Chapter 1

General introduction
**Childhood overweight**

Overweight and obesity in children is a rapidly growing problem worldwide (1). In recent decades the prevalence of overweight children in the Netherlands substantially increased. In 1980, an average of 5.4% of the 0-21 year old boys and 7.7% of girls were overweight and/or obese. In 1997, these percentages were respectively 10.3% and 13.5% and in 2009 15.1% and 17.1% (2).

Childhood overweight and obesity are associated with many serious health conditions such as type 2 diabetes, cardiovascular disease, and with psychosocial problems and a reduced quality of life (3-7). Obesity during childhood is a strong predictor for obesity in adolescence and adulthood (8, 9). Therefore, childhood obesity contributes to high medical costs, impaired health and reduced quality of life (10), which could potentially be avoided when preventing overweight and obesity at an early age.

**Energy imbalance**

Obesity is caused by a higher energy intake than energy expenditure, resulting in excessive weight gain (11). Different energy-balance related behaviours are associated with childhood overweight and obesity (12) and for practical reasons these energy-balance related behaviours are divided roughly into: dietary behaviours that affect the energy intake and physical (in)activity behaviours that affect energy expenditure (13). Several studies linked skipping breakfast, low intake of fruit and vegetables, high intake of sugared drinks and energy-dense snacks with childhood overweight (14-19). Moreover, low levels of physical activity and high levels of sedentary activities (such as TV viewing and computer use) have been associated with childhood overweight (20-27). In addition to dietary, physical activity and sedentary behaviour, there is increased attention to a short duration of sleep in relation to childhood overweight (28-30). Possible explanations for this association include the role of behavioural and hormonal factors; short sleep duration leaves more time for eating, particularly snacking and drinking sugared drinks, and causes alterations in appetite-regulating hormones resulting in overeating (28, 29, 31). Moreover, sleepiness during the day as a consequence of short sleep duration may result in reduced physical activity and increased sedentary behaviour (28, 29, 31).

**Systems approaches towards obesity**

The underlying mechanisms of the energy imbalance are part of a complex system in which behaviours are affected by interactions of biological predisposition and socio-environmental changes (32). Glass and McAtee visualized this process by a multilevel model applied to the study of obesity with an integration of biological and socio-environmental influences on behaviour (33) (Figure 1). The vertical axis illustrates the hierarchy of biological, social and
environmental systems and the horizontal axis illustrates the life course at individual level or social change at population level. Biological and socio-environmental factors influence the health behaviours leading to health outcomes (32).

Figure 1. A multilevel model by Glass and McAtee applied to the study of obesity. The contingent effects of risk regulators (i.e., embodiment, opportunity, and constraint) are shown with dotted arrows. “Causal” effects of biological and behavioural variables are shown with solid arrows. Feedback loops existing within grouped variables are not shown. Specific effects and multiple, time-ordered feedback loops between the variables are not shown in order to reduce diagram complexity (33).

Thus, next to biological and characteristics of children, aspects of the (local) environment such as cultural norms, area deprivation, psychosocial hazards, (local) built- and local food environments and commercial messages play an important role in determining energy balance related behaviours. This is in line with studies showing that people living in deprived neighbourhoods are more likely to be overweight than those living in less deprived neighbourhoods (34-36). Children living in neighbourhoods with facilities such as stores selling moderately priced fresh products and playgrounds, parks and other recreational facilities, have a healthier diet, engage in more physical activities and are less likely to be overweight or obese (37). Moreover, an increase in facilities, such as parks, physical fitness facilities, sport clubs, swimming pools, is associated with a decrease in
overweight and an increase of achieving five or more times per week of moderate-vigorous physical activity (38).

Taking a closer look into the local environment, that seems to play an important role according to Figure 1, and focussing on young children, it seems that the local environment is particularly determined by the home environment (parenting styles and family characteristics) and the community (demographic and societal characteristics). This is illustrated by a model, developed by Davison and Birch (Figure 2) (39). For the development of this model Davison and Birch used the Ecological Systems Theory (EST) by Bronfenbrenner (1989) as a basis. The ecological systems theory divides the environment into micro-, meso-, and macro systems with a person at the centre. These different levels directly or indirectly influence each other and the child’s development (40). The model by Davison and Birch (Figure 2) illustrates that the child’s weight status is moderated by child’s characteristics as gender and age and child’s risk factors as susceptibility to weight gain and, dietary intake, physical activity and sedentary behaviour. Parenting styles and family characteristics influences these risk factors of children by, for example, parental dietary intake and activity patterns, child feeding practices and parent-child interactions. The outer

**Figure 2.** Ecological model of predictors of childhood overweight. * Child risk factors (shown in upper case lettering) refer to child behaviours associated with the development of overweight. Characteristics of the child (shown in italic lettering) interact with child risk factors and contextual factors to influence the development of overweight (i.e. moderator variables) (39).
layer of the model indicates the influence of the community, demographic and societal characteristics as socio-economic status (SES), safety of the neighbourhood, characteristics of the school environment (school physical education programs), accessibility of recreational facilities and convenience foods and restaurants. This is consistent with the risk regulators mentioned in the model by Glass and McAtee (Figure 1).

**Integrated approach to tackle overweight**

There were several international, national and local (Zwolle) developments in order to achieve an integrated approach to tackle overweight (Figure 3).

**Figure 3.** International, national and local developments in order to achieve an integrated approach to tackle overweight.
International developments

Internationally, a community-based intervention approach was developed over a time span of 12 years in two towns in the north of France and found to be effective across all socioeconomic levels (41). Four critical pillars were identified from this approach and these formed the basis of the EPODE (Ensemble Prévenons l’Obésité des Enfants) approach, which was launched in ten French pilot communities in 2004 (42). EPODE is an integrated approach aimed at encouraging and facilitating the adoption of a healthy lifestyle to tackle overweight in children by involvement of different stakeholders and targeting both individual behaviour and environment from different settings: family, school and neighbourhood (42). This approach is based on the four critical pillars: 1) political commitment, 2) social marketing, 3) public-private partnership and 4) scientific evaluation and monitoring.

National developments

In de meanwhile, in the Netherlands the desire to tackle the problem of overweight and obesity is getting a more prominent place on the Dutch public health, as well as the political agenda in 2002 (43). The Knowledge Centre Overweight (KCO) was set up to provide professionals with access to knowledge regarding aetiology, prevention, treatment options and consequences of overweight and obesity and encourage research (43). In 2004, to encourage cooperation between public and private parties with special attention for environmental changes, the Overweight Covenant (later, the Healthy Weight Covenant) was established. In 2008, Partnership Overweight Netherlands (PON) was initiated and facilitated the development and implementation of a chronic disease management model for overweight and obesity (43). In 2009, a Dutch adaption of the promising EPODE approach was developed and called JOGG (Dutch acronym for ‘Young people at a Healthy Weight’). In the Dutch JOGG approach a fifth pillar is added; the link between prevention and health care.

Local developments

In the city of Zwolle, Windesheim University of applied science established together with Amsterdam VU University and VU medical Centre a research centre in 2005. This research centre wanted to develop socially relevant knowledge through scientific research on promoting a healthy lifestyle, healthy environment and care to prevent and treat overweight and obesity. The research centre for the prevention of overweight Zwolle (OPOZ), takes different “risk regulators” (Figure 1) of obesity into account when conducting research. The aim of this research centre is to develop a research program that combines scientific research and applied science with practice and policy in order to develop, implement and evaluate tailored community interventions (44). The focus of research conducted by the researchers of OPOZ is on prevention of overweight in the local environment; in the settings neighbourhood, schools and families. Moreover, research is on how to develop
and evaluate an integrated approach where activities within these settings are being coordinated and reinforced by each other. In Zwolle, there was a political commitment to put health as one of the main themes on the political agenda; Zwolle wanted to position itself with this theme. Moreover an active network of public organisations in the field of health, welfare, sports and education were working together. This resulted in a program called ‘Healthy together’, a community-based program in which several organisations for health, welfare, sport and education in Zwolle worked together to promote a healthy lifestyle, to create healthy environments and to prevent childhood overweight and obesity. In 2006, this program started under the direction of the Municipal Health services IJsselland. For practical reasons this program prioritised in two deprived neighbourhoods with relatively high prevalence of low SES families in 2006. So, there was a good basis for the three pillars political commitment, the link for prevention and care and scientific monitoring of JOGG. From 2009, the first steps were made in the field of social marketing and public-private partnership. In 2010, Zwolle was chosen as the first JOGG city and a local adaption of the JOGG approach started with the name ‘Zwolle Healthy city’ with special focus on two deprived neighbourhoods.

**ChecKid: a dynamic cohort study**

At the start of the program ‘Healthy together’ in 2006 a dynamic cohort study started, named ChecKid. The objectives of ChecKid were to study lifestyle behaviours related to childhood overweight and obesity and determinants of these behaviours within neighbourhoods, schools and families (the different layers of Figure 2). Secondly, the study aimed to investigate trends of overweight and energy-balance related behaviours. With this, targets can be found to improve existing interventions and activities or develop new interventions and activities to promote a healthy lifestyle and to prevent childhood overweight.

The population of the ChecKid study are primary school children in the age between 4 and 13 years. Every three years height, weight and waist circumference are measured in children and their parents complete a questionnaire on nutrition, physical (in)activity, their physical and social home environment, opinions on their neighbourhood, safety and hygiene. Therefore, the ChecKid study is a dynamic cohort study. Every three years a cross-section of all primary school children is made. With this, the ChecKid study gives the possibility to investigate cross-sectional trends and relations and also to follow children individually over time.

For the measurements, around 80 students of several higher vocational educations of Windesheim University of Applied science were selected and trained to measure body height, weight and waist circumference using a protocol in children. These measurements
took place in three weeks in October/November in 2006 and 2009. In 2006 and 2009 around 80% of the schools agreed to participate, with an equally distribution across the different neighbourhoods in Zwolle. Around 65% (n = 5,219) of the invited parents gave written informed consent in 2006 and 47% (n = 4,590) in 2009. In 2006, both anthropometrical and parental questionnaire data were available for 4,072 children (78% of the children with informed consent) and in 2009, both anthropometrical and parental questionnaire data were available for 3,026 children (70% of the children with informed consent).

Most analyses in this dissertation were performed on the ChecKid 2006 dataset; except for chapter 6 for which longitudinal (children measured in 2006 as well as in 2009) data was used. For this dataset, the children in class 1 through 5 participating in ChecKid in 2006 were included (n=2,686), because children in senior groups left primary school in 2009. The total number of children with an anthropometric measurement and a filled in parental questionnaire in both 2006 and 2009 was 1,048. The study design is further explained in chapter 2.

**Outline of this thesis**
The overall aim of this thesis is to find indications for the prevention of childhood overweight and obesity in the city of Zwolle, especially in the context of the home environment. For the structure of this dissertation, the ecological model by Davison and Birch was used (Figure 2) (39). Therefore chapter 2 aimed to identify neighbourhoods with significantly higher prevalence rates of childhood overweight than the other neighbourhoods in Zwolle and to investigate the energy-balance related behaviours associated with living in these neighbourhoods (outer ring of the model in Figure 2). Whether these energy-balance related behaviours explain the association between the neighbourhood and the high prevalence of childhood overweight is also investigated. The neighbourhood, which encompasses schools and families, was measured roughly in the ChecKid study, in order to gain better understanding of the direct surroundings of children, the focus of the next chapters is on the physical and social home environment in association with energy-balance related behaviours (second ring). The specific behaviours that are investigated further are based on literature and opinions of experts, which will be further explained bellow.

In chapter 3, the focus is on determinants of TV viewing and computer use in the home environment. Sedentary behaviours (TV viewing and computer use) have been identified as important risk behaviours for overweight (24, 26, 27). Nevertheless, most studies did not analyse the association separately for younger and older children and the role of gender in this association is still unclear (45, 46). Moreover, TV viewing and computer use are studied separately in chapter 3 because time spent on these sedentary behaviours
may vary for children across different ages. In addition, different determinants might be associated with TV viewing and computer use.

The determinants in the home environment of short sleep duration are described in chapter 4. Information on determinants in the home environment of short sleep duration and information on competing activities for sleeping can help prioritising prevention strategies (47, 48).

Chapter 5 focuses on the determinants of fruit and vegetables consumption in the home environment. Eating sufficient amounts of fruit and vegetables are important targets in childhood overweight prevention as their health benefits are considered to be sustainable and significant over the long-term (14, 17). Children living in families with a low SES generally have less healthy eating habits than children living in families with high SES (49, 50). Therefore, the determinants in the home environment are investigated separately for low, middle and high SES families.

In chapter 6 the changes in weight status, BMI-standard deviation scores (sds) and energy-balance related behaviours between 2006 and 2009 and association between energy-balance related behaviours and changes in BMI-sds are described (third ring of the model of Figure 2).

In the general discussion (chapter 7) the general findings are summarised and integrated with results from other studies, methodological implications, implications for practice, policy, education and research are discussed.
Chapter 1

Reference list


