GENERAL INTRODUCTION

Over the past decades, the prevalence of overweight and obesity has substantially increased. A positive energy balance resulting from food intake that exceeds daily energy requirements is one of its major causes. While the etiology of obesity is multi-factorial, changes in food portion sizes are considered an important contributor to the obesity epidemic via increased food (energy) consumption. In the general introduction (chapter 1), the rationale for considering portion size as a focus of weight management interventions was presented.

Since the 1970’s, the food industry introduced supersizing of food portions as a marketing strategy. By means of supersizing, larger portions are offered for a relatively lower price. There is considerable research showing that portion size is positively associated with energy intake. Changes in portion size have influenced people’s perceptions of what an appropriate amount to consume is. In addition, large food portions promote passive overconsumption, irrespective of hunger or satiety. As a consequence, people eat more when they are served a larger portion of food. Moreover, while people increase their energy intake of a larger portion in a single meal, they continue to overeat when portion sizes are increased over several days. The risk of overconsumption resulting from large food portions is further enhanced by external factors such as mindless eating (people are not eating with deliberate attention or being distracted). These influences of portion size on energy intake highlight the potential of targeting portion size in weight management interventions. However, comprehensive behavioral change interventions to help people cope with the supersized food environment are lacking.

The aims of this thesis were to explore the portion size food environment and develop and evaluate a weight-management intervention aimed at portion size to stimulate weight loss. In part 1 the macro- (supermarket) and micro-level (at home) portion size food environments are explored. In part 2, weight-management intervention aimed at portion size was developed and evaluated.
MAIN FINDINGS

After the general introduction, part 1 examined the international portion size food environment at a macro-level by studying the available package and serving sizes of sugar sweetened beverages available in four high-income countries (Australia, Canada, New Zealand, and The Netherlands). **Chapter 2** reported that a wide variety of package sizes were available and there was substantial inconsistency in package sizes and manufacturer recommended serving sizes of non-alcoholic beverages between the four high-income countries. Serving size regulations, preferably set by governments and global health organisations, are needed to provide consistency. In doing so, serving sizes would help people to make healthier food choices.

**Chapter 3** presented a cross-sectional observation of factors endorsing surplus food intake in 278 home food environments of overweight and obese gatekeepers. Results showed that in the majority of the households a large number of processed snack-food packages were available and to some lesser extent were visible within the home. Also, the majority of dinnerware items (e.g., bowls, glass) used in the households were larger than standard dinnerware sizes (“reference sizes”) according the Netherlands Nutrition Centre Foundation. Moreover, older gatekeepers used on average smaller sizes of most of the measured dinnerware items than younger ones. Overall, the results indicated that home-environmental factors endorsing overconsumption were commonly presented in the home environments of overweight and obese individuals. This may counteract adequate portion size selection and intake.

**Chapter 4**, (Part 2) of this thesis outlined the development and evaluation of the PortionSize@warenessTool, a web-based tool aimed to increase awareness of reference portion sizes and factors that may contribute to overeating in response to large portion sizes. A randomized controlled trial was conducted with 310 participants and demonstrated significantly higher awareness of portion sizes among participants in the intervention group after visiting the PortionSize@warenessTool, constituting it a promising tool to improve portion size awareness.

In **chapter 5**, multiple studies were combined. First, 32 behavioral strategies to control portion size selection and intake were identified from previous literature. Subsequently, strategies
were subjectively reported as feasible and useful in weight management behavior among 52 potential users. In addition, two cross-sectional studies were conducted among 120 and 278 participants, showing that frequent use of strategies discriminated non-overweight from overweight individuals, but did not discriminate overweight from obese individuals. Overall, this study provided preliminary evidence for effective and acceptable portion control strategies in weight-management.

**Chapter 6** described the development and evaluation of the PortionControl@HOME intervention on body mass index and portion control behavior by means of a randomized controlled trial among 278 overweight and obese participants. The intervention group received the PortionControl@HOME intervention program over three months. The intervention consisted of the following four elements: 1) The PortionSize@warenessTool, 2) Portion Control Strategies, offered by means of a DVD, an educational book (Smartsize Me) including written assignments, 3) The portion control cooking class and 4) The Portion control Home-Screener. The intervention group reported a greater weight loss compared to the control group after completing the intervention, which was mediated by portion control behavior. Once the intervention ceased, sustained effects on body mass index were no longer evident.

**GENERAL DISCUSSION**

The general discussion is presented in **Chapter 7**. Taken together, findings from this thesis showed that the current portion size food environment hinders healthy portion control food choices. Although portion control behaviour might be beneficial for weight-management, and was successfully improved after the PortionControl@HOME intervention, favorable effects on weight-loss were only established directly after the intervention and were not sustained.

**Implications for practice and policy**

Based on the main findings, several implications for practice and policy were suggested. First, public policies for preventing further increase in obesity levels may need to be changed. With respect to support adequate portion size selection and intake, serving sizes displayed on food
packages should be regulated more strictly and need to provide unambiguous recommendations of the amount that is normally consumed in one sitting. Additionally, to help people regulate adequate portion size selection and intake, nudging strategies by which a more portion-choice friendly food environment is created, should be considered.

Second, the food home environment should play an important target in future weight-management programs or in weight-management counseling. Health professionals (e.g., weight consultants) could for example help individuals in setting up their home environment in such a way to facilitate adequate portion size selection and intake.

Third, future use of the PortionControl@HOME intervention needs to strengthen the alignment with the important theoretical behavior change techniques (e.g., self-monitoring) as weight loss effects were not sustained. In addition, the overall or components of the PortionControl@HOME intervention could be integrated as part of existing weight-management programs.

**Implications for future research**

Based on the main findings, suggestions for future research are recommended. With respect to the macro level food environment, a long term monitoring of portion size policies (of the government and the private sector) and the monitoring of the actual available portion sizes of foods and beverages is recommended. In doing so, it is of importance to determine the effects of changing corporate pledges, governmental regulations on actual portion sizes and individual purchase, eating behaviors, weight and health status using long-term research.

With respect to the PortionControl@HOME intervention, it is advisable to build upon the current program and perform additional research to evaluate the effects of an extended intervention. Several recommendations for the extended intention are suggested. First, a prolonged, continued PortionControl@HOME program is advisable. In doing so, the intervention materials could be used as the foundation for a larger, more comprehensive program. Second, it is advisable to include physical activity promotion in the intervention because a combination of a behavioural nutrition and physical activity components has been suggested to be more effective than a behavioural nutrition intervention only. Third, more
comprehensive relapse prevention strategies need to be included. Important relapse prevention strategies are to strengthen participants’ coping capacity, self-efficacy and enhancing autonomous motivation. Fourth, also other elements of the intervention (not only the cooking class) could be targeted in group-sessions or interpersonal counseling with weight-coaches or other suitable professionals.

**GENERAL CONCLUSION**

The intervention PortionControl@HOME is a promising strategy in weight-loss and is advisable to be embedded in weight-management therapy or public health efforts. However, improvement of the program is needed to strengthen and prolong its effects on weight-loss. The current food environment is not supportive for choosing adequate portion sizes and must be targeted as well. Therefore, complementary to educational approaches, environmental interventions aimed at portion size are needed in order to help consumers to make the ‘portion controlled choice’, the easiest choice. In order to curb obesity levels national or globally, larger food environmental, system-based changes are required. Without such efforts, individual level approaches will not provide the solution to the obesity epidemic.