute to closing this gap by showing how individuals' daily living conditions may influence the differential impact of food environment policies on dietary behavior. To reflect on the findings of this study and understand the differential impact of food environment policies on socioeconomic inequalities in diet, Backholer et al.'s framework, which is founded on the agency-structure sociological theory, can be used (70). In this framework, agency represents one extreme on a continuum, which emphasizes individual free will and where the intended outcome of an intervention relies on the conscious action of the individual (70). Structure lies at the opposite end of the continuum and stresses that an individual behaves within the constraints or opportunities of the pervasive environment (70). Our study in Chapter 4 outlined that food environment policies that require higher levels of individual agency (e.g., food labeling) more likely lead to a widening of socioeconomic inequalities in diet (70), as individual agency for making informed healthy food choices may be constrained by the generally less favorable daily living conditions of individuals in lower socioeconomic groups (e.g., higher levels of financial scarcity) (Chapter 4). Conversely, structural policies (e.g., mandatory restrictions on marketing of unhealthy foods to children) are more likely to lead to a reduction in socioeconomic inequalities in diet (70), as they lead to an improvement of unfavorable food environmental features to which individuals in lower socioeconomic groups are more often exposed, as a result of elements in daily living conditions (e.g., social practices, media use) (Chapter 4). However, many universal preventive interventions could be called *agento-structural interventions*, as they are not purely agentic or purely structural (70). Agento-structural interventions account for the environment in which health behavior occurs but still require some level of individual agency for behavioral change (70). An example of an agento-structural intervention is a fiscal regulation of unhealthy foods that would make the purchase of unhealthy foods less attractive, while shifting the optimal default to healthy foods alternatives (e.g., water) through a price differential (70). The extent to which these agento-structural interventions may reduce socioeconomic inequalities in diet likely depends on a wide range of factors, including elements in broader daily living conditions (e.g., social support, financial, time, or physical constraint) (70). This implicates the importance of considering the effects of food environment policies on socioeconomic inequalities in diet in a broader context of factors that may influence dietary behaviors of persons in different socioeconomic groups. Moreover, a broader systems perspective, which provides insights into the main drivers and underlying mechanisms of unhealthy and healthy dietary behaviors among different subgroups in the population, can contribute to the identification of leverage points for change and the formulation of food environment and social policies needed to reduce socioeconomic inequalities in diet (71).

The study in Chapter 5 also aimed to contribute to taking broader factors underlying dietary behaviors into account. It investigated the differential impact of food environment policies (i.e., food-related taxes) on the healthiness of food purchases of subgroups experiencing differential levels of financial constraint or stress. This study did not find significant evidence for financial constraints modifying the effect of food-related taxes on the healthfulness of food purchases. This might be explained by the fact that implementing price interventions without additional interventions is not sufficient to modify the healthfulness of food purchases, especially among people experiencing higher levels of financial constraint (72). Several other studies did not find a modifying role of income or educational level in the association between price interventions and food purchases (72-74), although the evidence is inconclusive (75, 76). Moreover, people may have different reasons for changing and subsequently maintaining their (un)healthy behavior (72). For instance, arguments related to stress, limited benefits, class distinctions, social support, and knowledge of risk can all shape motives for (un)healthy behavior (77). Additionally, daily experiences of stress, scarcity, and cognitive demands can lead to a present-biased mindset that prioritizes one's immediate needs (e.g., solving financial problems) and gratification (e.g., junk food) over longer-term goals (e.g., dietary choices that contribute to improved health) (77, 78). However, neither did we find significant evidence for a modifying role of perceived stress on the effect of food-related taxes on the healthfulness of food purchases (Chapter 5). The design of our study (a virtual supermarket experiment) may have contributed to this, as people experiencing higher levels of stress might have less cognitive bandwidth available to participate in such an experiment (79). Thus, although investigating effects of food environment policies on differential subgroups' dietary behavior is valuable, finding statistically significant results for a modifying role of underlying factors on different subgroups' dietary behavior might be difficult, requiring the formulation of well-thought-out hypotheses.

In addition, visualizing the results of moderation analyses can provide important insights. In Chapter 5, visualizations of the results in the study suggested that, in the control condition, the overall healthiness of food purchases was lowest and SSBs purchases were highest among those with moderate/high levels of financial constraint. Compared to the control condition, in a nutrient profiling tax condition, the overall healthiness of food purchases was higher and SSBs purchases were lower, especially among those with moderate/high levels of financial constraint. Indeed, prior evidence also suggests that experiencing financial constraints and stress as a result of unfavorable daily living conditions can lead to poorer dietary choices and that individuals in lower socioeconomic groups experiencing budget constraints may react more strongly to price changes (75, 76). Therefore, and in line with earlier studies, this study indicates the need to further explore the modifying role of underlying mechanisms such as stress

and financial constraints to investigate the influence of food environment policies on socioeconomic inequalities in diet (75, 80).

7.2.3 The impact of an SSBs tax on socioeconomic inequalities in diet

An SSBs tax is an example of a governmental food environment policy that is likely to decrease socioeconomic inequalities in diet; this can be also substantiated by evidence (81). The study in Chapter 6 concluded that stakeholders in the Netherlands believe that an SSBs tax could contribute to a reduction in socioeconomic inequalities in dietary intake and health. However, the ethical considerations of the effects of an SSBs tax on equality are debated (82). Tax opponents argue that SSBs taxes are regressive and therefore unfair (82). In the study in Chapter 6, this regressive financial effect of an SSBs tax was mentioned by participants from all stakeholder groups. However, some participants also mentioned that the regressive effect is likely to be marginal for this specific SSBs tax. Indeed, studies found only a small difference in the impact of SSBs taxes on spending between low- and high-income households (e.g., an additional 0.1–1.0% of annual household income for low-income vs. 0.03–0.6% for high-income households) (82). Moreover, in the study in Chapter 6, participants from all stakeholder groups except trade associations indicated that an SSBs tax could have progressive health benefits among lower socioeconomic groups. Indeed, this progressive effect of SSBs taxes is substantiated by evidence (83, 84) and is also an argument frequently used by tax proponents emphasizing the distribution of health benefits (82). Wright et al.'s (83) review of empirical studies states that available research does not sufficiently address the question of whether the progressive effects exceed the regressive effects of health taxes. However, a study that analyzed the ethical implications of SSBs taxation suggests that there is a strong ethical case for SSBs excise taxes that likely promote greater equality, because the largest health benefits from the tax are expected to accrued to lower socioeconomic groups, even more so when revenues are spent on health and social equity (82).

Furthermore, the study in Chapter 6 highlighted the need for additional interventions to implement an SSBs tax, in order to reduce SSBs consumption among lower socioeconomic groups. This is in line with Backholer et al.'s argumentation that complementary interventions should be incorporated to maximize effectiveness among lower socioeconomic groups (70). Frohlich and Potvin (2008) also argued that selective prevention strategies that specifically address the needs of vulnerable populations should be implemented, in addition to universal, preventive measures (85). The Dutch Scientific Council for Government Policy emphasized that interventions should be aimed at vulnerable groups whose health is the poorest and where the greatest health benefits can be obtained, in addition to universal policies (86). Thus, for universal preventive measures to be most effective, support by selective preventive measures or

elements targeting specific subpopulations is needed, such as food voucher schemes to buy healthy foods or free healthy school lunches for people below a certain income level (71, 86, 87).

7.3 METHODOLOGICAL CONSIDERATIONS AND IMPLICATIONS FOR FUTURE RESEARCH

The studies included in this thesis were conducted using a variety of methodologies. To evaluate the implementation of governmental food environment policies by the EU and the Dutch national government, the Food-EPI tool and process was applied (Chapters 2 and 3). To investigate how food environment policies may differentially impact on socioeconomic inequalities, three different studies using different methodologies were conducted (Chapters 4, 5, and 6). The methodological considerations and the implications for future research that arise from these considerations are discussed below.

7.3.1 Methodological considerations and future research to evaluate the implementation of food environment policies

7.3.1.1 Strengths of the Food-EPI and its application in future research

The main strength of the Food-EPI studies is that they provided comprehensive, in-depth, and systematic evaluations of EU-level and Dutch national food environment policies. By applying the Food-EPI, extensive evidence documents describing existing EU-level and Dutch national food environment policies were created, insights into the state of affairs regarding the implementation of these policies were gained, and lists of recommendations on how to improve food environments in EU member states in general, and in the Netherlands specifically, were developed. Together, these results can be used to support advocacy efforts and increase governments' accountability for improving food environments (5). Indeed, studies have shown that applying the Food-EPI can contribute to policy change (88). Moreover, the fact that the Food-EPI is internationally standardized allows for comparison of the implementation of governmental food environment policies across countries, as has been done across countries globally (5) and across European countries (4).

The Food-EPI can be used in future studies to monitor progress on the implementation of food environment policies over time (e.g., every five years) within countries and allow for further comparisons between countries to catalyze government action to create healthy food environments and reduce the burden of obesity and NCDs (89, 90). Moreover, whereas the studies in this thesis applied the Food-EPI at supranational and national level, it would be valuable to adapt this tool to be able to apply it at local government (e.g., municipality) level. Local government authorities have a critical and unique role

to play in shifting population-level diets, as their closeness to their constituents and communities gives them the opportunity to respond quickly to citizens' (changing) needs (91, 92). Important food environment policies that can be, and have been, taken by local governments include, for example, establishing guidelines for school feeding programs, restricting unhealthy food outlets, or restricting unhealthy food marketing (91, 92). For instance, in London and Amsterdam, local governments have introduced a ban on unhealthy food marketing in public transport (66). Additional assessments of the implementation of food environment policies at local level would contribute to getting a comprehensive overview of policy implementation and would be relevant, as the implementation of governmental food environment policies at one level may also be dependent on the possibilities created at another government level. For example, the VAT rate on fruit and vegetables at national level depends on EU regulations, and policies to ban fast-food restaurants at local level depend on regulations at national level. In the Netherlands, the national government recently announced that it would provide local governments with legal opportunities to regulate the availability of fast-food outlets (93).

In addition to applying the Food-EPI at local level, it would be advisable to develop indicators for benchmarking in settings such as local activity centers (e.g., high streets and markets) and university campuses (94). Future studies applying the Food-EPI are also recommended to include policy indicators related to environmental sustainability (94), as creating healthy as well as sustainable food environments is important to improve population diets, which play a critical role in linking human health and environmental sustainability (95).

7.3.1.2 Limitations of the Food-EPI

Despite the strengths of the Food-EPI, some limitations of the tool should also be mentioned. Firstly, the Food-EPI is not a validated instrument and the ratings by experts are subjective. The results are also affected by the different backgrounds and interests of participating experts (e.g., food and health experts), and this may lead to bias (4). Furthermore, participation drop-out (fewer experts participated in the second and the final survey compared with the first) might have led to selection bias. However, all the experts were provided with the same evidence document with the food environment policies on which they were asked to base their ratings. Moreover, the inter-rater reliability for the Food-EPI policy indicators indicated that there was strong agreement among experts in our two Food-EPI studies about the strength or implementation at EU and Dutch national level. It might be expected that this would also apply to the selection of recommended actions and prioritization of these actions, if more experts had participated in the second and the final survey.

Nevertheless, as separate expert panels independently assessed the degree of policy implementation in different countries and at EU level, the comparability of current results might be limited, as some expert panels might have been more critical than others (4). Moreover, the composition of expert panels might be different in future Food-EPI studies at EU level and in the Netherlands, thereby potentially constraining comparability over time. The study that compared the results of Food-EPI studies in 11 countries globally partly addressed this by expressing and interpreting data in bands of implementation scores rather than using absolute total scores to rank countries (5).

Secondly, the Food-EPI process requires an intensive and time-consuming involvement of experts (5). Experts had to read the full evidence document, including the best practice examples, and participate in three surveys to rate existing policies and recommend and prioritize actions. In addition, for some policies or infrastructure support indicators, fewer best practice examples have been identified than for others, possibly making the ratings of some indicators more difficult. Moreover, benchmarking food environment policies against best practice examples may hold countries accountable to a low standard and potentially lower demands on governments (96). However, experience in New Zealand showed that conducting a repeated Food-EPI becomes less burdensome and less resource intensive, and it is anticipated that the best practice examples will change and improve over time (5).

7.3.1.3 Improvement of the Food-EPI tool and the use of other tools to evaluate food environment policies in future studies

To partly address subjectivity, the Food-EPI could be improved by surveying panel members' expertise to guide panel selection and ensure that there is an appropriate mix of knowledge across the range of policy areas included in the Food-EPI tool (88). Establishing a central international or European assessment panel, rather than separate assessment panels across countries, may also help to increase comparability of assessments across countries (88). In addition, relevant country-level contextual information such as demographic and socioeconomic data, key information on population health, available infrastructure, resources and capacity, political system and structure, should be collected when comparing countries, as these factors might influence the experts' assessments (90).

Future studies evaluating food environment policies also require the application of other tools with a lower degree of subjectivity. However, most other available tools to assess governmental food environment policy implementation also include degrees of subjectivity, by using expert panels, interviews, and/or self-administered questionnaires among non-government as well as government experts (97). The NOURISHING policy index has some advantages over the Food-EPI tool. Firstly, the NOURISHING policy

index, which has been pilot tested recently, allows for a more objective assessment of food environment policies than the Food-EPI. That is, the policy valuation is based on the presence or absence of a certain policy (e.g., yes/no) and on associated policy attributes valuing the quality of the policy design (e.g., legislation and regulations, standards, or guidelines), rather than the Food-EPI expert valuation, which is based on rating the implementation of policies on a scale (96). Secondly, the quality of the design of implemented policies is assessed by reference to aspirational benchmarks, holding national governments to a higher standard than currently implemented best practices applied by the Food-EPI (98). Thirdly, the NOURISHING policy index builds on existing NOURISHING resources (e.g., the NOURISHING database with more than 1000 verified nutrition and diet-related governmental policy actions currently in effect globally), making the tool less time-consuming and less intensive than the Food-EPI (98).

However, the NOURISHING policy index does not include all indicators covered by the Food-EPI (e.g., infrastructure support indicators) and does not cover the formulation of concrete actions for governments to improve the healthiness of food environments (98). Moreover, the NOURISHING index is applicable only to assessing national food environment policies, whereas the Food-EPI can also be applied at other government levels. Nevertheless, comparison of the Food-EPI indicators with the NOURISHING index benchmarks and the Food-EPI country reports with the results of the NOURISHING index reveals that the tools have similarities and communicate similar overall results (98). For instance, Dutch government policies related to food prices, food marketing, and creating a healthy retail and food service environment were, like in the Food-EPI, assessed as poor in the NOURISHING policy index (98).

Thus, in future studies, the Food-EPI can be improved by, for instance, establishing a central international or European assessment panel, including more objective assessments based on the presence or absence of aspirational policy attributes, and referring to aspirational benchmarks instead of best practices, by integrating assessment methods or results of the NOURISHING policy index. Moreover, for sustained impact, studies applying the Food-EPI will need to be embedded within other broader monitoring initiatives such as the WHO NCD Global Monitoring Framework or the Food Systems Dashboard, which can provide valuable information on where and how to intervene to improve human and planetary health (94, 99).

7.3.1.4 Investigating underlying barriers to policy implementation and effects of food environment policies

Applying the Food-EPI tool provides insight into the current state of affairs regarding the implementation of governmental food environment policies, but it does not lead to insights into why food environment policies are implemented or not, and what the

effects of implementation are. Therefore, a recommendation for future studies would be to investigate why differences can be observed in performance across countries (94). As addressed earlier in this thesis, barriers such as the framing of the issue of overweight and obesity, applying certain policy styles, political and institutional contexts, industry influence, and the absence of public support may play a role in causing certain policy implementation gaps. Insights into possible barriers to policy implementation and how to overcome these barriers can support the future uptake of policies (100). For instance, it might be hypothesized that the uptake of food environment policies may be supported if governments acknowledge the important influence of food environments on population diet, apply an 'imposing' policy style that does not pursue consensus, have governing political parties and a population that are in favor of implementing food environment policies, and have regulations that restrict the influence of the food industry on policy developments. Additionally, crises (e.g., health, financial) may play a facilitating role in the adoption of food environment policies. For instance, studies showing a relation between the severity of COVID-19 illness and overweight and obesity have led to considerable attention being given to the problem of overweight and obesity (13, 101). Moreover, studies have shown that state budget deficits could play a facilitating role in the adoption of food-related taxes (15, 102).

To gain insight into whether implementation of, or improvements in, food environment policies actually result in an improvement in the healthiness of food environments, the effects of these policies must be monitored, e.g., monitoring the status of food environments but also investigating the effects on food purchases and food consumption. An example is a recent study of the healthiness of food availability and food promotions in supermarkets and food service outlets in the Netherlands (103), which – compared with earlier years – did not show substantial improvements (104, 105). Another example is evidence showing that the implementation of an SSBs tax in the United Kingdom led to product reformulation (i.e., reduction of sugar in soft drinks) and a reduction in consumer purchases of soft drinks (106). To monitor and evaluate the commitments made by the food and beverage industry, the Business Impact Assessment on Obesity and Population Nutrition (BIA-Obesity) developed by INFORMAS could also be used (107). It is also important for future studies to investigate the effects of the implementation of food environment policies on longer-term population health outcomes (i.e., overweight and obesity), for instance by conducting natural experiments (108).

Additionally, the systems-based PEN framework can help future studies to provide an overview of the complex processes of policy design, implementation, and outcomes, how each of these feeds into the others and interacts with the context, and how a focus on equity can be assured in each of these domains (109). For instance, if impact evaluations

(policy outcome domain) show that the public acceptability of selected policy actions is low, this may imply that adaptations to the execution strategy (e.g., enforcement strategies) or delivery mechanisms or agents are needed (policy implementation domain) (109). The framework therefore also indicates that the involvement of the target population in each domain is crucial so that policies match with (different) target groups' preferences, capabilities, and opportunities (109). To conclude, future studies investigating underlying barriers to policy implementation and the effects of food environment policies can strengthen the evidence base and help to support effective advocacy, inform policy decisions, and thereby lead to effective development and implementation of future food environment policies (67).

7.3.2 Methodological considerations and future research to investigate how food environment policies may impact socioeconomic inequalities in diet

As limited research has been conducted taking underlying mechanisms into account into the potential differential impact of food environment policies for lower and higher socioeconomic population groups, the studies in this thesis used a variety of approaches and methodologies to gain further insights into how these policies may impact socioeconomic inequalities in diet.

By applying theories explaining socioeconomic inequalities in health (Chapter 4), we were able to illustrate the potentially differential impact of selected food environment policies among people in lower and higher socioeconomic groups. Overall, the application of theories explaining socioeconomic inequalities, such as Bourdieu's capital theory, can provide important insights into a wide range of underlying mechanisms regarding the effects of policies on inequalities in health behaviors but also on inequalities in other behaviors (e.g., volunteering (110) or opposition to governmental policies (111)). In Chapter 4 we focused on the concept of cultural capital to explain differential effects of food environment policies on health behaviors, but Bourdieu's theory distinguishes between three different forms of capital (i.e., economic, cultural, social) (112). Moreover, these three forms of capital can interact with, and be conditional on, one another, where having a specific level of one form of capital can encourage or limit the use and acquisition of another form of capital (113, 114). Therefore, it would be interesting to further conduct research based on Bourdieu's theory, as reasonings based on the interrelations of the three forms of capital and their conditionality influencing dietary behavior could provide valuable, additional perspectives. For instance, having a strong, supportive social network (social capital) has the potential to increase healthy dietary behavior when shared values and skills to pursue a healthy lifestyle (embodied cultural capital) are present and promoted among individuals within such a network (114, 115). This can lead to the formulation of hypotheses for future studies positing that structural, universal, preventive policies that dampen the importance of social and

embodied cultural capital (e.g., policies that improve the composition of unhealthy foods or restrict unhealthy food marketing) may be especially beneficial for people who are not supported by a social network that values and promotes healthy behavior.

Theoretical insights can lead to the formulation of hypotheses that can be tested in empirical studies, for example moderation analyses. An advantage of moderation analyses is that they could further contribute to the development of theories for explaining health inequalities. However, it should be considered that, in these moderation analyses, a lack of power for detecting interaction effects might be an issue. Nevertheless, it is essential that future empirical studies investigate far more often the differential effects of food environment policies for specific subgroups in the population. So far, studies investigating interactions similar to those in our study in Chapter 5 and potential differential effects of nudging and pricing strategies based on personal characteristics have been conducted in virtual environments, which might not reflect food purchases in the real world (116).

As shown in Chapter 6 in this thesis, qualitative studies can complement theoretical and quantitative/ experimental studies. They can provide useful insights into how different stakeholders view the impact of food environment policies on socioeconomic inequalities in diet, the underlying mechanisms that they address, and how the pro-equity impact of policies can be improved. However, it should be borne in mind that participants interviewed for our study might not be representative of their full stakeholder group (e.g., health and consumer organizations, policymakers, parliamentary parties) and that the study focused specifically on stakeholder groups and the implementation of an SSBs tax in the Netherlands; this highlights the relevance of considering the national context when interpreting these results. Nevertheless, the insights generated by this study into how an SSBs tax may impact on the budgets and dietary intake of people in lower and higher socioeconomic groups are not country specific and therefore likely be comparable to other high-income countries. Future studies need to generate more evidence about the contribution of an SSBs tax to health inequalities and should further investigate issues addressed by participants in our study, such as possible adverse health effects among lower socioeconomic groups and the additional interventions that would be needed to prevent these adverse effects.

Thus, the studies in this thesis provided important insights into several underlying mechanisms – including food environment exposures, daily living conditions, and individual-level factors – that may impact on socioeconomic inequalities in diet. However, to account for all the determinants involved in the numerous underlying mechanisms between socioeconomic position and dietary intake, the application of a systems perspective (a system of multiple, interconnected factors exerting a non-linear

influence on dietary intake) is recommended in future studies (81). These insights into all interactions between individuals in lower socioeconomic groups, their environments (e.g., sociocultural, physical), and the desired behavioral changes can help to better understand the persistence of socioeconomic inequalities in diet and how these inequalities can be reduced (117). An umbrella review showed how poor dietary intake in low-income groups can be presented as an emergent property of a complex adaptive system that sustains an unhealthy food environment (71). For instance, evidence from that review indicates that unhealthy foods tend to be selected in cost-determined purchases because of objective and subjective product characteristics (e.g., price, longevity, palatability, brand allegiance, potential for satiety), restricted longer-term financial planning (e.g., pre-specified plans to manage food budgets, limited interest in promotions of healthy foods), individual capability (e.g., cooking skills), and acceptability in the household (e.g., avoidance of food waste) (71). Consequential prioritization of unhealthy foods in cost-determined purchasing pushes sociocultural and individual dynamics to favor unhealthy food intake, thereby over time reinforcing the acceptability and affordability of these foods (because of the wider supply-and-demand loop), further strengthening their preference in cost-determined purchases (71).

7.4 IMPLICATIONS FOR POLICY AND PRACTICE

7.4.1 Strengthen food environment policies to create healthy food environments

To improve food environments, the top five policy actions and the top five infrastructure support actions were recommended to the EU and the top six policy actions and top five infrastructure support actions were recommended to the Dutch national government for immediate implementation. However, all the actions recommended in the studies, 19 policy and 18 infrastructure support actions for the EU and 18 policy and 11 infrastructure support actions for the Dutch national government are recommended to be implemented in the near future to create healthy food environments. Based on these recommendations, the most important implications for policy and practice are described below.

7.4.1.1 Develop an EU-level comprehensive policy framework to create healthy food environments in EU member states

The study in Chapter 2 recommended the EU, amongst other actions, to develop a high-level EU NCDs Prevention Strategy, to include in EU work programs clear priorities to reduce health inequalities, and to harmonize the promotion of healthy diets with issues such as climate change and environmental protection. The Farm to Fork (F2F) Strategy, published by the EU in 2020, has already partly addressed this wider approach, as it integrates all stages of the food system (from production to consumption) and includes the importance of creating a healthy and sustainable food environment (118). However,

as not all actions recommended in the EU Food-EPI are included in the F2F Strategy, and most actions in this F2F Strategy are voluntary and self-regulatory (e.g., expecting food companies to take action on reformulation and adapting marketing strategies), the EU Food-EPI actions could very well be used to complement the actions in the F2F Strategy to create healthier and more sustainable food environments in EU member states.

Moreover, in December 2021, the European Commission launched the Healthier Together – EU NCD initiative (2022–2027), which promotes a holistic and coordinated approach to prevention and care by addressing environmental, commercial, and lifestyle-related risk factors (e.g., improving nutritional quality of food, reducing health inequalities) (119, 120). This initiative aims to support EU countries in identifying and implementing effective policies and actions to reduce the burden of NCDs and improve citizens' health and wellbeing (119, 120). Although the initiative suggests policy options for member states to implement (e.g., subsidies to increase the intake of fruit and vegetables, providing healthy meals at schools, regulating the marketing of unhealthy foods and beverages to children below 18 years of age) and addresses underlying health determinants (121), it does not include mandatory structural interventions that the EU itself should implement such as formulating ambitious, mandatory food composition targets or requiring member states to restrict or ban the marketing of unhealthy foods to children.

The EU could boost its regulatory capacity at EU level (28), for instance by providing a clear, comprehensive framework including binding regulations to ensure the uptake of food environment policies in, and alignment of these policies between, member states. The need for a legislative framework for a sustainable food system has also been addressed in the F2F Strategy (118). However, the F2F Strategy leaves open what such a framework would look like in practice (25). Ultimately, the strategy's success will depend on the resolution of challenges like its vulnerable institutional embedding within the European Commission and limited coordination with the EU's member states (25). Furthermore, the EU could increase regulatory powers at national level (28), of which the recently adopted measure to allow member states to implement a VAT exemption of 0% for all fresh fruit and vegetables is an example (122). Thus, the improvement of food environments cannot be organized at one level; both the EU and the member states are needed (28). The studies in Chapters 2 and 3 showed, by applying the Food-EPI at both supranational (EU) level and national level, that national governments are dependent on EU regulations and some policy changes cannot be implemented without policy changes at EU level.

Moreover, the fulfilment of the Sustainable Development Goals might be an opportunity for the EU to shape an agenda and narrative in which health becomes directly and

indirectly a focus of EU policies (27). With this fulfilment, the promotion of healthy diets can be harmonized with other issues of concern such as climate change and environmental protection and aligned with the inclusion of priorities to reduce health inequalities or protect vulnerable populations in the multi-annual work programs/annual State of the Union, as also recommended in the study in Chapter 2.

Furthermore, the EU is recommended to take a stronger role with regard to benchmarking and evaluating food environment policies, supporting and coordinating the exchange of good practices, and supporting member states with monitoring the status of food environments (Chapter 2). The EU Public Health Best Practice Portal, included in the EU NCD's Initiative guidance document, could be an instrument for this. Together, these actions could contribute to the creation of healthy food environments and the reduction of the burden of obesity and NCDs in EU member states.

7.4.1.2 Strengthen the Dutch national prevention policy and strongly address improvement of the food environment

The Dutch national government is recommended to strengthen its national prevention policy, in which the improvement of the food environment should be strongly addressed. The recommended actions in the Food-EPI study indicate the need for more ambitious, structural, and binding prevention measures to create healthy food environments (e.g., ban unhealthy food marketing to children, decrease the price of healthy foods, increase the price of unhealthy foods, implement mandatory and ambitious food composition targets). This need was also recognized by the former State Secretary for Health in reaction to our Food-EPI report (June 2021) (123) and by the current State Secretary for Health in a letter to the parliament (December 2022) (93). In the coalition agreement 2021–2025 and the December 2022 letter to the parliament, the Dutch government announced that it would implement some structural and binding measures to create healthier food environments (93, 124). Actions announced include making *binding* agreements with the food industry about healthier foods, increasing the consumption tax applied to SSBs, and investigating how to introduce a sugar tax and lower the current VAT tariff of 9% on vegetables and fruit to 0%. Moreover, the government announced the implementation of legislation to ban unhealthy food marketing to children up to 18 years old and to provide local governments legal possibilities to regulate food environments, for instance by banning fast-food restaurants (93).

These announcements are great steps forward; however, because of the urgency of the obesity pandemic, it is recommended that these measures should be implemented as soon as possible and combined with other recommended policies from our Food-EPI study to create healthy food environments and improve population diet. Other recommended policy actions include, for instance: formulate clear rules for

supermarkets, quick-service restaurants, caterers, and shops to increase the relative availability of healthy foods; encourage supermarkets and food producers to promote healthy foods via proven effective incentives (Chapter 3).

In addition, the government is recommended to include these measures in a government-wide national prevention policy and implementation plan containing universal, selective, indicated, and care-related prevention measures, aimed at healthy food consumption and the reduction of diet-related chronic diseases among the entire population. In this prevention policy and implementation plan, it is necessary to address the physical, socioeconomic, and digital living environments and underlying socioeconomic determinants of unhealthy food consumption (e.g., poverty, stress). All ministries should be made co-owners of this policy, and collaboration between the ministries in this field should be encouraged. In this way, the creation of a healthier food environment could be combined with interventions in social and economic domains (e.g., debt assistance, enhancing job security, financing food-related income support, offering free healthy school lunches), thereby contributing to a decrease in socioeconomic inequalities in diet and to a reduction in obesity and NCDs. These comprehensive policy approaches are important, as dietary behaviors are impacted by complex and interwoven systems (71, 81, 125). Therefore, it is unlikely that a sustainable effect on dietary behavior will be achieved through single, isolated interventions aimed at increasing the accessibility, availability, affordability, or acceptability of healthier products (71, 81). In order to reshape the system dynamics driving unhealthy food environments, a comprehensive package of intervention measures (including structural, universal, preventive measures that create healthy food environments) is needed to enable sustainable change in population diet (70, 71, 126). Some European countries have already developed a more integrated strategy aimed at improving the food system. For instance, the Flemish government developed an inclusive food strategy, Go4Food, by applying a systems-based approach with four strategic pillars: Healthy and sustainable food for everyone; Food system inside ecological borders; All for a resilient food economy; Food connects farmer to citizen (127). This strategy was developed in collaboration across different policy domains, such as agricultural policy, environment, economy, labor and social economy, health and wellbeing, and education (127). In Germany also, the development of such a sustainable and healthy nutrition strategy is high on the political agenda (128).

Moreover, the Dutch national government is recommended to take a stronger role with regard to monitoring the food environment (policies). Concrete, measurable targets should be developed (preferably integrated in the national prevention policy) for preventive measures aimed at healthy food consumption, a healthy food environment, and reducing NCDs. The achievement of these targets can be assessed

by an independent organization (the National Institute for Public Health and the Environment), and a comprehensive overview of the achieved and unachieved results on these targets should be made publicly available. Furthermore, an instrument should be developed for reporting about the food availability in supermarkets, shops, quick-service restaurants, and catering that shows the proportion of healthy foods in relation to the total food product range. Structural monitoring can provide important insights into whether policies contribute to creating a healthy food environment, improving population diet, and reducing obesity and NCDs.

7.4.2 Use a systems-based approach to improve population diet and reduce socioeconomic inequalities in diet

As population diets are produced by long-term feedback loops across the wider food system (129), as well as by social, economic, commercial, and political systems that drive the production, distribution, marketing, and consumption of food (69), there is great potential for applying a systems-based approach to improve population diet (130). Such systems-based approaches can specify how food environment policies (as formulated and prioritized in Chapters 2 and 3) are supposed to impact on what outcomes, including feedback loops and interactions, with a focus on context and equity (109). For instance, already during policy design, potential (unwanted) side effects of policies need to be considered, as this allows policies to be reshaped or additional, counteracting policies to be developed (109). Likewise, interactions with other existing policies should be kept in mind (109). Furthermore, using a systems-based approach to improve population diet could provide insights into how food environment policies could be linked to solutions to other societal problems, such as climate change (6). This could create windows of opportunity for policy change and drive shifts in food systems that explicitly include benefits to human health, environmental sustainability, and equity, rather than focusing only on what is currently most often the ultimate goal: economic prosperity (6, 39). Moreover, views of stakeholders (e.g., target population, implementers, policymakers, lobbying groups) should be considered, as their involvement and interactions will also affect policy design, implementation, and outcomes (109).

Importantly, using a systems-based approach can provide insights into the broader daily living conditions influencing the dietary behavior of lower and higher socioeconomic groups (80), into how policies would (taking these broader-level factors into account) affect the dietary behavior of people in these groups (109), and into the combination of food environment policies and policies tackling more distal determinants of unhealthy diets (e.g., financial debts, deprived housing conditions) that would be most effective in tackling socioeconomic inequalities in diet (as addressed in Chapter 4). Combining food environment policies and social policies is increasingly important in financially insecure times with rising energy and food prices and the resultant rising poverty levels. Examples

of useful additional measures include economic interventions aimed at facilitating longer-term financial management in low-income households (71), improving access to education and employment (131), or, as recommended in our study in Chapter 6, investing SSBs tax revenues in a fund from which supplementary interventions that benefit the health of people with a lower socioeconomic position can be financed (131). It is also important to combine actions relating to food environments with actions addressing the deeply rooted sociopolitical drivers of health and nutrition inequities (69). The reason why this is important is that neoliberalism ideologies (e.g., market freedom, minimal government intervention, an expanded role for the private sector) have obstructed the regulation of harmful commercial activities, negatively influencing food environments and disproportionately targeting and affecting vulnerable groups (69). Additionally, as systems out of which certain levels of health-related behaviors emerge consist not only of objective determinants, but also of different stakeholders' experiences, norms, and beliefs, the participation of all stakeholders including the most vulnerable groups is an important aspect in using systems-based approaches (117). Thus, to ultimately achieve equity in diet, power imbalances need to be addressed by holding the powerful to account and foregrounding the interests and voices of the most vulnerable groups (69).

7.4.3 Involve citizens and strengthen the role of civil society organizations in policy design and implementation

The engagement of people, communities, and diverse groups is crucial for achieving changes to food environments and food systems (6). Specifically, people can act as agents of change in their roles as elected officials, employers, parents, customers, and citizens and influence the societal norms and institutional policies of worksites, schools, food retailers, and communities (6). With that, popular support for governmental food environment policies can be generated, making the idea of taking policy action a powerful one for politicians to address (132). Moreover, citizen involvement can enable the development of governmental food environment policies that are relevant to people's needs, align with local contexts and values, and promote take-up by intended users (132, 133). Involving vulnerable and marginalized population groups most affected by unhealthy food environments can help to strengthen democratic systems, rebalance power towards public benefits, and mitigate inequalities (69, 134).

Moreover, governments could invest in increasing civil society action (6) by building strong relationships with CSOs that support healthy food policies (88). CSOs can, amongst other actions, independently monitor progress towards obesity action objectives, create a large demand for changes to food environments and systems (134), strengthen public interest coalitions, and ensure that policies represent and reach all community members to achieve impact (52, 133). These actions could offer an important counterweight to the

enormous commercial investments focused on promoting sales of unhealthy foods and opposing policies for healthier food environments (6). Brazil is a good example of having a formal mechanism to give civil society a strong voice in developing governmental food policies, i.e., the National Food and Nutrition Security System (134). Here, a government council with two-thirds representation from civil society translates resolutions from the national conference on food and nutrition security into political proposals that are transmitted to a cross-ministerial government body charged with translating them into government programs and implementing them (134). At EU level, in December 2022, the EU4Health Civil Society Alliance published a joint paper on ways to build a more meaningful engagement of public health CSOs in EU policymaking (135).

7.4.4 Strengthen the role of human rights to improve food environments

Community and civil society involvement and empowerment for action to improve food environments and reduce socioeconomic inequalities in diet and health cannot be separated from governments' responsibility to guarantee a comprehensive set of rights and ensure the fair distribution of essential material and social goods among population groups (68). Therefore, strengthening the role of human rights and national and international obligations to respect, protect, and fulfil these rights can play an important role in addressing health problems such as obesity and NCDs and improving food environments (6). Besides the human rights to food, health, cultural rights, and rights of a child, on October 8, 2021, the United Nations Human Rights Council adopted a resolution recognizing the human right to a clean, healthy, and sustainable environment (136). This international recognition paves the way for its effective integration in international law and stronger implementation domestically (136, 137), as it signals the UN member states' strong political commitment to this right (137). It is expected to lead to positive results regarding clean, healthy, and sustainable environments by raising public awareness and improving accountability and enforcement (137). In particular, it could be a catalyst for change by providing a strong basis for environmental litigation in courts, as was the case in the Urgenda case in the Netherlands, *Affaire climat* in Belgium, and *L'affaire du siècle* in France (137).

The Lancet Commission on Obesity proposes the use of a right to wellbeing framework that includes the human right to food, health, cultural rights, children's rights, and right to a healthy environment to address problems such as obesity, undernutrition, and climate change (6). Moreover, the Lancet Commission has recommended the development of a global framework convention on food systems by UN agencies and regional bodies (e.g., the EU) that would provide the global legal structure and direction for countries to translate the principles and guidelines into national laws to protect their populations from practices that undermine healthy food environments (6).

7.5 OVERALL CONCLUSIONS

This thesis shows that there is a lack of food environment policies supporting a healthy population diet at national level in the Netherlands and at EU level. To improve population diet, the EU and the Dutch national government should implement multiple actions in order to create healthy food environments. Such structural policies, for instance the introduction of an SSBs tax or the reduction of the VAT on fruit and vegetables to 0%, are also likely to contribute to a reduction in socioeconomic inequalities in diet. Taking specific elements of broader daily living conditions into account may explain how food environment policies differentially affect subgroups' dietary behavior. In order to be effective, food environment policies should be aligned and combined with policies tackling the social determinants of health. In future research and policy development, the application of a systems perspective, in which all stakeholders – including target groups – collaborate, can enhance the development and implementation of effective policies to create healthy food environments, improve population diet, and tackle socioeconomic inequalities in diet.

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Summary

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Summary

In the past decades, the prevalence of overweight, obesity, and diet-related non-communicable diseases (NCDs), such as cardiovascular diseases and type 2 diabetes, has substantially increased globally. The increase in overweight, obesity, and NCDs is caused predominantly by changes in dietary patterns, with a large majority of the population consuming too many ultra-processed foods, which are rich in saturated fat, refined carbohydrates (sugar), and salt, and too few fresh, unprocessed products such as vegetables, fruit, and fiber-rich foods.

Population diets are strongly influenced by the food environment to which people are exposed every day. Food environments can be defined as the collective physical, economic, policy, and socio-cultural surroundings, opportunities, and conditions that influence people's food choices and nutritional status. In contemporary food environments, cheap, energy-dense, nutrient-poor foods are abundantly available and heavily promoted, and thus stimulate unhealthy food choices. To improve population diet and reduce overweight, obesity, and NCDs, universal preventive strategies are greatly needed, including governmental policies that lead to healthier food environments. An advantage of such policies is that they target the entire population and are structural; they target the systemic determinants of dietary behavior and obesity (e.g., food prices, availability) and thus affect current and future generations. Although many European countries face a severe obesity epidemic, the extent to which governmental food environment policies have been developed and implemented at EU level and in EU member states is largely unknown.

Furthermore, socioeconomic inequalities in diet and health are observed in many European countries. However, it is largely unknown how and via what underlying mechanisms different food environment policies may impact on socioeconomic inequalities in diet. General theories explaining socioeconomic health inequalities stress the important role of daily living conditions (e.g., financial deprivation, housing, social support). Such theories may help to increase our understanding of the underlying mechanisms via which food environment policies may differentially affect people in lower and higher socioeconomic groups. Moreover, there is a lack of empirical studies investigating whether unfavorable daily living conditions – to which people in lower socioeconomic groups are more often exposed (e.g., financial constraints or perceived stress) – may modify the effect of food environment policies on the dietary behavior of people in lower and higher socioeconomic groups. In addition, it would be valuable to gain insights into the perspectives of different stakeholders (e.g., health professionals, policymakers, food producers) on the potential effects of food environment policies,

such as a sugar-sweetened beverages (SSBs) tax, on socioeconomic inequalities in health and how the pro-equity effect of these policies could be increased.

As introduced in **Chapter 1**, the main aims of this thesis are:

1. *To assess the extent to which food environment policies have been implemented by the European Union and the Dutch national government and to identify policy actions to create healthy food environments and*
2. *To gain insight into how governmental food environment policies may differentially impact socioeconomic inequalities in diet.*

In **Chapter 2**, an international standardized tool and process, the Healthy Food Environment Policy Index (Food-EPI), was applied to assess the strength of food environment policies at EU level and the EU-level actions needed to improve food environments in EU member states. Independent food and health experts rated the strength of 26 policy indicators that encompass the necessary directions for government policies to create healthy food environments, relating to the domains: food composition, labeling, provision, price, marketing, retail, and trade. In addition, they rated the strength of 24 infrastructure support indicators relating to domains supporting the implementation of food environment policies: leadership, governance, monitoring, funding, platforms for interactions, and health-in-all-policies. Overall, the experts' ratings point to a clear need to strengthen and increase the development and implementation of EU-level food environment policies and infrastructure support. Regarding the policy indicators, most EU-level policies were rated as weak (65%) or very weak (23%). The strength of infrastructure support indicators was rated somewhat higher; 63% of the infrastructure support indicators were rated as of moderate strength, whereas 33% were rated as weak. Further, experts recommended 18 policy actions and 19 infrastructure support actions to the EU to improve food environments and prioritized these actions on importance, achievability, and potential to reduce socioeconomic inequalities in diet. The top five prioritized EU policy and infrastructure support actions recommended by experts are listed in Box 1.

Box 1. The priority policy and infrastructure support actions recommended by experts to the EU

The top five prioritized EU policy actions are:

- (i) Set mandatory, ambitious, comprehensive, and time-specific food composition targets for added sugars, salt, and saturated fat for all food categories sold in EU member states.
- (ii) Adopt a legislated ban on trans fats in processed and ultra-processed foods sold in EU member states.
- (iii) Allow member states to implement a VAT exemption of 0% for all fresh fruit and vegetables and encourage member states to implement this VAT exemption to encourage healthy food choices.
- (iv) Set mandatory, ambitious, and comprehensive reformulation targets for added sugars, salt, and saturated fat for processed and ultra-processed foods and meals sold at quick-service restaurants.
- (v) Require member states to implement (1) minimum and time-based restrictions or bans on the (online) marketing of foods high in saturated fat, trans fat, salt, or added sugars to children and adolescents up to 19 years old in all digital (including broadcast, online, and social) media and (2) bans on food packages for marketing foods high in saturated fat, trans fat, salt, or added sugars to children and adolescents up to 19 years old.

The top five prioritized EU infrastructure support actions are:

- (i) Develop a high-level EU non-communicable diseases prevention strategy.
- (ii) Benchmark food environment policies regarding food reformulation, food labeling, food marketing, food prices, food provision in public spaces and retail, and support and coordinate the exchange of good practices between member states.
- (iii) Include clear priorities to reduce health inequalities or protect vulnerable populations in the multiannual work programs/annual State of the Union.
- (iv) Harmonize the promotion of healthy diets with other issues of concern such as climate change and environmental protection.
- (v) Recommend and support member states to set up a monitoring system to assess the status of food environments and to measure progress on achieving the goals of nutrition and health plans.

In **Chapter 3**, the Food-EPI was applied to assess the implementation of governmental food environment policies at national level in the Netherlands. This study revealed several gaps in the implementation of food environment policies in the Netherlands. Independent food and health experts rated policies for 50% of the 22 policy indicators as having a low level of implementation and for 41% of the 22 policy indicators as having a very low level of implementation. The implementation of infrastructure support was, similar to that found at EU level, rated higher; 42% of the 24 infrastructure support indicators were rated as having a fair level of implementation and also 42% as having a medium level of implementation. A total of 18 policy actions and 11 infrastructure support actions were recommended by experts to improve food environments in the Netherlands. The six policy actions that the experts considered most important, achievable, and equitable and the five infrastructure support actions that they considered most important and achievable are listed in Box 2.

Box 2. The priority policy and infrastructure support actions recommended by experts to the Dutch national government

The top six prioritized policy actions are:

- (i) Ensure that the new product improvement system meets at least the following requirements: more ambitious food composition targets, annual targets to reduce the amount of salt, saturated fat, and added sugars in all product categories, a clear timeline with annual independent monitoring including baseline measurement, proven effective incentives per product category.
- (ii) Ban all forms of marketing aimed at children under the age of 18 years of foods that fall outside the Dutch healthy dietary guidelines (i.e., the Wheel of Five) (an advertisement is 'aimed at children' when it reaches an audience consisting of $\geq 10\%$ children under 18).
- (iii) Increase the price of unhealthy foods such as sugar-sweetened beverages, for example via a proven effective VAT increase or excise tax.
- (iv) Formulate clear rules and regulations for caterers, quick-service restaurants, supermarkets, and shops to increase the relative availability of healthy foods compared with the total food product availability.
- (v) Reduce the price of healthy foods such as fruit and vegetables by, for example, reducing the VAT to 0%.
- (vi) Finance food-related income support by, for example, providing people below a certain income level with vouchers to purchase healthy foods (such as fruit and vegetables).

The top five prioritized infrastructure support actions are:

- (i) Develop a government-wide national prevention policy and implementation plan containing universal, selective, indicated, and care-related prevention measures, aimed at, for example, healthy food consumption and the reduction of diet-related chronic diseases among the entire population.
 - (ii) Support local governments to develop and implement prevention measures aimed at healthy food consumption, a healthy food environment, and the reduction of diet-related chronic diseases.
 - (iii) Develop concrete, measurable targets with regard to prevention measures aimed at healthy food consumption, a healthy food environment, and the reduction of diet-related chronic diseases and make a comprehensive overview of the achieved and unachieved results on these targets publicly available.
 - (iv) Increase the budget for universal, selective, indicated, and care-related prevention in the national budget, with at least 10% of the healthcare budget going to prevention in the first four years and gradually reversing the financing pyramid for healthcare (with the vast majority of it going to prevention instead of curative care).
 - (v) Develop an instrument for reporting about the food availability in supermarkets, shops, quick-service restaurants, and catering that shows the proportion of healthy foods in relation to the total food product range and make binding agreements with the involved parties about the monitoring and reporting thereof.
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In **Chapter 4**, two contemporary theories that help to understand socioeconomic inequalities in health and health-related behaviors were applied (Bourdieu's capital theory and the scarcity theory) to reason how various food environment policies may impact persons in lower and higher socioeconomic groups differently. This chapter showed, from a theoretical perspective, that food environment policies that still require high levels of individual agency to achieve dietary changes (e.g., food labeling) may lead to a widening of socioeconomic inequalities in diet, as people in lower socioeconomic groups are impeded by their generally less favorable daily living conditions, leaving no time, money, or energy for other, less urgent matters (such as a healthy lifestyle). Conversely, this chapter showed that more structural food environment policies (e.g., restricting unhealthy food promotion) are more likely to decrease socioeconomic inequalities in diet, because such structural policies require less cognitive effort from

individuals to change dietary behavior and lead to an improvement in the unfavorable food environmental features to which lower socioeconomic groups are more often exposed (e.g., less exposure to fast-food marketing may unconsciously lead to lower fast-food consumption). Moreover, the chapter illustrated that the application of these theories can guide future empirical studies and thereby enhance the development of effective policies tackling socioeconomic inequalities in diet.

The study in **Chapter 5** investigated whether financial constraints and perceived stress modified the effects of food-related taxes on the healthiness of food purchases in a virtual supermarket. Data from a randomized controlled trial among Dutch participants were used (n=386). Financial constraints and perceived stress did not significantly modify the effects of food-related taxes on the healthiness of food purchases. However, visualizations of the outcomes showed that the overall healthiness of food purchases was higher and SSBs purchases were lower in a nutrient profiling tax condition compared with the control condition, especially among people with moderate/high levels of financial constraint. Such patterns were not observed for perceived stress. Future studies with larger sample sizes are recommended to assess whether, and, if yes, why, food-related taxes differentially affect subgroups' food purchases.

Finally, **Chapter 6** describes an interview study conducted to understand how various stakeholder groups in the Netherlands perceive the potential effects of an SSBs tax on different socioeconomic groups. In total, 27 stakeholders from a wide range of sectors were interviewed (i.e., ministries, parliamentary parties, advisory bodies, academia, health and consumer organizations, trade associations, and health professional associations). The results showed that the majority of stakeholders believed an SSBs tax could contribute to a reduction in socioeconomic inequalities in dietary intake and health. However, additional interventions (e.g., reducing the price of fruit and vegetables or investing SSBs tax revenues in a fund from which supplementary interventions that benefit the health of people with a lower socioeconomic position can be financed) were recommended to facilitate a reduction in SSBs consumption among lower socioeconomic groups in response to an SSBs tax and to prevent adverse health effects.

Chapter 7 summarizes and reflects on the main findings of the studies presented in this thesis. This thesis shows that there is a lack of food environment policies supporting healthy population diets at EU level and at national level in the Netherlands. Applying the multiple streams theory illustrated how various factors related to the problem, policy, and politics streams may have led to the predominantly weak and low implementation of food environment policies at EU level and in the Netherlands. These factors included: framing overweight and obesity as an individual responsibility, focus on cure instead of prevention, restricted EU competences, pursuing consensus

in policymaking, a strong food-industry lobby, unfavorable political and institutional contexts, a lack of involvement of civil society organizations, and the absence of public support. To improve population diets via healthy food environments, the EU and the Dutch national government should develop and implement multiple, recommended actions as identified by the studies in this thesis. Such structural policies may also contribute to a reduction in socioeconomic inequalities in diet. Besides, in order to reduce socioeconomic inequalities in diet, food environment policies should be aligned and combined with policies tackling more social determinants of health (e.g., financial debts, deprived housing conditions). Developing effective policies that account for various determinants underlying dietary behavior simultaneously is important to shift the current system, which results in a high prevalence of overweight and obesity, to a system that explicitly includes benefits to population health.

Samenvatting

De afgelopen decennia is het aantal mensen met overgewicht en obesitas wereldwijd sterk gestegen, net als de prevalentie van voedingsgerelateerde ziekten zoals hart- en vaatziekten en diabetes type 2. De toename in overgewicht, obesitas en voedingsgerelateerde chronische ziekten wordt grotendeels veroorzaakt door een veranderd voedingspatroon. Een groot deel van de bevolking consumeert teveel sterk bewerkte voedingsmiddelen die rijk zijn aan verzadigd vet, geraffineerde koolhydraten (suiker) en zout, en te weinig verse onbewerkte producten zoals groente, fruit en vezelrijke voedingsmiddelen.

Voedingspatronen worden sterk beïnvloed door de voedselomgeving waaraan mensen elke dag worden blootgesteld. De voedselomgeving kan worden gedefinieerd als de collectieve fysieke, economische, beleidsmatige en sociaal-culturele context, en de mogelijkheden en voorwaarden die de voedselinname en voedselkeuzes van mensen beïnvloeden. In de huidige voedselomgeving worden veel goedkope, energierijke voedingsmiddelen met weinig voedingsstoffen aangeboden en gepromoot, wat ongezonde voedselkeuzes stimuleert.

Voor een gezondere voedselconsumptie van de bevolking, en om overgewicht, obesitas en voedingsgerelateerde chronische ziekten te reduceren, zijn universele, preventieve strategieën hard nodig, waaronder overheidsbeleid dat leidt tot een gezondere voedselomgeving. Een voordeel van zulk beleid is dat het gericht is op de gehele bevolking en dat het structureel is; het richt zich op de systemische determinanten van voedingsgedrag en obesitas, zoals voedselprijzen en beschikbaarheid, en heeft zo effect op huidige en toekomstige generaties. Hoewel veel Europese landen te maken hebben met een obesitas epidemie is het grotendeels onbekend in hoeverre overheidsbeleid met betrekking tot de voedselomgeving is ontwikkeld en geïmplementeerd door de Europese Unie (EU) en in Europese landen.

Daar komt bij dat er in veel Europese landen grote sociaaleconomische verschillen bestaan in voedselconsumptie en gezondheid. Echter, het is grotendeels onbekend hoe en via welke onderliggende mechanismen verschillende beleidsmaatregelen met betrekking tot de voedselomgeving impact kunnen hebben op sociaaleconomische verschillen in voedselconsumptie. Algemene theorieën die sociaaleconomische gezondheidsverschillen verklaren, benadrukken de belangrijke rol van dagelijkse leefomstandigheden (zoals armoede, woonomstandigheden, sociale steun). Zulke theorieën kunnen helpen de onderliggende mechanismen beter te begrijpen waarlangs beleid met betrekking tot de voedselomgeving effect kan hebben op mensen in lagere en hogere sociaaleconomische groepen. Daarbij is er ook een gebrek aan empirische studies die onderzoeken of

ongunstige dagelijkse leefomstandigheden - waaraan mensen in lagere sociaaleconomische groepen vaker zijn blootgesteld (bijv. moeite met rondkomen, stress) - het effect van beleid op voedselconsumptie van mensen in lagere en hogere sociaaleconomische groepen kan beïnvloeden. Bovendien is het nuttig om opvattingen van verschillende stakeholders (bijv. gezondheidsprofessionals, beleidsmakers, voedselproducenten) te kennen over de mogelijke effecten van beleidsmaatregelen (zoals een belasting op suikerhoudende dranken) op sociaaleconomische gezondheidsverschillen, en te achterhalen hoe zij denken dat het effect van dergelijke beleidsmaatregelen op het verkleinen van sociaaleconomische verschillen kan worden vergroot.

Zoals geïntroduceerd in **Hoofdstuk 1**, zijn de hoofddoelen van dit proefschrift:

1. *Het beoordelen van de mate waarin beleid met betrekking tot de voedselomgeving is geïmplementeerd door de EU en de Nederlandse rijksoverheid en het identificeren van beleidsacties voor het creëren van een gezonde voedselomgeving.*
2. *Het verkrijgen van inzicht hoe overheidsbeleid met betrekking tot de voedselomgeving impact kan hebben op sociaaleconomische verschillen in voedselconsumptie.*

In **Hoofdstuk 2** is een internationaal gestandaardiseerd instrument, de Healthy Food Environment Policy Index (Food-EPI), toegepast om de mate waarin de EU beleid heeft ingevoerd voor het creëren van een gezonde voedselomgeving te beoordelen, en te identificeren welke acties op EU niveau nodig zijn om voedselomgevingen in EU lidstaten gezonder te maken. Onafhankelijke voedings- en gezondheidsexperts hebben het bestaande beleid beoordeeld aan de hand van 26 punten die refereren naar de ideale richting van overheidsbeleid voor het creëren van een gezonde voedselomgeving, verdeeld over de categorieën: voedselsamenstelling, etikettering, aanbod, prijzen, marketing, retail en handel. Daarnaast keken de experts naar 24 punten die refereren naar beleidsondersteunende domeinen verdeeld over de categorieën: leiderschap, bestuur, monitoring, financiering, platformen voor interactie, en integraal gezondheidsbeleid. De beoordeling van de experts liet duidelijk zien dat het nodig is om de ontwikkeling en implementatie van beleid en beleidsondersteuning op EU niveau te verbeteren voor het creëren van een gezonde voedselomgeving. Met betrekking tot de beleidspunten werden de meeste beleidsmaatregelen op EU niveau als zwak (65%) of heel zwak (23%) beoordeeld. De beleidsondersteunende punten werden iets hoger beoordeeld; 63% werd beoordeeld als gemiddeld, terwijl 33% als zwak werd beoordeeld. Verder hebben de experts 18 beleidsacties en 19 beleidsondersteunende acties voor het verbeteren van de voedselomgeving aanbevolen aan de EU en deze acties geprioriteerd op relevantie, haalbaarheid en potentieel om sociaaleconomische verschillen in voedselconsumptie te verkleinen. De top vijf van geprioriteerde EU beleids- en beleidsondersteunende acties aanbevolen door de experts zijn weergegeven in Box 1.

Box 1. De geprioriteerde beleids- en beleidsondersteunende acties aanbevolen door experts aan de EU

De top vijf geprioriteerde EU beleidsacties waren:

- (i) Stel verplichte, ambitieuze, alomvattende en tijd-specifieke voedselsamenstellingsdoelen m.b.t. toegevoegde suikers, zout, en verzadigd vet, voor alle voedselcategorieën die verkocht worden in EU lidstaten.
- (ii) Neem een wettelijk verbod aan op transvetten in bewerkte en sterk bewerkte voedingsmiddelen die verkocht worden in EU lidstaten.
- (iii) Sta toe dat lidstaten een btw uitzondering van 0% voor alle verse fruit en groenten implementeren en stimuleer lidstaten deze btw uitzondering te implementeren om zo gezonde voedselkeuzes aan te moedigen.
- (iv) Stel verplichte, ambitieuze, en alomvattende voedselherformuleringsdoelen m.b.t. toegevoegde suikers, zout, en verzadigd vet voor bewerkte en sterk bewerkte voedingsmiddelen en maaltijden verkocht in quick-service restaurants.
- (v) Eis dat lidstaten (1) minimum en tijdsgebonden beperkingen of een algeheel verbod op de (online) marketing van voedingsmiddelen met veel verzadigd vet, transvet, zout of toegevoegde suikers gericht op kinderen tot 19 jaar in alle digitale (inclusief tv, online en sociale) media en (2) een verbod op voedselverpakkingen voor de marketing van voedingsmiddelen hoog in verzadigd vet, transvet, zout of toegevoegde suikers gericht op kinderen tot 19 jaar implementeren.

De top vijf geprioriteerde EU beleidsondersteunende acties waren:

- (i) Ontwikkel een EU strategie ter preventie van voedingsgerelateerde chronische ziekten.
 - (ii) Benchmark beleidsmaatregelen met betrekking tot voedselsamenstelling, voedselketting, voedselmarketing, voedselprijzen, voedselaanbod in publieke ruimten en retail, en ondersteun en coördineer de uitwisseling van goede voorbeelden tussen lidstaten.
 - (iii) Includeer duidelijke prioriteiten om gezondheidsverschillen te reduceren of kwetsbare bevolkingsgroepen te beschermen in de meerjarige werkprogramma's/jaarlijkse Staat van de Unie.
 - (iv) Harmoniseer de promotie van gezonde voedingspatronen met andere punten van zorg zoals klimaatverandering en milieubescherming.
 - (v) Beveel lidstaten aan en ondersteun hen bij het opzetten van een monitoringssysteem om de status van voedselomgevingen te beoordelen, en om de voortgang te meten op het bereiken van doelen uit voedings- en gezondheidsplannen.
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In **Hoofdstuk 3** is de Food-EPI toegepast om de implementatie van overheidsbeleid met betrekking tot de voedselomgeving op nationaal niveau in Nederland te beoordelen. Deze studie liet zien dat er te weinig beleidsmaatregelen zijn geïmplementeerd om een gezonde voedselomgeving te creëren in Nederland. Onafhankelijke voedings- en gezondheidsexperts beoordeelden dat 50% van de in totaal 22 beleidspunten een laag implementatieniveau heeft en 41% van de beleidspunten een heel laag implementatieniveau heeft. De implementatie van de beleidsondersteuning werd, net als op EU niveau, hoger beoordeeld; de implementatie van 42% van de in totaal 24 beleidsondersteunende punten werd beoordeeld als acceptabel en 42% werd beoordeeld als matig. De experts raadden in totaal 18 beleidsacties en 11 beleidsondersteunende acties aan om de voedselomgeving in Nederland te verbeteren. De zes hoogst geprioriteerde beleidsacties (op basis van relevantie, haalbaarheid en het meeste potentieel om sociaaleconomische verschillen in voedselconsumptie te verkleinen) en de vijf hoogst geprioriteerde beleidsondersteunende acties (op basis van relevantie en haalbaarheid) door de experts, zijn weergegeven in Box 2.

Box 2. De geprioriteerde beleids- en beleidsondersteunende acties aanbevolen door experts aan de Nederlandse rijksoverheid

De top zes geprioriteerde beleidsacties waren:

- (i) Zorg dat het nieuwe systeem voor productverbetering minimaal voldoet aan de volgende vereisten: ambitieuzere doelstellingen, jaarlijkse doelstellingen voor het verminderen van de hoeveelheid zout, verzadigd vet en toegevoegd suiker in alle productgroepen, een heldere tijdslijn met jaarlijkse onafhankelijke monitoring inclusief nulmeting, en bewezen effectieve incentives per productgroep.
- (ii) Verbied alle vormen van reclame gericht op kinderen onder de 18 jaar voor voedingsmiddelen die buiten de Schijf van Vijf vallen (een reclame-uiting is gericht op kinderen wanneer de reclame-uiting publiek bereikt dat bestaat uit 10% kinderen onder de 18 jaar of meer).
- (iii) Verhoog de prijzen van ongezonde voedingsmiddelen zoals suikerhoudende dranken, bijvoorbeeld door een bewezen effectieve btw-verhoging of accijnsheffing.
- (iv) Formuleer duidelijke regels en voorschriften voor cateraars, quick-service restaurants, supermarkten en winkels voor het vergroten van het aandeel gezonde voedingsmiddelen t.o.v. het totale productaanbod.
- (v) Verlaag de prijzen van gezonde voedingsmiddelen zoals groenten en fruit, bijvoorbeeld door een btw-verlaging naar 0%.
- (vi) Financier voedselhulp, bijvoorbeeld door het verstrekken van vouchers aan mensen onder een bepaalde inkomensgrens voor het kosteloos afnemen van gezonde voedingsmiddelen.

De top vijf geprioriteerde beleidsondersteunende acties waren:

- (i) Ontwikkel een overheidsbreed nationaal preventiebeleid en implementatieplan met daarin universele, selectieve, geïndiceerde, en zorg-gerelateerde preventieve maatregelen, onder meer gericht op een gezonde voedselconsumptie en de reductie van voedingsgerelateerde (chronische) ziekten onder de gehele bevolking.
 - (ii) Ondersteun gemeenten bij het ontwikkelen en uitvoeren van preventieve maatregelen gericht op een gezonde voedselconsumptie, een gezonde voedselomgeving en de reductie van voedingsgerelateerde (chronische) ziekten.
 - (iii) Ontwikkel concrete, meetbare doelen met betrekking tot preventieve maatregelen (bij voorkeur geïntegreerd in een nationaal preventiebeleid) gericht op een gezonde voedselconsumptie, een gezonde voedselomgeving en de reductie van voedingsgerelateerde (chronische) ziekten, en maak het totaal overzicht van de behaalde en niet behaalde resultaten op deze doelen publiekelijk toegankelijk.
 - (iv) Vergroot het budget voor universele, selectieve, geïndiceerde en zorg-gerelateerde preventie in de rijksbegroting, waarbij de eerste vier jaar minimaal 10% van het zorgbudget naar preventie gaat en waarbij geleidelijk de financieringspiramide aan de zorg wordt omgedraaid (waarbij het overgrote deel naar preventie in plaats van curatieve zorg gaat).
 - (v) Ontwikkel een instrument voor verslaglegging van het voedingsaanbod in supermarkten, winkels, quick-service restaurants en catering waaruit het aandeel gezonde voedingsmiddelen t.o.v. het totale productaanbod blijkt, en maak bindende afspraken met betrokken partijen over de monitoring en verslaglegging hiervan.
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In **Hoofdstuk 4**, zijn twee theorieën toegepast die helpen om sociaaleconomische verschillen in gezondheid en gezond gedrag te begrijpen (Bourdieu's kapitaal theorie en de schaarste-theorie). Aan de hand van deze theorieën is beredeneerd hoe verschillende beleidsmaatregelen met betrekking tot de voedselomgeving een verschillende impact zouden kunnen hebben op het gedrag en de gezondheid van mensen in lagere en hogere sociaaleconomische groepen. Dit hoofdstuk liet vanuit een theoretisch perspectief zien dat beleidsmaatregelen die nog steeds veel individuele inspanning vergen om gedrag aan te passen (bijv. voedsel etikettering) kunnen leiden tot een vergroting van sociaaleconomische verschillen in voedselconsumptie. Dit kan worden

verklaard doordat mensen in lagere sociaaleconomische groepen vaker te maken hebben met minder gunstige dagelijkse leefomstandigheden waardoor voor andere, minder urgente zaken (zoals een gezonde leefstijl) geen tijd, geld of energie overblijft. Daartegenover liet dit hoofdstuk zien dat andere, structurelere beleidsmaatregelen (bijv. beperking van marketing voor ongezonde voedingsmiddelen) waarschijnlijk een grotere bijdrage leveren aan het verkleinen van sociaaleconomische verschillen in voedselconsumptie. Dit komt omdat dergelijke beleidsmaatregelen minder cognitieve inspanning vragen van individuen om hun gedrag aan te passen en leiden tot een verbetering van de ongunstige omstandigheden in de voedselomgeving waaraan individuen in lagere sociaaleconomische groepen vaker worden blootgesteld (bijv. omdat minder blootstelling aan fastfood reclame onbewust kan leiden tot een lagere consumptie van fastfood). Verder liet dit hoofdstuk zien dat de toepassing van deze theorieën door toekomstige empirische studies tot meer inzicht in onderliggende mechanismen kan leiden en daarbij de ontwikkeling van effectieve beleidsmaatregelen kan versterken om sociaaleconomische verschillen in voedselconsumptie te verkleinen.

In de studie in **Hoofdstuk 5** is onderzocht in een virtuele supermarkt of de effecten van voedingsgerelateerde belastingen op de mate van gezondheid van voedselaankopen verschillen tussen mensen die wel of geen moeite hadden met rondkomen, of wel of geen stress ervaarden. Data van een gerandomiseerd, gecontroleerd onderzoek naar de effecten van een suikerhoudende drankenbelasting en een nutriëntenprofielingsbelasting gebaseerd op Nutri-Score op voedselaankopen van Nederlandse consumenten werden gebruikt (n=386 deelnemers). De effecten van voedingsgerelateerde belastingen op voedselaankopen bleken niet significant anders te zijn voor mensen die moeite met rondkomen of stress ervaarden, vergeleken met mensen die dat niet ervaarden. Niettemin, visualisaties van de uitkomsten lieten zien dat het aandeel gezonde voedselaankopen hoger lag en aankopen van suikerhoudende dranken lager waren in een nutriëntenprofielingsbelasting conditie in vergelijking met de controle conditie, vooral onder degenen met gemiddelde of hoge niveaus van moeite met rondkomen. Dergelijke patronen werden niet waargenomen voor ervaren stress. Toekomstige studies met een grotere steekproef omvang werden aanbevolen om te beoordelen of voedingsgerelateerde belastingen een mogelijk verschillend effect hebben op voedselaankopen van subgroepen in de bevolking, en zo ja waarom.

Tot slot beschrijft **Hoofdstuk 6** een interviewstudie die is uitgevoerd om te begrijpen hoe verschillende stakeholders in Nederland de potentiële effecten van een belasting op suikerhoudende dranken voor verschillende sociaaleconomische groepen zien. In totaal zijn 27 stakeholders uit een breed scala van sectoren geïnterviewd (ministeries, politieke partijen, adviesorganen, wetenschap, gezondheids- en consumentenorganisaties, brancheorganisaties en verenigingen van gezondheidsprofessionals). Een meerderheid

van de stakeholders benoemde dat een belasting op suikerhoudende dranken kan bijdragen aan het verkleinen van sociaaleconomische verschillen in voedselconsumptie en gezondheid. Echter, aanvullende interventies werden aanbevolen, om zo de reductie in suikerhoudende dranken consumptie als reactie op een belasting in lagere sociaaleconomische groepen te faciliteren, en ongewenste gezondheidseffecten te voorkomen. Voorbeelden van aanvullende interventies die genoemd werden zijn een verlaging van de prijzen van groenten en fruit, of het investeren van de inkomsten van een belasting op suikerhoudende dranken in een fonds waaruit aanvullende interventies kunnen worden betaald voor het verbeteren van de gezondheid van mensen in lagere sociaaleconomische groepen.

Hoofdstuk 7 is de algemene discussie waarin gereflecteerd wordt op de belangrijkste bevindingen van het proefschrift. Dit proefschrift laat zien dat er te weinig beleidsmaatregelen met betrekking tot de voedselomgeving zijn geïmplementeerd op EU niveau en in Nederland die een gezond voedingspatroon onder de bevolking stimuleren. Door de 'multiple streams theorie' toe te passen werden mogelijke factoren besproken die ertoe kunnen hebben geleid dat de implementatie van beleid met betrekking tot de voedselomgeving voornamelijk zwak of laag is op EU niveau en in Nederland. Deze factoren zijn bijvoorbeeld: het framen van overgewicht en obesitas als een individuele verantwoordelijkheid; een focus op genezen in plaats van op preventie; beperkte bevoegdheden van de EU; streven naar consensus in het ontwikkelen van beleid; een sterke lobby van de voedselindustrie; ongunstige politieke en institutionele contexten; een gebrek aan betrokkenheid van maatschappelijke organisaties; en de afwezigheid van publieke steun voor de implementatie van beleidsmaatregelen. Om de voedselomgeving gezonder te maken en daarmee dus de voedselconsumptie van de bevolking te verbeteren, moeten de EU en de Nederlandse rijksoverheid meerdere acties implementeren die werden aangeraden door experts betrokken bij de studies van Hoofdstuk 2 en 3.

Dergelijke structurele beleidsmaatregelen kunnen ook bijdragen aan een verkleining van sociaaleconomische verschillen in voedselconsumptie. Daarbij moeten beleidsmaatregelen met betrekking tot de voedselomgeving worden afgestemd en gecombineerd met beleidsmaatregelen die de sociale determinanten van gezondheid aanpakken (zoals het verminderen van financiële schulden, ongunstige woonomstandigheden). Het ontwikkelen van effectieve beleidsmaatregelen die rekening houden met verschillende determinanten onderliggend aan voedingsgedrag is belangrijk om het huidige systeem dat leidt tot een hoge prevalentie van overgewicht en obesitas te verschuiven naar een systeem dat expliciet winst oplevert voor de volksgezondheid.

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Sanne Djojosoeparto was born on 20 February 1984 in Rotterdam, the Netherlands. After secondary school (gymnasium) at the Stanislascollege in Delft in 2002, she completed a Bachelor Cultural Anthropology and Development Sociology in Leiden (University of Leiden, 2005) and a Master Sociology (Issues of Policy and Organization) in Utrecht (Utrecht University, 2006). In 2006, she started to work as a government trainee for the Ministry of Transport, Public Works and Water management in the Hague. As a government trainee she worked in various positions at different departments of the Ministry of Transport and was for six months seconded as a researcher to the Dutch National Court of Audit. After the government trainee program, she



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continued working for the Ministry of Transport. In 2010, she changed jobs to work as an advisor in the local governments groups of PwC Advisory, where she conducted various researches for local governments. At the end of 2011, she moved together with her husband to Switzerland (Schaffhausen). In Schaffhausen, she worked in several positions at Unilever and followed a study 'Food and Health' at the Dutch Open University. Moreover, during the time living in Switzerland her two daughters were born (2013 and 2015). After moving back to the Netherlands in 2016, she started working at Oxfam Novib in the Food, Land and Water team. When the opportunity for a PhD position on policies influencing healthy food environments came by, she did not have to think twice and joined in 2019 the Department of Human Geography and Spatial Planning at Utrecht University. In the final year of her PhD research, she was seconded to Wageningen University & Research to conduct a study on the protein transition in public procurement. From March 2023, she is working as a postdoctoral researcher in the chair group Consumption and Healthy Lifestyles at the Wageningen University & Research.

