CHAPTER 1

General introduction
In this thesis, the feasibility and effectiveness of environmental interventions targeted at portion size was evaluated. Throughout human history, for many people food was scarce and hunger was a life-threatening menace. Until the industrial revolution, food was produced in a labor-intensive and small-scale manner that was vulnerable to seasonal influences. In light of the societal problems that stemmed from the many hungry people, there were clear and valid political motives to deal with this matter. For instance, at the 1974 World Food Conference, the representatives of 135 governments proclaimed that "every man, woman and child has the inalienable right to be free from hunger and malnutrition in order to develop their physical and mental faculties" [1, 2].

Indeed, in order to address the issues that were related to hunger and malnutrition, agricultural and farming practices have changed drastically in the US and other western countries since WWII [3]. A first development that took place was that many governments started and have continued to heavily subsidize certain (cash) crops. For instance, in 2008 subsidies of $30 to $50 billion were allocated for the production of corn, soybeans, meat, and poultry [3]. Secondly, agricultural technologies (such as irrigation, genetic engineering, use of pesticides and antibiotics) considerably increased the production of wheat, soybeans, corn and rice. Thirdly, increasing means of transportation paved the way for worldwide food trade activities. And lastly, up-scaling made the agriculture and food production more efficient, but also brought about organizational changes in the sector. As a result, nowadays the agricultural sector and food industry is dominated by just a few companies.

Overall, the technical, organizational and political developments described above have been very successful at increasing the productivity of certain crops and making them as cheap as possible, and have thereby radically altered our food environment. For instance, the price of beef has declined from $530 for 100 kilograms in 1970 to $190 for the same amount in 1995 [3]. The abundance, accessibility and affordability of food have had important implications for our food intake. At a certain point in time, more calories were produced than needed, and these calories (superfluous or not) had to be sold and consumed. As an illustration, between the early 1980s and the mid-1990s increasing trends in total energy supply per capita (not taking waste into account) were found in most high-income countries and China [4]. Furthermore, a recent Canadian study shows that the
estimated energy availability (adjusted for wastage at the retail, household, cooking and plate levels) increased from 2350 calories in 1976 to 2766 in 2003 [5].

Without wanting to oversimplify the situation and state that the food industry is the only driver of food consumption, one can wonder how the food industry has become so successful at contributing to the accelerating food intake. It is therefore important to look into the strategies or tactics the food industry has developed to push food consumption. One of these tactics is to increase portion sizes [6], and the next paragraph will discuss the development of growing portion sizes and its impact on consumption behavior.

**Increasing food portion sizes**

In the 1970s, marketing directors at McDonald’s conceived that consumers would buy more of their products if they were sold in large sizes and if value size pricing (i.e. a lower price per unit for large portion sizes compared to small portion sizes) was employed [7]. The rationale behind increasing portion sizes is that consumers want value for their money [7, 8], and for food producers it is more profitable to increase their portion sizes than to decrease their prices. As clarified by Marion Nestle and others [9, 10], the costs of food are low in relation to other factors (e.g. preparation, packaging, transport, and advertising). After McDonald’s, other companies in the fast-food and packaged-food industry copied the strategy of increasing portion sizes, product bundling, and value size pricing, and a culture of supersizing has steadily been created [3, 11].

Several studies show that portion sizes, especially of high caloric foods and drinks, have increased enormously in recent decades [12-16]. For instance, originally food products such as French fries and soft drinks were introduced in only one portion size. Over the years however, sizes that were two to five times larger than the original size have been added to the assortment [8]. Although the US is known for its supersizing practices, portion sizes have also increased in Europe. A study that was conducted in the Netherlands, has revealed that larger sizes have been added to the portion size portfolio. Also, the portion sizes of a number of products have increased since their introduction. As an illustration, family bags of Smiths potato chips have increased from 75 g in 1990 to 110 g in 2008. Finally, multi-packs
have been introduced and the number of items contained in multi-packs has also increased [14].

**The impact of portion size on consumption**

Large portion sizes of (energy-dense) food may lead to an increased food intake. There is empirical evidence to support the proposition that large portion sizes enhance consumption both in the case of single-meal settings [17-19] and in cases when people are chronically exposed to large portion sizes [20, 21]. Also, in the case of pre-packaged snacks or snacks with an unfavorable perceived taste, people eat more when served a larger portion [22, 23]. Unfortunately, people do not tend to compensate over time for an increased food intake as a result of larger portion sizes [21]. Also, dividing large portion sizes into small portion sizes does not (always) seem sufficient to help consumers regulate how much they consume. A recent study has shown, for instance, that when large portions of two-pack king-size candy bars were divided in two in order to facilitate sharing the candy bar or spreading the consumption over time, consumers still reported that they immediately consumed the entire portion [24]. In the majority of the studies, the tendency to eat more when served larger portions has been found regardless of subject characteristics such as sex, BMI (Body Mass Index), or a tendency towards either dietary restraint or disinhibition. However, it should be mentioned that a recent experimental study demonstrated that overweight participants were more susceptible to increases in portion sizes than participants with a normal weight [17].

Having outlined the robust impact of portion size on consumption behavior, it is worth mentioning one study that has somewhat different outcomes than the generally observed finding that large portion sizes accelerate food intake [25]. Coelho do Vale and colleagues demonstrated that the likelihood of opening a bag of potato chips was higher when participants received four 50 gram packages of chips compared to one 200 gram package. Furthermore, among participants whose weight concerns were activated, compared to the large bags the small bags caused the amount consumed to increase [25]. It is unclear under what circumstances large portion sizes encourage or reduce consumption,
but the activation of weight concerns and self-control seems to play an important role. All in all, the majority of the research findings indicate that larger portion sizes encourage consumption and that therefore smaller portion sizes might help consumers to better self-regulate how much they consume of palatable and high-caloric snacks. On the other hand, the potential risk of small portion sizes “flying under the radar of self control” [25] should not be ignored. This is especially the case when multiple small portions are available as is, for instance, the case with multi-packs.

Another issue related to the growing portion sizes is that companies increasingly offer assortments that are tailored to individual consumer demands, providing as much as possible freedom of choice (Seidell and Brownell, unpublished data). This also holds for portion sizes, which are—as mentioned before—available in a growing number of sizes [14]. This phenomenon is illustrated by the Coca-Cola website that is entitled “Coca-Cola for everybody” and displays a large variety of Coca-Cola bottles and cans that are suitable “for big and small, and for every taste and desire” [26]. Although having a larger number of options to choose from is considered a valuable asset in many western societies, it might also become a “tyranny” by overwhelming and confusing consumers [27]. In combination with the development of growing portion sizes, norms about standard quantities that are appropriate to consume have gradually changed and many people have difficulties defining what a normal portion size is. This phenomenon has been described as “portion distortion” and studies have found that in the case of high caloric foods and drinks, people tend to perceive larger quantities than recommended by dietary guidelines, as appropriate amounts to eat at a single occasion [28-30].

In summary, portion sizes—especially of calorie-dense foods and drinks—have grown in past decades and are often larger than recommended. Furthermore, in most cases, large portion sizes lead to portion distortion and overconsumption. Therefore, current food portion sizes of energy-dense products can be seen as an obesogenic factor that drives weight gain. As will be outlined in the next paragraph, overweight (BMI ≥ 25 kg/m2) and obesity (BMI ≥ 30 kg/m2) have globally reached pandemic proportions and are a threat to public health.
Overweight and obesity

In many societies overweight and obesity pose a burden on people’s health. Globally, mean BMI has increased between 1980 and 2008, although the trends and mean population BMI in 2008 varied substantially between nations [31]. Other studies show that in the US 68% of the population were overweight or obese in 2007-2008 [32], and in the Netherlands 46.5% of the adult population were overweight or obese in 2004 [33]. In developing countries, overweight and obesity prevalences are also increasing and, in addition to undernourishment, place a double burden on the populations’ health [31].

Being overweight has an important impact on both morbidity and mortality. Elevated BMI levels are associated with higher risks of cardiovascular diseases, type 2 diabetes mellitus, certain types of cancer, osteoarthritis, work disability, and sleep apnea [34]. Overweight also negatively affects people’s quality of life and psychological wellbeing. There is, for instance, a reciprocal link between depression and obesity [35]. A factor that might mediate the relation between obesity and a decreased level of psychological wellbeing is stigmatization. In the US 12.2% of the people experience weight-related stigma or discrimination [36].

Weight gain is the result of an imbalance between energy intake and energy expenditure levels (the so-called energy gap [37]), and can be approached by focusing on high-risk individuals, or by taking the distribution of determinants in the entire population into account [38]. By taking the latter perspective, it is observed that the BMI distribution has shifted to higher levels across the US population. Furthermore, the lower end of the distribution has not changed much but the upper tail is increasingly skewed [39]. This means that over the years people in Western countries have (almost) all gained weight, but also that the differences in BMI (and consequently the health inequalities) between people have increased. Therefore, in order to tackle the problem of overweight and obesity, interventions should both aim to shift the curve to the left and to normalize the skewed curve (i.e. reducing the number of people that are –morbidly– obese) [40]. Veerman and colleagues calculated how much behavior change (in order to reduce the energy gap) was necessary to stop the increasing rise in obesity prevalence among the American population.
Based on their calculations, they concluded that it would be sufficient for every American to consume approximately 10 calories less or walk an extra 2 to 3 minutes per day.

The calculations made by Veerman et al. lead to the conclusion that, rather than advocating large behavioral changes among a small number of people, small changes on a population level could stop the “obesity epidemic” from advancing. This implies that it is sensible to regard obesity as a public health problem rather than as an individual matter [41]. The problem is, however, that although small changes can have an enormous impact on a population level, they do not have large benefits on an individual level [42]. The phenomenon that a “preventive measure that brings much benefit to the population but offers little to each participating individual” has been described as the “Prevention Paradox” [38]. As a result of the Prevention Paradox, it is difficult to translate information about the impact of small changes on a population level into recommendations that are relevant for individuals. In addition to educating individuals about the importance of healthy eating, it is therefore highly important to focus on making the environment healthier. In doing so, physical activity and a healthier food intake can be fostered, while deliberate behavioral choices from individuals are required to a lesser extent. This will be discussed further in the next paragraph.

**Environmental interventions aiming to prevent obesity**

Over the years, a growing apprehension has evolved about the impact of the “obesogenic” environment on people’s energy balance related behaviors (EBRBs). The obesogenic environment has been described as “the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations” [43]. The central idea of this approach is that our genes (promoting the intake of high caloric foods and drinks and avoiding physical activity) were adaptive in environments that were characterized by scarcity, but easily lead to weight gain in our current environment that promotes excessive food intake and discourages physical activity [44]. Focusing on individual lifestyle factors and educating people about how to prevent weight gain without addressing environmental obesogenic factors is therefore not sufficient to reverse the obesity epidemic.
Interventions that target the obesogenic environment aim to facilitate people to improve their dietary patterns and physical activity levels [44]. Also, environmental interventions may be less stigmatizing for obese individuals than interventions targeting individual lifestyle factors [45].

Swinburn and colleagues have developed the ANGELO framework (Analysis Grid for Environments Linked to Obesity) to conceptualize the obesogenic environment [43]. The ANGELO framework distinguishes four types of environmental factors (i.e. physical, economic, political, and socio-cultural) and allocates them to either a micro-environmental setting (e.g. a school or workplace) or a macro-environmental sector (e.g. food marketing, the health system). The ANGELO framework can be a useful tool to identify goals for environmental interventions that aim to reverse the obesity epidemic [46]. Within the ANGELO framework, the interventions that are studied in this thesis are situated in physical and economic micro-environmental settings.

Certainly, it would be too simplistic to state that the environmental perspective is sufficient to explain the obesity epidemic. Individuals differ greatly in how they are affected by environmental influences. The Environmental Research framework for weight Gain prevention (EnRG) acknowledges that the environment influences behavior for each individual differently, and postulates that the environment has both a direct and indirect impact on EBRBs. The indirect effect of the environment on behavior is mediated by cognitive factors such as attitudes, subjective norms, perceived behavioral control, and intention. In addition, the association between the environment and EBRBs is moderated by personal variables such as demographics, personality, awareness, and habits [47]. Although this thesis focuses on environmental interventions aiming to prevent weight gain, variables on an individual level will be taken into account.

All in all, it can be concluded that as a result of agricultural developments, and political choices, our food environment has changed drastically in the past decades. Most importantly, for many people hunger has been replaced by a profusion of affordable foods and drinks that contain many calories. Furthermore, the available products are vigorously marketed by a dominant food industry, a phenomenon that is exemplified by increasing portion sizes and value size pricing. These, and other, developments have led to the obesity
epidemic that we are nowadays confronted with. Hence, interventions preventing weight gain are needed. In the paragraphs above, arguments have been given in favor of promoting small behavioral changes among a large number of people rather than bringing about large behavioral changes among a small number of people. The topic of this thesis—environmental interventions targeted at portion size—should be positioned in this perspective.

Outline of this thesis

This thesis describes the development and evaluation of environmental interventions targeted at food portion sizes. Part I of this thesis gives an overview of the interventions targeted at portion size that were developed during this research project. Chapter 2 further outlines the problem of increasing portion sizes and its impact on consumers’ perceptions and behaviors with respect to food quantities. Furthermore, chapter 2 emphasizes the need for intervention studies in this field and presents a framework for portion size interventions. From this framework, amongst others, the following interventions that are situated in the physical and economic food environment can be identified: offering a larger variety of portion sizes; reducing the size of the available portions; pricing strategies (i.e., proportional pricing in order to remove beneficial prices for large portion sizes); and food labels that provide clear and concise information about appropriate portion sizes. Food labels can be considered an environmental intervention as they intend to inform consumers about healthy food choices at the point-of-purchase.

Before studying the effectiveness of environmental interventions targeted at portion size, it is important to assess the feasibility of implementing them in point-of-purchase settings. Therefore, we conducted a number of focus group discussions to assess consumers’ attitudes and perceptions towards interventions targeted at portion size. Furthermore, we interviewed a variety of point-of-purchase setting representatives to gain insight into their opinions towards the implementation of interventions targeted at portion size. The results of both studies, which are presented in Chapters 3 and 4, indicate that consumers and point-of-purchase representatives considered three interventions directed at portion size as most
feasible to implement. These interventions were: portion size labeling; offering a larger variety of portion sizes; and proportional pricing.

Having identified three interventions targeted at portion sizes that both consumers and point-of-purchase representatives considered feasible to implement, the next step was to study whether they improved consumers’ choice and consumption behavior. In Part II of this thesis the impact of portion size labeling on (intended) behavior is described. First, we conducted a questionnaire study to measure the impact of the portion size portfolio and different labeling formats on portion size choices. This study is presented in Chapter 5. Second, Chapter 6 describes a study that assessed the effectiveness of portion size labeling on choice and consumption behavior of soft drinks in a cinema. Third, in Chapter 7, we conducted a similar study assessing the impact of different portion size labeling formats on size choices of popcorn.

In Part III of this thesis, the impact of offering a larger variety of portion sizes combined with proportional pricing is evaluated. Chapter 8 presents the results of a questionnaire study that was conducted into the impact of proportional pricing on portion size choices. Chapter 9 describes a field study that was carried out in several worksite cafeterias in order to assess the impact of introducing small meals and proportional pricing on choice and consumption behavior. The process of implementing this intervention was also evaluated in a separate study that is further outlined in Chapter 10.

Chapter 11 summarizes the study results that are included in this thesis. Furthermore, the results of this research project will be put in a broader perspective, and future directions for both research and practice will be provided.
REFERENCES


