

Chapter 1

GENERAL INTRODUCTION

The first-ever High-Level Meeting of the UN General Assembly on non-communicable diseases held in September 2011 demonstrates one of the major challenges in today's society: establishing healthier population diets ¹. This thesis aims to explore the feasibility and effectiveness of one strategy in particular to accomplish this goal, being *food pricing*. Economists state that they have no idea how to change people's preferences, the way to change behaviour is to change the cost ². Living in an era of economic imperialism (economics are the major force in the shape and governance of our world today) ³ such an economic approach may help finding a solution in tackling the growing public health problems related to unhealthy food intake.

PROBLEMS RELATED TO DIETARY INTAKE

At this time, industrialized countries suffer from the consequences of overconsumption and excessive intakes of energy, sugar, salt and saturated fat on the one hand and too

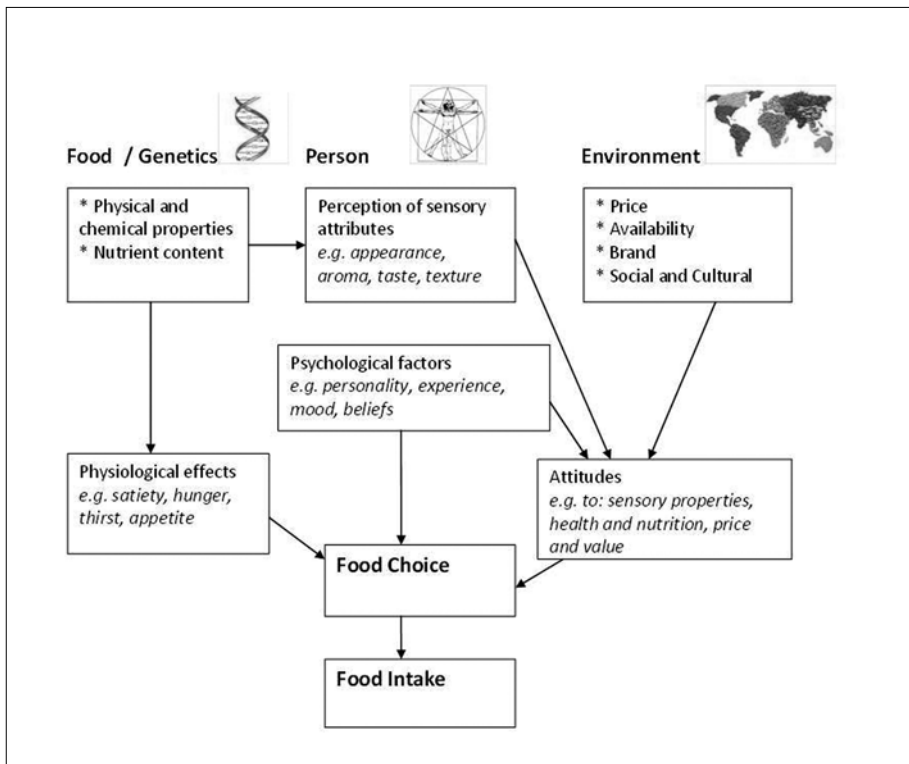


Figure 1.1 Factors affecting food choice – based on Shepherd, R. (1999) ¹¹

low intakes of fibre, fruits and vegetables on the other. For example, the latest Dutch Food Consumption Survey (2007–2010) revealed that 85 percent of the population consumed too much saturated fat ⁴. Furthermore, the range of people meeting the guidelines for vegetable intake was only between 1 and 14 percent; for fruit this range was between 3 and 26 percent ⁴. Also in the US ⁵ and other European countries ⁶ intakes of fruits and vegetables are far below minimum levels. Unhealthy dietary patterns are major contributors to the growing global burden of non-communicable diseases such as cardiovascular disease, diabetes type 2, obesity and cancer ^{7–9}. A recent UK modelling study found that 33,000 deaths per year would be prevented as a result of improvements in the population diet to a level that is in line with government recommendations ⁸. The largest part of this result was explained by improved health due to increased fruit and vegetable intake (15,000) ⁸. Based on such observations the World Health Organization (WHO) and the Federal Agricultural Organization (FAO) have called for action to improve population diets and reduce the burden of nutrition-related disease ^{9,10}.

FACTORS AFFECTING FOOD CHOICE

In attempting changing food intake it is essential to look into aspects affecting food choices. Here, a wide scale of factors can be distinguished (Figure 1.1) ¹¹. Firstly, human food preferences are influenced by *genetic factors*. Through evolution, humans have developed a strong biological preference for foods high in protein, fat and carbohydrates. These nutrients were scarce in times where people had to gather and hunt for their food and a natural mechanism strongly preferring a taste for sweet, fat, salt and high energy dense foods was good for survival those times ¹². This genetic hardware is however fixed and therefore unsuitable for interventions. Second, food preferences are subjective to *personal characteristics* such as taste, attitude or knowledge. These determinants are unfixed and thus fit for interventions. The past decades, much effort was made in directing peoples' food choices towards healthier ones by focusing on these personal characteristics. For example, national public campaigns such as the American food pyramid system ¹³ and also the Dutch 'Schijf van Vijf' ¹⁴ were transmitted to educate the public about what a healthy diet looks like (e.g., to increase knowledge). Next, much research has been conducted delving into individual determinants of food choice and effective programs to change these determinants. Most of these interventions build on theoretical insights from cognitive psychology using 'deliberative processing models that imply that people's attitudes are formed after careful consideration of available information' such as the Theory of Planned

Behavior (TPB)¹⁵ or self-regulatory process such as action planning (e.g., specifying when and how to act) and coping planning (e.g., anticipating personal risk situations and planning coping responses beforehand)¹⁶. There is quite some evidence showing positive effects of such a rational approach in improving dietary intake, for example on computer-tailored education¹⁷ and behavioral interventions using group interaction and goal setting¹⁸. Nevertheless, there is growing recognition that this way of dealing is not sufficient to solve the whole problem¹⁹. The sustainability and affordability of such programmes are key continuing challenges, especially when it is aimed to reach whole populations. Furthermore, such programmes do not address the strong societal forces (e.g., food availability, costs, merchandising, etc.) that work against individual behaviour change²⁰. These societal forces may be of key relevance since there is imperative evidence from the field of consumer psychology that consumer choices are mostly not rational, but merely unconscious and heavily influenced by environmental factors²¹. This third factor in food choice – e.g., the role of the *food environment* – will be discussed in the next paragraph.

OUR FOOD ENVIRONMENT

There is growing recognition that a supportive environment is needed for people to make healthier food choices^{19,22}. An illustrious saying on this aspect is ‘making the healthy choice the easy choice.’ Nevertheless, evidence shows that our environment is better defined as ‘obesogenic’¹⁹ opposed to ‘health stimulating’. Food is generally widely available and easy accessible at low cost and our genetic hardware may not be well adapted to this obesogenic food system^{19,23}. For example, numerous studies have shown that portion sizes, especially of high caloric foods and drinks, have increased extremely in recent decades^{24,25}. Another major indicator is the issue of food related communications. Next to governmental health messages, people are exposed to a whole gamut of industrial advertising. In 1999, US food companies spent more than \$33 billion annually on advertising and promoting their products. Nearly 70% of this money was spent on advertisements for convenience foods such as fast food and snacks. These industrial advertising costs exceeded, per single product, governmental expenditures on promoting dietary guidelines by at least 15 times²⁶. Results of longitudinal analysis reveal that dietary intake is indeed strongly correlated with technological innovations enabling this product development and our surrounding environment²⁷.

¹ The obesogenic environment is defined as “the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations”¹⁹.

Swinburn and colleagues developed a framework for understanding the role of our food environment in food choice and for prioritizing environmental components for intervention: the ANGELO-Framework (Analysis Grid for Environments Linked to Obesity). The model makes a distinction in the size (e.g., micro level or macro level) and the type of the environment (e.g., physical, economic, political and socio cultural) ¹⁹. The physical environment refers to the presence of food in all settings including supermarkets, vending machines and worksites. The political environment refers to laws and regulations that apply for food. The socio-cultural environment includes components such as traditions and religion which have a powerful influence on peoples' dietary rituals and habits. Finally, the economic environment refers to food costs and income ¹⁹. This economic environment has different facets and its potential role in dietary intake (interventions) will be explained in the following sections.

ECONOMIC FOOD ENVIRONMENT

As mentioned earlier, the economic way of changing behaviour is by changing the cost; the first economic law of demand states that if prices of a certain product increase, the demand will decrease and vice versa ². Indeed, economic strategies have previously been successful in reducing the use of alcohol and tobacco ²⁸. Furthermore, arguments for taking pricing strategies on food into consideration can be found in different domains, including the shape of the current food market and socio economic gradients ²⁹. The following sections will provide an overview of these aspects and illustrate why food pricing strategies are an approach worth bearing in mind.

First, it may be important to look at the historic development of food prices. Our current food system originates from the post WWII period where a major shift towards agricultural protectionism occurred using the techniques rose from the industrial revolution ³⁰. Building on periods of anxiety and crisis, food policy had as major goal to produce as much food as possible. This lead for example to the creation of the United Nations' new Food and Agricultural Organization (FAO) in the 1940's and the European Common Agricultural Policy (CAP) in 1957 ³¹. Currently, the Organisation for Economic Co-operation and Development (OECD) countries invests almost US\$ 1 billion per day into agriculture subsidies ³². Both these subsidy systems and general improvements in agricultural productivity have led to increased availability of dietary energy supplies and overproduction of certain crops ^{32,33}. This food system has large effects on food supply, availability and prices ³⁴. American consumer price index (CPI) data show that relative food prices fell

14% from 1980 to 2000. Interestingly, the price of fresh fruits and vegetables, fish, and dairy products increased by 118%, 77%, and 56%, respectively, whereas sugar and sweets, fats and oils, and carbonated beverages increased much less 46%, 35%, and 20% ³⁵. This development has led to the situation that currently our economic food environment does not support healthier food choices. International studies have revealed that sugars and fats provide most calories for money and that nutrient-rich, low-energy-dense foods (e.g., fruits and vegetables) are generally relatively more expensive than high-energy-dense, fat and sugar rich foods ³⁶⁻³⁸. In addition, it is suggested that in the current market, fruit and vegetables are promoted less than more profitable, highly processed foods containing more fats and sugars ^{22,39}. The relatively high prices for healthier foods do not stimulate healthier food choices and may even form a barrier in choosing healthier alternatives, especially for groups with a lower socio economic status (SES) ⁴⁰. This socio economic gradient will be explained in more detail in the next section.

LOWER SOCIO ECONOMIC GROUPS

Throughout history, health has been closely linked to socio economic status (SES). Typically, people with a higher SES live longer and in better health compared to people with a lower SES. Sociologists use different methods to define SES, but the model mostly used in empiric settings is the one that uses income, education level and employment status as most important indicators ⁴¹. Also in our current society, SES is aversely related to health. Recent numbers show that Dutch men with a low education level have a seven year lower life expectancy compared to men with a higher education level ⁴². One mechanism through which this link is explained is that risk factors, such as unhealthy dietary patterns, are more prevalent among lower SES groups. Dutch numbers show that people with a lower SES consume as well less vitamins, essential minerals, as fruits and vegetables compared to higher SES groups ⁴³, a pattern that was also found in other European countries ⁴⁴. One way to explain this socio-economic gradient in healthy food consumption is that people in the lower groups may be less aware of what a healthy diet looks like and have less knowledge on the healthiness of food ⁴⁵. Nevertheless, economics may also play a significant role here. As outlined in the previous paragraph, there is a large body of evidence showing that a healthy diet is relatively expensive ³⁶⁻³⁸. Furthermore, evidence shows that besides taste and quality, price is the main factor in food choice, and that price is especially significant for low SES consumers ⁴⁶⁻⁵⁰. Also, a study conducted among low-income consumers revealed a negative perception towards the price of fruit and vegetables in particular ⁵¹.

Several groups counteract this economic barrier in healthy food selection by arguing that a healthier diet can be obtained without increasing costs if people shop carefully. Indeed, it seems commonsense that people may reduce costs by buying seasonal products or by choosing frozen or canned fruits and vegetables. Darmon et al. put this to the test in a paper examining the effects of a cost constraint on nutritionally adequate food choices⁵². Results show that it is indeed possible to select a nutritionally adequate diet for low cost, however, that this can only be achieved if people are willing to consume diets that substantially differ from the average national diet. Also, it was found that the minimum costs that are needed for a nutritious diet are above expenditures of people living in the lowest income groups⁵². Thus, to put at least, the healthier choice is not the easier choice and may even form a barrier for healthy food choices in lower SES groups. Whether we should actually consider implementing food pricing interventions and which factors complicate such an approach will be outlined next.

FEASIBILITY OF FOOD PRICING STRATEGIES

Interrupting in the free market?

One major concern with food pricing interventions is that it requires interference in the market; something that is not preferred by many people including politicians and economists²⁹. However, important assumptions of perfect competitive free markets are that individuals are perfectly rational, that the production and consumption of goods force no costs on others in society and that all information is perfectly accurate and readily available⁵³. If these assumptions are desecrated, economists recommend policy interventions in order to restore a market that does justice to social welfare⁵³.

Looking at our food environment, it can be argued that the free market assumptions are violated, at least to some extent². First, it can be questioned whether people are actually able to make rational food choices in their best interest (e.g., maximizing utility). As noted earlier, people have a biological preference for fat and sugar rich foods. At first, they have a high utility by consuming tasty foods at low costs, however, the ultimate consequences (e.g., overweight, heart disease) do not reveal until years later. Many consumers do not incorporate this effect in their utility analyses when choosing food⁵⁴. Interventions may thus help people to maximize their utility by including a factor they are unable to incorporate themselves: effects in the future⁵⁵. A second important argument refers to what economists call 'externalities'; that is

if the costs of a good are imposed on others. Recent published findings show that nearly half of obesity-attributable medical expenditures are financed by government payers and eventually the taxpayer⁵⁶. Thus, the true costs of an unhealthy diet are not carried by people themselves, but by society in general. A final important argument is that the risks of unhealthy dietary patterns are not equally spread throughout society, but mostly affects people with a lower SES, which was explained in the previous paragraph. All the above listed process reveal a phenomenon called *market failure*; the free market system fails to promote and sustain long-term individual objectives⁵⁴.

Issues to be considered

Market failure is the one reason for interrupting in the free market and therefore food pricing strategies seem both from an economic and public health viewpoint a justifiable tool to stimulate healthier food choices. Still, it is not known what kind of pricing strategies are feasible and how these strategies can best be implemented in our society. For example, it is a complicating factor that, unlike tobacco and alcohol, food is a basic element for survival and the discrimination of healthy versus unhealthy foods is not well established^{29,57,58}. Also, food prices constitute by a complex process involving divergent sectors (e.g., government, industry, retail, agriculture, etc.) and responsibility issues may raise barriers to the deciding stages of the introduction of food price strategies^{29,59}. This feasibility issue is one of the core themes in this thesis.

EFFECTIVENESS OF FOOD PRICING STRATEGIES

Price elasticity of demand

A second core issue to be considered is the effectiveness of food pricing strategies. Within this effectiveness aspect, price elasticity of demand (PED) is a key concept. PED is a measure from the field of micro economics that refers to the responsiveness of the quantity demanded (ΔQ_d) of a certain good due to a price change (ΔP) of this good. If, for example, the demand of soft drinks decreases drastically due to a soda tax (price increase) this is considered an elastic good. As a rule, goods are seen as elastic if the price elasticity is greater than one, using the following formula: $PED = \frac{(\Delta Q_d / Q_d)}{(\Delta P / P)}$ ⁶⁰. So far, there is promising evidence from both experimental and modelling studies showing that food choices change in reaction to changing food prices, meaning that food is an elastic good and Neoclassical Economic Theory⁶¹ holds true.

Well known examples of experimental pricing studies in the field of health promotion is the work by French and colleagues. They conducted experiments in vending machines where prices of low-fat snacks were reduced by 10, 25 and 50 percent and found that sales of these products raised by 9, 39 and 93 percent respectively ⁴⁸. These results were duplicated in later studies of them ⁶². Also, they found that reducing prices of fruits and vegetables with 50 percent in school canteens lead to a two-fold increase in vegetable and four-fold increase in fruit purchases ⁴⁸. Other experimental studies are the work by Epstein and colleagues who conducted a study on several pricing schemes in a laboratory supermarket ⁶³, the work by Nederkoorn and colleagues on a high caloric tax in a web-based supermarket ⁶⁴, and the work by Giesen and colleagues on taxing high caloric university lunch menus ⁶⁵. All these studies revealed significant effects of the price changes.

Next to experimental studies, modelling studies provide insight into the effect of price changes. These studies simulate the effects of tax reforms using real data on food expenditures such as national household consumption surveys. Similar to the experimental studies, also simulation modelling studies found evidence that demand of food is reactive to price changes ^{66,67}. Recently, Andreyeva and colleagues published a review on the PED of food. Based on a selection of 160 studies, they concluded that food is elastic and that the highest PED was found for food away from home, soft drinks, juice, meats, and fruit and the most inelastic demand for eggs ⁶⁸. Overall, results show that people react to changing food prices, meaning that this is a promising strategy in directing food choices.

Issues to be considered

Unlike the promising data on the PED of food, there are some gaps that need to be filled before pricing strategies can be designated as a solution in health promotion ⁶⁹. The main issue here is *cross price elasticity*. This economic term refers to the responsiveness of the demand for a good as a result of a price change of another good. In order to find out whether people actually obtain a healthier diet when relative prices of healthier and unhealthy products are changed, it is vital to consider this issue carefully ⁷⁰. For example, if apples become cheaper, people may use the spare money to buy chocolate and not to buy more apples. Different studies already highlighted such side effects ^{63,67}.

Cross-price elasticity is consequently referred to as being highly complex ⁷⁰. Its true nature is not well uncovered by modeling studies or experiments in small

environments with a limited selection of food products such as vending machines or laboratories. Furthermore, it is important to realize that price is a complex construct and it is not just the *actual price* but also *price perception* and *reference prices* that are of major influence. Most consumers have a bad knowledge of actual prices rather, they compare the price of a food with a similar product, or a promotional price (external reference price) and compare prices with remembered prices such as prices in other supermarkets (internal reference prices). To assist their purchasing decisions, people are dependent on cues to update their expectations about relative prices and future product availability⁷¹. Also, people have the tendency to buy products simply because they are on sale⁷². Furthermore, price is not only a negative construct (e.g., losing money) but also a positive one (if a product costs more, it must be of higher quality)⁷³.

In order to gain insight in the multifaceted effects of food pricing strategies, it is of importance to study them in larger food environments, where people buy most of their foods, that is retail settings^{68,74}. In large parts of the world, supermarkets are the most dominant and powerful food environment^{75,76}, but evidence on effective

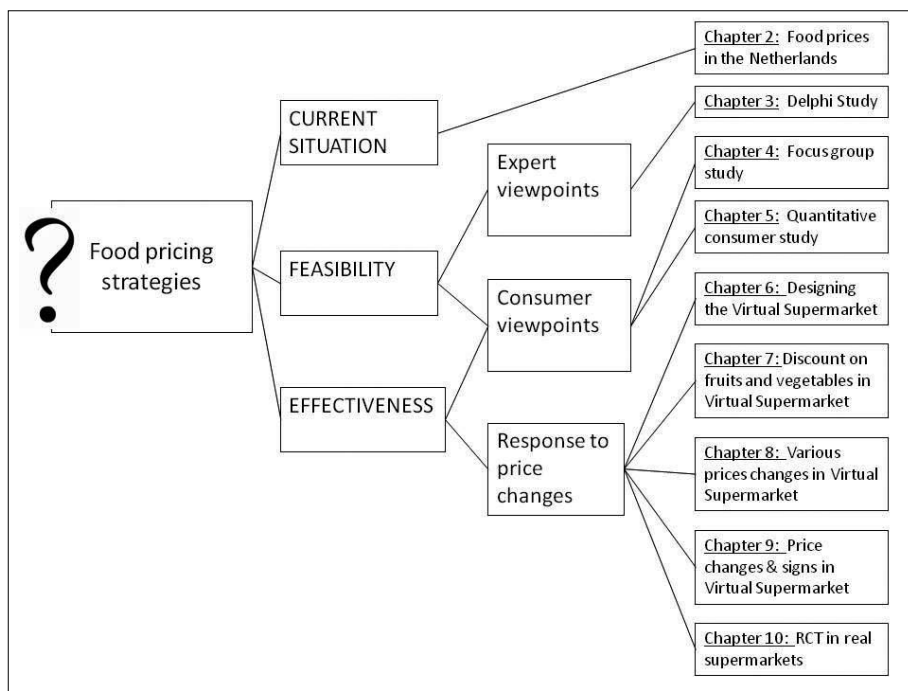


Figure 1.2 Overview of this thesis

interventions in retail settings is small ⁷⁷. To our knowledge, the only two examples of large-scaled randomized controlled trials on the effects of retail pricing strategies are the New Zealand SHOP study ⁷⁸ and a recently published French study on the effects of fruit and vegetable vouchers ⁷⁹. SHOP evaluated the effects price reductions of healthier foods (12.5%) and nutrition education on supermarket purchases among 1,104 consumers. The authors found that the pricing intervention alone lead to more healthy food purchases ⁷⁸. Also the French study found that vouchers were effective to stimulate fruit and vegetable consumption, however a major limitation of this study was a significant loss to follow-up, meaning that results were restricted to a 3-month time frame ⁷⁹. As these two studies are the only supermarket trials on the effectiveness of food pricing strategies to stimulate healthy food purchases available at present, more research is needed to learn about the actual effects of food pricing strategies. These studies are important complementing those that use data from large datasets (e.g., household expenditure surveys) and thereby gaining insight into complex processes such as own-price elasticity, cross-price elasticity, sales cues and positive price constructs ^{69, 74}.

AIM AND OUTLINE OF THIS THESIS

Based on previous studies we may conclude that food pricing strategies are a promising intervention tool in stimulating healthier food choices, especially among low-income groups. A broad mixture of pricing strategies can be considered, including taxes on unhealthier foods or subsidies on healthier foods. However, before food pricing strategies are introduced, it is of importance to consider feasibility and effectiveness issues carefully. **This thesis aims to gain insight into the complex processes surrounding food pricing strategies by studying feasibility and effectiveness aspects.** Findings will be triangulated to make robust recommendations about how food pricing strategies might be designed to assist in decreasing the burden of non-communicable diseases and improve public health. The outline of this thesis is as follows (see also Figure 1.2):

First, it is relevant to study the current food price climate in the Netherlands. *Do healthier diets indeed cost more?* Chapter 2 examines the association between energy density (kcal/gram) and energy costs (€/kcal) in single food items and composed diets. For this study we used a cross-sectional design using data from two Dutch cohort studies and retail food prices from the two market leader supermarkets. The second step was to assess the *feasibility of food pricing strategies*. Chapter 3 describes the results of a study where opinions of experts from academia, industry, retail,

agriculture, government, consumers and non-governmental organizations were systematically examined using a Delphi design. This study resulted in a list of pricing strategies that were viewed as feasible and potentially effective by this mixed group of experts. Following, it was of interest to know *consumer perceptions and viewpoints towards the pricing strategies that resulted from the Delphi Study*. For this purpose, we conducted a qualitative focus group study among lower SES consumers (Chapter 4) and a supplementing quantitative questionnaire study (Chapter 5). All together, these studies resulted in a summation of pricing strategies that were viewed as being feasible and potentially effective from the viewpoint of both experts and consumers.

The next step was to test the effectiveness of promising pricing strategies (that resulted from the previous studies) in stimulating healthy food purchases. Because supermarkets are the major point-of-purchase in the Netherlands, we wanted to test these strategies in a retail environment. However, the implementation of such studies is highly complex and costly. Therefore, we developed a three-dimensional software application in the image of a real supermarket: *the Virtual Supermarket*. Chapter 6 describes the features of this software application, how it was designed and the results of a pilot study on its effectiveness. The Virtual Supermarket was then used to examine the effectiveness of several food pricing strategies. The conducted experiments studied the effects of a 25% discount on fruit and vegetables (Chapter 7); the effects of price increases on unhealthier foods combined with price discounts on healthier foods (Chapter 8) and the effects of price discounts on healthier foods combined with sales and health promotion signs (Chapter 9).

For all studies we recruited Dutch adults from the general population, where Chapter 8 and 9 specifically aimed at including consumers with a relatively low SES. The experiments provided important new insights into the effects of food pricing strategies in a retail environment. A strong point of the virtual supermarket studies was the internal validity due to a highly controlled environment. However, the experiments were conducted in a virtual setting, meaning that it was vital to validate the virtual supermarket results in a real supermarket environment. Therefore, the final study in this thesis describes the results of a randomized controlled trial in four real supermarkets in the Netherlands. This nine month trial (6 month intervention period) studied the effects of a 50% discount on fruits and vegetables and nutrition education on fruit and vegetable purchases and consumption (Chapter 10). In conclusion, Chapter 11 provides a summary and synthesis of the main findings presented in this thesis.

Furthermore, results are put in a broader perspective and placed in the current societal context. Finally, future directions for research, practice and policy are provided.

References

1. United Nations. General Assembly. Scope, modalities, format and organization of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases. New York; 2011.
2. McCarthy M. The economics of obesity. *Lancet* 2004;364(9452):2169-70.
3. Fine B. Economics Imperialism and Intellectual Progress: The Present as History of Economic Thought. *History of Economics Review* 2000;32:10-36.
4. van Rossum CT, Fransen HP, Verkaik-Kloosterman H, Buurma-Rethans EJM, Ocke MC. Dutch National Food Consumption Survey 2007-2010. Bilthoven: National Institute for Public Health and the Environment; 2011.
5. CDC. Fruit and Vegetable Consumption Among Adults - United States, 2005. Atlanta: CDC. Centers for Disease Control and Prevention; 2007:213-217.
6. Naska A, Fouskakis D, Oikonomou E, et al. Dietary patterns and their socio-demographic determinants in 10 European countries: data from the DAFNE databank. *Eur J Clin Nutr* 2006;60(2):181-90.
7. Lock K, Pomerleau J, Causer L, Altmann DR, McKee M. The global burden of disease attributable to low consumption of fruit and vegetables: implications for the global strategy on diet. *Bull World Health Organ* 2005;83(2):100-8.
8. Scarborough P, Nnoaham KE, Clarke D, Capewell S, Rayner M. Modelling the impact of a healthy diet on cardiovascular disease and cancer mortality. *J Epidemiol Community Health* 2010;doi:10.1136/jech.2010.114520.
9. World Health Organization. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva: WHO; 2009.
10. Joint WHO/ FAO Expert Consultation. Diet, nutrition and the prevention of chronic diseases. WHO, ed. Geneva: WHO; 2003.
11. Shepherd R. Social determinants of food choice. *Proc Nutr Soc* 1999;58(4):807-12.
12. Drewnowski A. Energy density, palatability, and satiety: implications for weight control. *Nutr Rev* 1998;56(12):347-53.
13. US Department of Agriculture and US Department of Health and Human Services. Dietary Guidelines for Americans, 2010. 7th Edition. Washington DC. US Government Printing Office; 2010.
14. Dutch Nutrition Center (Voedingscentrum). The Disc of Five (de Schijf van Vijf). Available at: <http://www.voedingscentrum.nl/nl/schijf-van-vijf/schijf.aspx>.
15. Conner M, Norman P, Bell R. The theory of planned behavior and healthy eating. *Health Psychol* 2002;21(2):194-201.

16. Sniehotta FF, Schwarzer R, Scholz U, Schuz B. Action planning and coping planning for long-term lifestyle change: Theory and assessment. *Eur J of Social Psychology* 2005;35:565-576.
17. Kroeze W, Werkman A, Brug J. A systematic review of randomized trials on the effectiveness of computer-tailored education on physical activity and dietary behaviors. *Ann Behav Med* 2006;31(3):205-23.
18. Ammerman AS, Lindquist CH, Lohr KN, Hersey J. The efficacy of behavioral interventions to modify dietary fat and fruit and vegetable intake: a review of the evidence. *Prev Med* 2002;35(1):25-41.
19. Swinburn B, Egger G, Raza F. Dissecting Obesogenic Environments: The Development and Application of a Framework for Identifying and Prioritizing Environmental Interventions for Obesity. *Prev Med* 1999;29(6):563-570.
20. Swinburn BA, Sacks G, Hall KD, et al. The global obesity pandemic: shaped by global drivers and local environments. *Lancet* 2011;378(9793):804-14.
21. Dijksterhuis A, Smith PK, van Baaren RB, Wigboldus DHJ. The unconscious consumer: Effects of environment on consumer behavior. *Journal of Consumer Psychology* 2005;15(3):193-202.
22. Nestle M. Conclusion. The politics of food choice. In: Goldstein E, ed. *Food politics. How the food industry influences nutrition and health*. Berkeley: University of California Press; 2007:358-374.
23. Popkin BM. *The World is Fat. The fads, trends, policies, and products that are fattening the human race*. New York: Penguin Group; 2009.
24. Nielsen SJ, Popkin BM. Patterns and trends in food portion sizes, 1977-1998. *Jama* 2003;289(4):450-3.
25. Steenhuis IH, Leeuwis FH, Vermeer WM. Small, medium, large or supersize: trends in food portion sizes in The Netherlands. *Public Health Nutr* 2010;13(6):852-7.
26. Nestle M. *Food Politics. How the industry influences nutrition and health*. Berkeley: University of California Press; 2007.
27. Bleich S, Cutler D, Murray C, Adams A. Why is the developed world obese? *Annu Rev Public Health* 2008;29:273-95.
28. Chopra M, Darnton-Hill I. Tobacco and obesity epidemics: not so different after all? *Bmj* 2004;328(7455):1558-60.
29. Kim D, Kawachi I. Food taxation and pricing strategies to "thin out" the obesity epidemic. *Am J Prev Med* 2006;30(5):430-7.
30. McMichael AJ, Powles JW, Butler CD, Uauy R. Food, livestock production, energy, climate change, and health. *Lancet* 2007;370(9594):1253-63.
31. Lang T, Barling D, Caraher M. Chapter 2. Defining food policy. In: *Food Policy. Integrating Health, Environment & Society*. Oxford: Oxford University Press; 2009.
32. Schafer Elinder L, Lock K, Blenkus. G. Chapter 5: Public health, food and agriculture policy in the

- European Union. In: Stahl T, Wismar M, Ollili E, Lahtinen E, Leppo K, eds. *Health in all policies. Prospects and potentials*: Finish Ministry of Social Affairs and Health, under the auspices of the European Observatory on Health Systems and Policies; 2006.
33. Silventoinen K, Sans S, Tolonen H, et al. Trends in obesity and energy supply in the WHO MONICA Project. *Int J Obes Relat Metab Disord* 2004;28(5):710-8.
 34. Lang T, Barling D, Carahar M. Chapter 1: Introduction and Themes. In: *Food Policy. Integrating Health, Environment and Society*. Oxford: Oxford University Press; 2009.
 35. Putnam J, Allshouse J, Kantor LS. US per capita food supply trends: more calories, refined carbohydrates, and fats. *Food Review* 2002;25(3):2-15.
 36. Drewnowski A, Darmon N. Food choices and diet costs: an economic analysis. *J Nutr* 2005;135(4):900-4.
 37. Drewnowski A. The cost of US foods as related to their nutritive value. *Am J Clin Nutr* 2010;92(5):1181-8.
 38. Waterlander WE, de Haas WE, van Amstel I, et al. Energy density, energy costs and income - how are they related? *Public Health Nutr* 2010;13(10):1599-1608.
 39. Ludwig DS, Nestle M. Can the food industry play a constructive role in the obesity epidemic? *Jama* 2008;300(15):1808-11.
 40. Burney J, Haughton B. EFNEP: a nutrition education program that demonstrates cost-benefit. *J Am Diet Assoc* 2002;102(1):39-45.
 41. Adler NE, Boyce T, Chesney MA, et al. Socioeconomic status and health. The challenge of the gradient. *Am Psychol* 1994;49(1):15-24.
 42. van der Lucht F, Bruggink JW, Kardal M, Lodder BJH. Are there differences within socio economic status? (Zijn er verschillen naar sociaal economische status?). In: *Public Health Future Exploration, National Compass Public Health*. Bilthoven: National Institute for Public Health and the Environment; 2011.
 43. Hulshof KF, Brussaard JH, Kruizinga AG, Telman J, Lowik MR. Socio-economic status, dietary intake and 10 year trends: the Dutch National food Consumption Survey. *Eur J Clin Nutr* 2003;57(1):128-137.
 44. Irala-Estevez JD, Groth M, Johansson L, Oltersdorf U, Prattala R, Martinez-Gonzalez MA. A systematic review of socio-economic differences in food habits in Europe: consumption of fruit and vegetables. *Eur J Clin Nutr* 2000;54(9):706-14.
 45. Parmenter K, Waller J, Wardle J. Demographic variation in nutrition knowledge in England. *Health Educ Res* 2000;15(2):163-74.
 46. Cassady D, Jetter KM, Culp J. Is price a barrier to eating more fruit and vegetables for low-income families? *J Am Diet Assoc*. 2007;107:1909-1915.
 47. European Commission. Risk Issues. Special Eurobarometer 238/ Wave 64.1. In; 2006.

48. French SA. Pricing effects on food choices. *J Nutr* 2003;133(3):841S-843S.
49. Glanz K, Basil M, Maibach E, Goldberg J, Snyder D. Why Americans eat what they do: taste, nutrition, cost, convenience, and weight control concerns as influences on food consumption. *J Am Diet Assoc*. 1998;98(10):1118-26.
50. Steenhuis IH, Waterlander WE, de Mul A. Consumer food choices: the role of price and pricing strategies. *Public Health Nutr* 2011:1-7.
51. Inglis V, Ball K, Crawford D. Why do women of low socioeconomic status have poorer dietary behaviours than women of higher socioeconomic status? A qualitative exploration. *Appetite* 2005;45(3):334-43.
52. Darmon N, Ferguson EL, Briend A. Impact of a cost constraint on nutritionally adequate food choices for French women: an analysis by linear programming. *J Nutr Educ Behav* 2006;38(2):82-90.
53. Cawley J. An economic framework for understanding physical activity and eating behaviors. *Am J Prev Med* 2004;27(3 Suppl):117-25.
54. Swinburn BA. Obesity prevention: the role of policies, laws and regulations. *Aust New Zealand Health Policy* 2008;5:12.
55. Cutler D, Glaeser M, Shapiro JM. Why have Americans become more obese? *Journal of Economic Perspectives* 2003;17:93-118.
56. Finkelstein EA, Fiebelkorn IC, Wang GJ. National medical spending attributable to overweight and obesity: How much, and who's paying? *Health Affairs* 2003;22(4):W219-W226.
57. Goodman C, Anise A. What is known about the effectiveness of economic instruments to reduce consumption of foods high in saturated fats and other energy-dense foods for preventing and treating obesity? In. Copenhagen: WHO, Regional Office for Europe; 2006.
58. Powell LM, Chaloupka FJ. Food prices and obesity: evidence and policy implications for taxes and subsidies. *The Milbank Quarterly* 2009;87(1):229-257.
59. Waterlander WE, Steenhuis IH, de Vet E, Schuit AJ, Seidell JC. Expert views on most suitable monetary incentives on food to stimulate healthy eating. *Eur J Public Health* 2010;20(3):325-331.
60. Perloff JM. *Microeconomics*. 4 ed. Boston: Pearson Education; 2007.
61. Veblen T. The Preconceptions of Economic Science. *The Quarterly Journal of Economics* 1900;14(2):240-269.
62. French SA, Hannan PJ, Harnack LJ, Mitchell NR, Toomey TL, Gerlach A. Pricing and availability intervention in vending machines at four bus garages. *J Occup Environ Med* 2010;52 Suppl 1:S29-33.
63. Epstein LH, Dearing KK, Roba LG, Finkelstein E. The Influence of Taxes and Subsidies on Energy Purchased in an Experimental Purchasing Study. *Psychological Science* 2010;21:406-414.
64. Nederkoorn C, Havermans RC, Giesen JC, Jansen A. High tax on high energy dense foods and its effects on the purchase of calories in a supermarket: An experiment. *Appetite* 2011;56(3):760-765.
65. Giesen JC, Payne CR, Havermans RC, Jansen A. Exploring how calorie information and taxes on

- high-calorie foods influence lunch decisions. *Am J Clin Nutr* 2011;doi: 10.3945/ajcn.110.008193.
66. Nnoaham KE, Sacks G, Rayner M, Mytton O, Gray A. Modelling income group differences in the health and economic impacts of targeted food taxes and subsidies. *Int J Epidemiol* 2009;38(5):1324-1333.
67. Nordstrom J, Thunstrom L. The impact of tax reforms designed to encourage healthier grain consumption. *J Health Econ* 2009;28(3):622-34.
68. Andreyeva T, Long MW, Brownell KD. The impact of food prices on consumption: a systematic review of research on the price elasticity of demand for food. *Am J Public Health* 2010;100(2):216-22.
69. Thow AM, Jan S, Leeder S, Swinburn B. The effect of fiscal policy on diet, obesity and chronic disease: a systematic review. *Bull World Health Organ* 2010;88(8):609-614.
70. Mytton O, Gray A, Rayner M, Rutter H. Could targeted food taxes improve health? *J Epidemiol Community Health* 2007;61(8):689-94.
71. Vanhuelle M, Laurent G, Dreze X. Consumers' immediate memory for prices. *Journal of Consumer Research* 2006;33:163-171.
72. Anderson ET, Simester DI. The role of sale signs. *Marketing Science* 1998;17(2):139-155.
73. Lichtenstein DR, Ridgway NM, Netemeyer RG. Price perceptions and consumer shopping behavior: a field study. *Journal of Marketing Research* 1993;30:234-245.
74. Ni Mhurchu C. Food costs and healthful diets: the need for solution-oriented research and policies. *Am J Clin Nutr* 2010;92:1007-8.
75. Hawkes C. Dietary implications of supermarket development: a global perspective. *Development Policy Review*. 2008;26(6):657-692.
76. Vorley B. Food, Inc.: Corporate Concentration from Farm to Consumer. In. London: International Institute for Environment and Development.; 2003.
77. Glanz K, Hoelscher D. Increasing fruit and vegetable intake by changing environments, policy and pricing: restaurant-based research, strategies, and recommendations. *Prev Med* 2004;39 Suppl 2:S88-93.
78. Ni Mhurchu C, Blakely T, Jiang Y, Eyles HC, Rodgers A. Effects of price discounts and tailored nutrition education on supermarket purchases: a randomized controlled trial. *Am J Clin Nutr* 2010;91(3):736-47.
79. Bihan H, Mejean C, Castetbon K, et al. Impact of fruit and vegetable vouchers and dietary advice on fruit and vegetable intake in a low-income population. *Eur J Clin Nutr* 2011.