Family matters?

Parental influences on primary school children's energy balance-related behaviours and weight

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Family matters?

Parental influences on primary school children's energy balance-related behaviours and weight

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A corner of the veil...

Imagine you are a parent of a son aged 8 years. You more or less follow the way of parenting that your parents used to apply: strictness and punishment in case of misbehaviour are your general parenting principles. However, because you sometimes encounter difficulties in raising your son, you start watching television programmes such as 'The Nanny'. These programmes introduce various new principles of parenting: for example, apart from setting rules, a parent should be involved and reward positive child behaviour instead of punishing misbehaviour (positive parenting). Your child is a 'picky' eater, he always makes a fuss about eating his vegetables during dinner. You now realize that you may be able to solve this problem by offering him his favourite ice cream as a dessert - as long as he does not make a fuss about eating his vegetables. This works: your son eats his vegetables without being difficult and the dinners now take place in a pleasant atmosphere.
A couple of months later, it is your son's birthday. You ask him what he would like to have as a birthday gift. He is very clear: a game computer, just like his friends at school. You know from parents at school that their children play computer games for many hours a day and have difficulty in stopping. To prevent your son from playing on the game computer for too many hours, you make a deal with him: you will get your game computer, but you are only allowed to play on it for one hour a day, after dinner. In practice, your son finds it very hard to comply with the one-hour rule. He is getting obsessed about playing on his game computer and gets rather angry when you tell him his playing time is over. This also adversely influences the bedtime ritual, which used to take place in an intimate atmosphere. Remembering the problems with eating his vegetables, you try to change the situation by rewarding your son for good behaviour. You promise him his favourite cake if he stops playing the game computer after one hour without any complaining. He can have his cake while you are reading to your son before bedtime. This works again, which increases your confidence about your parenting skills. However, then you notice that your son is gaining more and more weight. You realize that giving all these favourite products as a way of rewarding your child for eating vegetables and limiting his screen time is not a healthy solution. These new habits need to be changed: now, ice cream is given only once a week and your son gets extra reading time from you instead of cake when the screen time rule is obeyed.

This is an example of the complex situation in which children's dietary and activity behaviours can be formed. It shows the interplay between parent and child, between general parenting (setting rules, being involved and rewarding), food-specific parenting (rewarding with favourite products), activity-specific parenting (computer rules) and child characteristics (picky eater and obsessiveness), which determine child behaviour and weight. These are the types of factors addressed in this thesis.

Contents

chapter 1

General introduction

General introduction

1.1 Prevention of childhood overweight: a public health issue

In the Netherlands, as in many other countries, the prevalence of overweight and obesity among children has increased rapidly over the past decades[1-4]. Although there is convincing evidence for genetic susceptibility to overweight[5], this cannot explain the rising trend. The current obesogenic environment, characterized by the constant availability of cheap energy-dense food and advancement of sedentary lifestyles, is part of the explanation[6,7]. Between 1980 and 2010, the overweight prevalence among Dutch boys (aged 2-21 years) has increased from 5.1% to 13.3% and among Dutch girls from 7.2% to 14.9%[8]. Although a recent study among primary school children across Europe aged 10-12 years shows that the prevalence rates among Dutch primary school children were below the European average, 16.8% of Dutch boys aged 10-12 years were overweight (of which 4.5% obese) and 15.4% of the girls (of which 2.5% obese)[9].
Overweight and obesity are associated with premature mortality, and an increased risk of several diseases such as type 2 diabetes, musculoskeletal and pulmonary disorders, cardiovascular diseases and various types of cancer[10-12]. In addition, they are associated with psychosocial problems such as a low self-esteem, depression and eating disorders[13,14]. In view of these consequences, and given the tracking of overweight from childhood into adulthood[15], preventing overweight and obesity during childhood is an important public health target[4]. However, to achieve this target requires a detailed understanding of the most important and modifiable risk and preventive factors for childhood overweight, including their underlying determinants.

This introductory chapter first describes the general background and rationale for the studies presented in this thesis: §1.2 presents dietary and activity behaviours as behavioural determinants of childhood overweight, §1.3 underlines the importance of studying parental correlates as underlying factors of children's dietary behaviours, activity behaviours and weight, and §1.4 presents the theoretical framework that guided the studies presented in this thesis. Second, this chapter presents the general aim of this thesis (§1.5), followed by an introduction of the INPACT study (§1.6) which was initiated to conduct the studies that are described in this thesis. Finally, an outline is presented of the studies presented in this thesis (§1.7).

1.2 Behavioural determinants of childhood overweight

Weight changes are caused by an imbalance between energy intake and energy expenditure. Overweight is the result of a long-term positive energy balance, in which energy intake through foods and drinks exceeds energy expenditure, mainly through physical activity. As dietary and activity behaviours are associated with the energy balance, they are referred to as energy balance-related behaviours (EBRBs)[16]. EBRBs are seen as important behavioural determinants to induce or reduce childhood overweight. Obesity-inducing behaviours, which may lead to a positive energy balance, and obesity-reducing behaviours, which may lead to a negative energy balance, are therefore important starting points for interventions to prevent overweight development in children.

1.2.1 Dietary behaviour

Consumption of energy-dense food, sugar-sweetened beverages (SSBs), large portion sizes and eating away from home are the most important dietary determinants of childhood overweight and obesity[17], while diets rich in fruit and vegetables, and rich in fibre are associated with a healthy body weight[18-21]. Dietary habits often find their origin in early childhood[22], and, just as child overweight, are likely to track into adulthood[23-25]. In addition, dietary habits are influenced by the developmental stage of the child. For example, there is evidence that children's fruit intake decreases when they grow older[26]. Such developmental influences underline the importance of studying dietary habits in all developmental stages of childhood.

1.2.2 Activity behaviour: physical activity and sedentary behaviour

Children's physical activity (PA) includes behaviours such as active commuting to school, playing outside and playing sport at a club. Low levels of PA are an important determinant of childhood overweight and obesity[17], while an active lifestyle is associated with a healthy body weight[19].
Apart from low levels of PA, high levels of sedentary behaviour are an important determinant of childhood overweight and obesity[17]. Children's sedentary behaviour includes behaviours such as watching television and using the computer (including game computers). An increasing number of studies have supported an independent effect of sedentarism on childhood overweight, i.e. sedentary behaviour is a health risk in itself, regardless of the amount of physical activity[27,28], but contrasting findings are also reported[29].
Similar to dietary behaviour, the foundation for future PA and sedentary behaviour is formed in early childhood[30], and PA and sedentarism are likely to track into adulthood[24]. Research also shows a decrease in PA levels when children grow older[31,32], which again stresses the importance of studying EBRBs in all developmental stages of childhood.

1.2.3 Clustering of EBRBs

Instead of occurring in isolation, there is evidence for an interplay between important EBRBs of overweight. Various studies have examined the co-occurrence, or 'clustering', of EBRBs in children (e.g.[33-44]). Clusters are combinations of behaviours which are more prevalent than would be expected from the prevalence of the individual behaviours[45]. Examples of clusters in children that have often been reported are a 'sedentary-snacking' cluster, in which intake of unhealthy food items clusters with sedentary screen-based behaviour (i.e. television and computer use)[33-38,40,42,44], and an 'all-round-healthy' cluster of healthy food intake and

high levels of PA[34-36,38,39,44] and/or low levels of screen-based behaviour[35,38]. Cross-sectional[34,38] and longitudinal studies[40,41,43] that relate clusters of EBRBs to child weight show in general a positive association between unhealthy clusters ('sedentary-snacking' and 'energy dense-high fat') and child (over)weight. This finding of the potential synergy between unhealthy EBRBs in explaining child weight could be used in obesity prevention interventions, by applying an integrated approach, for example by addressing multiple behaviours simultaneously[46].

1.2.4 Improving child EBRBs as a target in itself

EBRBs are viewed as important behavioural determinants to induce or reduce childhood overweight and are therefore seen as important starting points for interventions to prevent overweight development in children. Apart from that, promoting healthy EBRBs in children is an end in itself because of its positive health effects, for example on reducing cardiovascular disease risk factors and some types of cancer[32,47,48]. It is widely acknowledged that children's dietary and activity behaviour needs to be improved: in general, children consume less fruit and vegetables than is recommended[49–53] and they do not meet physical activity recommendations[54]. Because of the persistence of children's EBRBs into adulthood, it is important to promote obesity-reducing EBRBs and discourage obesity-inducing EBRBs in childhood. This requires a detailed understanding of the modifiable factors that influence children's EBRBs. As the home environment is a critical context for the development of children's dietary and activity behaviours[55–59], and parents are primarily responsible for shaping the home environment, this thesis aims to elucidate parental influences on EBRBs and weight of primary school children, aged 8-12 years.

1.3 Home environment: parents as key players in determining children's EBRBs and weight

For children, parents are the primary source of socialisation[60,61]. While raising their children, parents teach them their values, norms and corresponding behaviour, including dietary and activity behaviour. This thesis aims to elucidate parental influences on EBRBs and weight of children in *late childhood* (children aged 8-12 years). Children in late childhood are still largely under parental influence[62], and eat most of their meals in the home/family environment, while increasing their autonomy. This makes studying parental influences on primary school children's EBRBs and weight highly relevant in this age group.

1.3.1 Levels of parental influence on children's EBRBs and weight

Parental influences can be classified into various levels, which are defined by their proximity to child behaviour: distal or higher-order variables are further removed from child behaviour than proximal or lower-order variables[63–65]. In this thesis, four levels of parental influence on children's EBRBs and weight are distinguished:

1. socio-demographic influences;
2. parenting styles;
3. parental feeding styles and
4. diet-related and activity-related parenting practices.

Socio-demographic influences include socio-economic status (SES), which is often operationalized in parental education level, and ethnicity. These influences are the furthest removed from behaviour (i.e. the most distal), are relatively stable and have effects on multiple behaviours, also outside the scope of EBRBs and weight. Since they are not (easily) modifiable, they are no feasible starting points for intervention development. However, socio-demographic influences can be important to identify specific target groups for obesity prevention interventions. Review studies on parental correlates of children's EBRBs and weight provide evidence for an inverse association between SES and weight[66,67] and favourable associations between SES and EBRBs (e.g., a positive association between SES and child fruit intake and an inverse association between SES and child screen time[68-71]). In addition, migrant children are at higher risk for overweight and obesity than their native counterparts[72].

Parenting style (or general parenting) generates the environmental and emotional context for child rearing. It can be defined as 'a constellation of attitudes toward the child that are communicated to the child and that, taken together, create an emotional climate in which the parent's behaviours are expressed'[73]. It is a concept consisting of three underlying dimensions: support, behavioural control and psychological control. Support (or involvement) refers to parental responsiveness and connectedness to the child. Behavioural (or strict) control refers to the regulation of the child's behaviour through firm and consistent discipline. Psychological control refers to the regulation of the child's behaviour through psychological means such as love withdrawal and guilt induction. Psychological control is a more manipulative, suppressive form of control[74-79] and therefore more likely to undermine the child's autonomy and ability to self-regulate behaviours, including EBRBs.

Researchers usually operationalize general parenting in two dimensions: support and behavioural control[73,79]. By crossing the dimensions of support and behavioural control, four prototypes of parenting are created[77]: authoritative parents (characterized by high levels of parental support and behavioural control), authoritarian parents (characterized by low levels of parental support and high levels of behavioural control), indulgent or permissive parents (characterized by high levels of support, but low levels of behavioural control), and neglectful or uninvolved parents (characterized by low levels of parental support and behavioural control). Of the parenting styles, authoritative parenting shows in general favourable associations with child weight and EBRBs[80].

Researchers tend to neglect the dimension of psychological control (see Barber[81]), also when exploring the relationship between parenting style and child EBRBs and/or weight.

In the few studies that assessed psychological control[82-85], the construct was related to unfavourable behavioural outcomes (e.g., high intake of calories and fat[82,83]) and, in general, higher child body mass index (BMI) z-scores[82,83,85]. In this thesis, parenting style is assessed three-dimensionally by adding the dimension of psychological control to the generally accepted dimensions of behavioural control and support.

Whereas parenting style describes parent-child interactions across a wide range of situations, *parental feeding style* describes these interactions only across food-related situations. In research, parental feeding styles are measured in various ways (e.g. [86-89]), which makes cross-comparisons of study findings difficult. Four commonly used aspects of parental feeding are instrumental feeding (i.e. using food to regulate a child's behaviour), emotional feeding (i.e. using food to temper a child's emotions), encouragement to eat,

and control over eating[86]. Of these aspects, instrumental and emotional feeding show unfavourable associations with child snacking behaviour, whereas encouragement and control over eating show favourable associations with child snacking behaviour[90]. There is evidence that normal-weight and obese mothers do not differ in the extent to which they offer food to deal with emotional distress, use food as a form of reward, or encourage their child to eat more than was wanted. However, they differ on 'control': obese mothers are less likely to execute control over their children's intake[86].

Diet-related and activity-related parenting practices are the most proximal parental influences of children's EBRBs. They can be defined as content-specific acts of parenting[73]. They include specific behaviours or strategies parents use to influence child dietary and/or activity behaviour, e.g. role modelling of healthy eating, limiting the intake of snack foods, increasing availability of fruits and vegetables in the home, and limiting screen time[89]. Parenting practices are often arranged by three *types* of home environment[6]:

1. the physical home environment;
2. the socio-cultural home environment, and
3. the political home environment

The physical environment refers to which EBRB options are available at home. It includes the parenting practices of home availability, visibility and accessibility of food and PA equipment. The socio-cultural environment refers to family beliefs, attitudes and values related to EBRBs, including parental role modelling. The political environment refers to family rules and policies related to EBRBs.
Of the parenting practices, parental intake, parental modelling, home availability and accessibility, family rules and parental encouragement are the most consistently supported positive determinants of child and adolescent fruit and vegetable intake[58,68-70]. For child and adolescent physical activity, parental support, parental encouragement and paternal physical activity are important positive correlates[58,71,91], while for child sedentary behaviour explicit rules restricting watching television are related to less sedentary behaviour (e.g. [92-94]). In research, parenting practices are mainly related to specific behaviours (e.g., availability of snack food is related to snack intake). The few studies that relate parenting practices to child weight, show inconsistent results[95].

1.3.2 Child characteristics and parent-child interaction

Research shows that parenting practices are related to child characteristics. Important child characteristics for diet-related parenting practices include gender, ethnicity, weight, eating style (or appetitive traits) and food preferences[88,96-104], whereas gender and activity style (active or not) are related to activity-related parenting practices[97]. In addition, there is increasing evidence that parents modify their feeding practices (i.e. pressure to eat, restriction and monitoring) in response to children's (perceived) weight, dietary behaviours and/or eating style[102,103,105,106]. Thus, parenting does not occur in isolation, but interacts with child characteristics and behaviours, which stresses the importance of incorporating child-related correlates of children's EBRBs and weight in studies of parental influences on children's EBRBs and weight. Apart from gender, age and weight status as child characteristics, child appetitive traits and child food-related and activity-related preferences are examined in this thesis. Child appetitive traits (or eating styles) reflect behavioural susceptibility to obesity. They can be divided into food-approaching appetitive traits (e.g. food responsiveness) and food-avoidant appetitive traits (e.g. food fussiness). Food approaching appetitive traits are positively related to child weight, while food avoidant appetitive traits are negatively related to child weight[107-112]. Although child appetitive traits have a strong genetic component[113] and are thus not easily modifiable, the evidence that parents react to them makes them interesting to study in relation to parental influences.
Child food preferences are an important determinant of children's food intake[114-119]. There is evidence that activity preferences are also associated with children's PA and sedentary behaviour[120-122]. Child preferences have the potential to be changed by parents[120] and are thus highly relevant to incorporate in studies on parental influences of children's EBRBs and weight.

1.4 Theoretical framework: ecological systems theory

The above-mentioned findings demonstrate that children's EBRBs and weight are influenced by multiple levels of parental factors and by child-related correlates. For years these potential determinants were mainly studied as isolated factors, providing context-free generalizations about determinants of children's EBRBs. However, there is theoretical and empirical evidence that parenting does not occur in isolation. According to the ecological systems theory, it is the result of bi-directional relationships between parent and child, influenced by interactions with the broader environment[64,65,124]. This section describes the ecological systems theory, and how it is applied as theoretical framework that guides the studies presented in this thesis. In addition, research gaps in light of the ecological systems theory are identified.

1.4.1 Ecological systems theory

Bronfenbrenner's ecological systems theory has its origin in developmental psychology. The theory emphasizes that environmental factors, on micro and macro level, play a major role in human development. Human behaviour is seen as a result of interaction between an individual and his/her environment.
As such, the ecological systems theory assumes that children's EBRBs are influenced by multiple levels and types of environments, and by individual characteristics, and that these various factors interact[64,65,124]. For example, a child's sport participation may be influenced by parental encouragement, which may depend on the child's gender, but - on a higher level - also by financial opportunities. Similarly, child fruit intake may be influenced by parental fruit intake and by availability of fruit at home, but these proximal factors may also be influenced by parental knowledge / education level. In the ecological systems theory, the levels of influence are presented as a set of nested structures, each inside the next. Figure 1.1 presents the four types of parental influences distinguished in this thesis. Higher-order factors, such as parental education level and parenting style, are hypothesized to moderate the influence of more proximal or lower-order factors, such as parenting practices, on child behaviour[124]. This implies that the direction and/or strength of the association between parenting practices and child behaviour may differ depending on the parent's education level or parenting style. In the same way, child characteristics are theorized to moderate environmental influences on child behaviour[125,126]. Acknowledging that various levels and types of parental influences and child-related factors interact in explaining and predicting children's EBRBs, provides more information than merely studying potential determinants of EBRB as isolated factors[127]. Elucidating under which circumstances a relationship occurs is assumed to be helpful for intervention development aimed at improving children's EBRBs and weight.

1.4.2 Research gaps in light of the ecological systems theory

So far relatively few studies have incorporated multiple levels of parental factors to explain children's EBRBs and weight. Findings of the few moderation studies indicate that general parenting has a differential impact on children's weight-related outcomes, depending on child and parental characteristics, but controversy exists regarding the optimal levels of parental control and support[80]. This suggests that more studies are needed in which parenting style and other higher-order factors are included as potential moderators of the associations between more proximal parental factors in relation to child EBRBs and weight.

Apart from moderation studies, the interplay between various levels of parental influence and child-related correlates can be studied as causal or reciprocal associations. For example, authoritative parenting has been associated with greater home availability of fruits and vegetables, with greater child consumption of dairy, fruits, and vegetables, and with lower consumption of junk foods[22]. However, the link between parenting style and specific feeding practices is equivocal, suggesting that parenting style does not inevitably determine parenting practices[88]. Thus, more studies are needed to explore this topic, preferably in mediation and moderation analyses[73], revealing the potential causal chain or contextual influence of distal and proximal parental factors in explaining children's EBRB and weight.

The ecological systems theory also assumes an interplay between multiple types of environments (e.g., the socio-cultural and physical home environment) in explaining children's EBRBs. There is evidence for associations between the physical, socio-cultural and political home environment regarding physical activity and regarding fat, fruit and vegetable intake[128], but a more interesting and new way to study the interplay between various types of environments is a clustering approach, especially because children's EBRBs are known to cluster in healthy and unhealthy patterns (see §1.2). Thus, clusters of unfavourable diet- and activity-related parenting practices could be indicators of a wider obesogenic parental context, which might explain detrimental behavioural clustering in the child. In the same way, child-related correlates can cluster in healthy and unhealthy patterns across the dietary and activity domain.

In this thesis, the scientific knowledge on the interplay between different types and levels of the home environment with factors at the individual level in explaining children's EBRBs and weight will be extended by examining higher-order moderation, (causal) associations, and clustering.

1.5 Aim and research questions

The aim of this thesis is to elucidate parental influences on primary school children's energy balance-related behaviours (EBRBs) and weight by studying the interplay between parental and child-related correlates.

The following research questions were derived from the research aim:

1. What are important parental and child-related correlates of children's EBRBs and weight?
2. To what extent and by which mechanisms do these parental and child-related correlates interact in explaining children's EBRBs and weight?

In this thesis, children's EBRBs include obesity-reducing behaviours, namely child fruit intake, sports participation, playing outside and active commuting to school, and obesity-inducing behaviours, namely child snack intake, sugar-sweetened beverage (SSB) intake and screen time (TV and computer).

Before providing an outline of the studies presented in this thesis, an introduction to the INPACT study is given.

1.6 INPACT

INPACT is the acronym of IVO Nutrition and Physical Activity Child cohorT. This cohort study was initiated in 2008 to collect data to perform studies focussing on parental influences of primary school children's EBRBs and weight, including the individual studies that are presented in this thesis. Over the years, the focus has been broadened to neighbourhood and school influences of primary school children's EBRBs and weight.

1.6.1 Study design

INPACT is a prospective, observational study conducted among primary school children and their primary caregivers in southern Netherlands (Eindhoven area). The study included four assessments with a one-year time interval. Baseline data collection took place in the autumn of 2008, when participating children were on average 8 years old. The final data collection period was in the autumn of 2011, when the children were on average 11 years old. Approval for the INPACT study was obtained from the Ethics Committee of the Erasmus MC (University Medical Center Rotterdam).

Recruitment of schools

Children and their primary caregivers were recruited through primary schools. To gain diversity in education level, ethnicity and level of urbanisation, INPACT was conducted among schools in the service area of the Municipal Health Authority for Eindhoven and surrounding area (GGD Brabant-Zuidoost). As the fifth-largest city in the Netherlands, Eindhoven city (almost 220,000 inhabitants) has a diverse population, including parents from lower socio-economic positions and foreign ethnicity. Apart from the city of Eindhoven, the service area of the Municipal Health Authority for Eindhoven and surrounding area includes rural villages.
Schools were recruited in collaboration with the Municipal Health Authority. The Municipal Health Authority invited school principals of all general primary schools in their service area by letter to participate in the INPACT study. Then, the school principals were contacted by a researcher, to whom they could express their interest to participate in the study. Of the 265 schools invited, 91 took part. The response rate from rural and urban schools was equal.

Recruitment of participants within schools

All primary caregivers of third-grade students (aged ≈ 8 years) of the participating schools were invited by letter to participate in the cohort study, together with their child, for four years. Of the 2948 parent-child dyads invited, 1839 (62.4%) gave written informed consent to participate in the INPACT study for these four years.

Procedure

Participating parents were asked to complete an annual questionnaire at home, using a paper-and-pencil administration format. The parent questionnaires were sent to the school principals and distributed through the teachers to the children, who gave them to their parents. The primary caregiver was asked to complete the questionnaire and to hand it in at school within two weeks of receipt. After two weeks, two qualified research assistants attended the school to measure the participating children's height, weight and waist circumference according to standard procedures described in a measurement protocol. The research assistants also collected the parent questionnaires and handed out reminders to children whose primary caregiver had not returned his/her questionnaire. Finally, under the guidance of the research assistants, the participating children completed a questionnaire, except for the baseline assessment. At baseline, the children's literacy was too low to complete a questionnaire themselves.

Apart from anthropometrical measurements and questionnaires, the third data collection period of the INPACT study included neighbourhood observations and interviews with school directors and teachers regarding diet- and activity-related school policies. As the neighbourhood and school environment fall outside the scope of this thesis, the procedures used to collect these data are described elsewhere (e.g. [130,131]).

1.6.3 Assessments

Questionnaires

The INPACT questionnaires were developed by using existing validated Dutch questionnaires where possible. If no validated questionnaires were available the INPACT questionnaires were informed by questionnaires on related topics that were used in on-going projects in the Netherlands, and questionnaires used in various studies worldwide.

The parent questionnaires assessed various parental and child background characteristics such as parental education level, parental BMI, ethnicity[1], child gender and child appetitive traits. The questionnaires also assessed the physical, socio-cultural and political home environment, including parenting styles, parental feeding styles and energy balance-related parenting practices. Finally, the questionnaires assessed EBRBs of the children and the parents, such as weekly fruit, snack and SSB intake, and the weekly number of days spent in different activities, such as playing sport at a club, active commuting, watching television and using the computer. One parent, the primary caregiver, completed the parent questionnaires.

The questionnaires for children assessed various child-related determinants of EBRBs, including diet- and activity-related preferences, as well as energy balance-related parenting practices and children's EBRBs.

Anthropometrics

Children's height, weight and waist circumference were measured at school according to standard procedures in light clothing without shoes, to the nearest 0.1 kg and 0.1 cm. Weight was measured with an electronic flat scale, height with a mobile measuring ruler, and waist circumference with a spring loaded measuring tape.

[1] In the studies described in this thesis, ethnic background is defined from the perspective of the child: if at least one parent was born abroad, a child is classified as non-native Dutch. However, concerning the influence of ethnicity on child dietary and activity behaviour, it is more plausible to consider it as a parental characteristic than as a child characteristic.

The studies presented in this thesis are based on parent- and child-reported data and measured height and weight from baseline (2008) to the third wave of data collection (2010).

1.7 Outline

Following this introductory chapter, chapters 2 through 7 present six empirical studies addressing the research questions. Figure 1.1 is a graphical representation of the outline, including the chapters in which the individual studies are presented. In line with the ecological systems theory, the levels of influence are presented as a set of nested structures, each inside the next.

Chapters 2 to 5 focus on parental correlates and chapters 6 and 7 on child-related correlates of children's EBRBs and weight. **Chapter 2** examines the association between general parenting and child BMI, including the potential moderating influence of parental education level, ethnicity and child age in a cross-sectional way. Figure 1.1 shows that general parenting can be modelled as a distal factor for child BMI. To open the black box between general parenting and child BMI, **chapter 3** describes cross-sectional and longitudinal associations between parental feeding styles with child dietary behaviours and weight, and explores whether general parenting interacts with these feeding-specific acts of parenting in determining child intake and weight. **Chapter 4** further explores the interaction between general parenting and parenting practices by studying parenting style, SES and ethnicity as higher-order moderators of the cross-sectional association between parental modelling of fruit intake and child fruit intake. In addition, these higher-order parental factors are studied as background variables of parental fruit intake in explaining child fruit intake.

Chapter 5 describes clustering between diet- and activity-related parenting practices. It also relates the clusters found to child and parental background variables, including parental education level, ethnicity and parenting style, and to child EBRBs in a cross-sectional way.

Chapter 6 describes cross-sectional and longitudinal associations between children's appetitive traits with child dietary behaviours and weight, and explores whether general parenting interacts with these individual characteristics in determining child intake and weight. **Chapter 7** discusses clustering of diet- and activity-related preferences of children and their cross-sectional associations with child and parental background variables, including parental education level, ethnicity and diet- and activity related parenting practices.

Finally, the general discussion in **chapter 8** summarizes and elaborates on the main findings of the six empirical studies, answers the research questions, presents limitations, discusses practical and theoretical implications, and finishes with an overall conclusion.

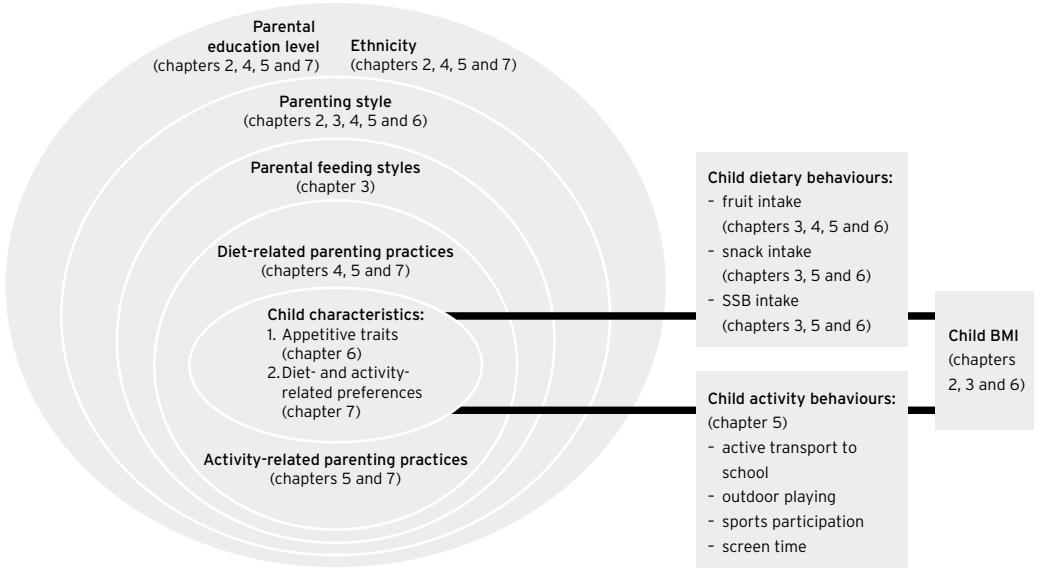

Figure 1.1 Graphical representation of the research framework, including an outline of the thesis.

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chapter 2

control

Psychological control by parents is associated with a higher child weight

Psychological control by parents is associated with a higher child weight

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2.1 Abstract

Objective
In this examination of the association between parenting style and child weight, the neglected concept of 'psychological control' has been added to the generally accepted parenting dimensions 'support' and 'behavioural control'. Also explored is whether the potential association between parenting and child weight is moderated by socio-demographic variables (child's age/ethnicity, and parent's education level).

Methods
A cross-sectional study was performed among 1,665 parent-child dyads. The children's mean age was 8 years. Their height and weight were measured to calculate their body mass index (BMI). Parents completed a questionnaire to measure the three parenting dimensions. Based on these dimensions, five parenting styles were defined: the authoritative, permissive, authoritarian, neglecting and rejecting parenting style. Child BMI z-scores were regressed on parenting style, adjusting for parental BMI, child ethnicity, and parent's education level.

Results
Rejecting parenting, characterized by high psychological control, low support and low behavioural control, is the only parenting style significantly related to child BMI z-scores (β=0.074, $p<0.001$). The positive association was not moderated by socio-demographic variables.

Conclusions
By adding the dimension of psychological control to the concept of parenting, this study has further elucidated the mechanisms whereby parenting may affect child weight. Demonstrating that 'rejecting parenting' is associated with a higher child weight, emphasises the need for longitudinal studies in which parenting style is measured three-dimensionally. Potential mediating effects of parental feeding style and children's eating style, as well as age moderation, should be included in these studies.

2.2 Introduction

In the Netherlands, as in many other countries, the prevalence of overweight and obesity among children is increasing rapidly[1,2]. Since the 1990s, in behavioural science attention has broadened from individual to environmental factors to explain this rising prevalence[3]. Parental influences, such as parental body mass index (BMI) and socio-economic status, are important risk factors in the socio-cultural environment[4,5].

Another potentially important socio-cultural factor, parenting style, is also receiving increased attention. Parenting style (or general parenting) can be defined as 'a constellation of attitudes toward the child that are communicated to the child and that, taken together, create an emotional climate in which the parent's behaviours are expressed'[6]. It is a concept consisting of three underlying dimensions: support, behavioural control and psychological control. Support (or involvement) refers to parental responsiveness and connectedness to the child. Behavioural (or strict) control refers to the regulation of the child's behaviour through firm and consistent discipline. Psychological control refers to the regulation of the child's behaviour through psychological means such as love withdrawal and guilt induction, e.g. behaving in a cool and unfriendly way when a child misbehaves or making a child feel guilty when he/she gets low grades in school. Psychological control is a more manipulative, suppressive form of control[7-12] and therefore more likely to undermine the child's autonomy and ability to self-regulate behaviours, including food intake[13].

Researchers usually operationalize general parenting in two dimensions: support and behavioural control[6,7]. However, they tend to neglect the dimension of psychological control (see Barber[14]), also when exploring the relationship between parenting and child weight. These studies, of which there are very few, have produced inconsistent results, as demonstrated in recent reviews[15,16]. To clarify such inconsistent and equivocal findings, researchers have increasingly called for the dimension of psychological control to be included in parenting research[14,17-20]. Therefore, the first aim of this study was to examine whether adding 'psychological control' to the generally accepted parenting dimensions of 'support' and 'behavioural control' would help to clarify the association between parenting and child weight. In studies relating parenting to children's behaviours, authoritative parenting (a way of parenting that combines high support with high behavioural control) was found to be a protective factor for problem behaviours[21]. Because health risk behaviours, overweight and obesity can be seen as problem behaviours, we hypothesized that the parenting dimensions support and behavioural control, and the authoritative parenting style, would negatively correlate with child overweight. Because psychological control is seen as a risk factor for problem behaviour[19,21], we hypothesized that psychological control and the rejecting parenting style

(characterized by high psychological control, low support and low behavioural control) would be positively associated with child overweight.

Apart from the growing obesity pandemic, several studies showed socio-economic differences in overweight[4,5]. In industrialized countries, low socio-economic status (SES) groups and minority groups had a higher prevalence of obesity[22-25], implying a particular need for research in these groups. In their review, Ventura and Birch suggested that the relationship between parenting and child weight could be clarified by including moderating factors in the analyses[15]. Therefore, our second aim was to establish whether the potential association between parenting and child weight is moderated by socio-demographic factors, such as child age, child ethnicity and parent's education.

2.3 Methods

Study design and procedure

To achieve our research aims, a cross-sectional study was conducted as part of the longitudinal INPACT study, which consists of 1,840 parent-child dyads. INPACT (IVO Nutrition and Physical Activity Child cohorT) is an observational study, initiated in 2008, focusing on modifiable determinants of overweight in the micro-environment of children in the Netherlands, aged 8-12 years. After approval for the INPACT study was obtained from the Ethical Committee of the Erasmus Medical Center, the first wave of data collection took place in the autumn of 2008 at Dutch primary schools in southern Netherlands (Eindhoven area). In recruiting the schools we collaborated with the Municipal Health Authority for Eindhoven and surrounding area (GGD Brabant-Zuidoost). The Municipal Health Authority invited all general primary schools in their service area to participate in the INPACT study. Of the 265 invited schools, 91 took part. There was an equal response rate from rural and urban schools. The primary caregivers of third-grade students (aged about 8 years) were invited to participate in the cohort study, together with their child. Of the 2,948 parent-child dyads invited, 1,840 (62.4%) gave informed consent to participate in the INPACT study over a four-year period.

The present study was based on the first wave of data collection, in which qualified research assistants measured the children's height and weight at school. The primary caregiver filled in a questionnaire at home, recording data on dietary and physical activity behaviours, and potentially relevant home environmental factors, including the three parenting dimensions, parental BMI and socio-demographic variables. Of the 1,840 participating parent-child dyads, 1,665 were included in the present study. We excluded underweight children (6.3%) and children with no or invalid data on the child BMI outcome measure (3.2%). Underweight children were excluded to prevent distortion of the results. International cut-off scores were used to determine whether a child was underweight[26].

Sample characteristics

Based on international cut-off scores[26], 11.8% of the 1,665 participating children were overweight and 3.5% obese. Most of the participating children were aged 8 (76.9%) or 9 (20.1%) years. Boys (51%) and girls (49%) were represented in almost equal numbers. Most of the primary caregivers who completed the questionnaire were female (92%) and lived with a partner (91%). Of the primary caregivers, 21% had finished education at a low level (primary school and lower vocational/lower general secondary education), 46% at medium level (intermediate vocational education, higher general secondary education and university prep) and 33% at a high level (higher vocational education and university). Over 15% of the children were from a non-Dutch ethnic background, with one or both parents born abroad: 9% from non-western countries (n=152); 7% from western countries (n=123).

Measurements

Parenting style

The parenting style of the primary caregiver was measured using the Dutch translation[27] of an instrument based on earlier work by Steinberg et al.[7,28]. This 22-item measure assessed three parenting-style dimensions (support, behavioural control and psychological control) using a response scale ranging from -2 (completely disagree) to +2 (completely agree). Support was measured with seven items, such as 'When my child gets a low grade in school, I offer to help him/her' (α=0.71). These items were combined in one variable by summing the item scores [range -14 (low) to +14 (high)]. Behavioural control was also measured with seven items, such as 'I know exactly what my child does in his/her free time' and 'I try to know where my child goes after school' (α=0.72). As recommended by Stattin & Kerr[29], behavioural control measured both parental knowledge and behavioural monitoring. After summing the item scores, the behavioural control variable ranged from -14 (low) to +14 (high). Psychological control was measured with eight items, such as 'I make my child feel guilty when he/she gets a low grade in school' (α=0.72). This variable ranged from -16 (low) to +16 (high).

Based on these three parenting dimensions, five parenting styles have been established: the authoritative (high support, high behavioural control, low psychological control), permissive (high support, low behavioural control, low psychological control), authoritarian (low support, high behavioural control, low psychological control), rejecting (low support, low behavioural control, high psychological control), and neglecting (low support, low behavioural control, low psychological control) parenting style (e.g. [30]). In addition to the separate dimensions we constructed these five parenting styles by dichotomising the sample on each dimension (median split) and examining the three variables simultaneously.

Socio-demographic variables

Measured socio-demographic variables included child's gender, age and ethnicity, as well as family structure and primary caregiver's education level (all assessed in the questionnaire completed by the primary caregiver). Child ethnicity was defined by the parents' country of birth, according to standard procedures of Statistics Netherlands[31]. If both parents were born in the Netherlands the child was classified as native Dutch, if at least one parent was born outside the Netherlands but inside Europe, including former Yugoslavia and Soviet Union, North America, Oceania, Indonesia or Japan, the child was classified as a western immigrant, and if at least one parent was born in Turkey, Africa, Latin America or Asia the child was classified as a non-western immigrant. By differentiating between western and non-western immigrants we tried to cover cultural differences that may substantially influence behaviour[32]. Family structure indicated whether the child lived in a family with one parent (primary caregiver only) or with two (primary caregiver plus spouse/partner). The education level of the primary caregiver was defined as low (primary

school and lower vocational/lower general secondary education), medium (intermediate vocational education, higher general secondary education and university prep) or high (higher vocational education and university), according to international classification systems[33].

Parental BMI

The primary caregiver reported his/her own height and weight and that of his/her partner. He/she also reported whether he/she and the partner were the child's biological parents. Maternal and paternal BMI (for biological parents only) were calculated on the basis of their answers ($n_{maternal\ BMI}$ = 1568; $n_{paternal\ BMI}$ = 1380).

Child BMI (z-scores)

The outcome measure child BMI was based on the child's height and weight: i.e. weight (kg)/height $(m)^2$, as measured by the qualified research assistants. Children were measured at school according to standard procedures in light clothing without shoes, to the nearest 0.1 kg and 0.1 cm. BMI z-scores were calculated[26] based on age and gender-specific values from the 1997 National Growth Study in the Netherlands[34]. BMI z-scores were used in all analyses and indicate by how many standard deviations a child's BMI differs from the median BMI of the reference population for his/her age.

Strategy for analyses

To explore the relationship between parenting and child BMI z-scores, Pearson's correlations between the three parenting dimensions, maternal BMI, paternal BMI, the socio-demographic variables (child gender/age/ethnicity, family structure and educational level of primary caregiver) and child BMI z-scores were computed. Variables that were correlated to both parenting dimensions and child BMI z-scores were included in multivariate linear regression analyses as potential confounders (control variables).
For descriptive purposes, for parenting dimensions that were significantly associated with child BMI z-scores, average scores were calculated for each stratum of the socio-demographic variables. Differences between strata were analysed with t-tests (child gender/age and family structure) or a one-way ANOVA (child ethnicity and educational level of primary caregiver).
Finally, multivariate linear regression analyses were performed to establish the relationship between parenting and child BMI z-scores. To determine whether separate parenting dimensions or parenting styles should be used as independent variables, we tested whether the three parenting dimensions interacted in relation to child BMI z-scores. If so, parenting styles would be used as independent variables in further regressions. We then tested a) whether parenting was correlated with child BMI z-scores, unadjusted and adjusted for parental BMI and socio-demographic variables, and b) whether child age/ethnicity and educational level of the primary caregiver moderated the relationship. Moderation was tested by adding interaction terms to the regression analyses (significance level: 0.05). As missing data on socio-demographic variables and parental BMI were not imputed, 1307 parent-child dyads were included in the regression analyses.

2.4 Results

Descriptives

Table 2.1 shows that psychological control is the only parenting dimension that was significantly associated with child BMI z-scores (r=0.088; p<0.01). The parenting dimension 'support' was negatively correlated with psychological control and positively correlated with behavioural control. Maternal and paternal BMI were positively correlated with both psychological control and child BMI, and were thus potential confounders. The socio-demographic variables child ethnicity (non-western immigrants versus native Dutch) and primary caregiver's education level were also related to psychological control and child BMI, and therefore also control variables.
Analyses of average scores on psychological control showed that primary caregivers of children aged 9 and 10 years reported significantly more psychological control (mean=-6.03; SD=4.41; n=340) than those of children aged 7 and 8 years (mean=-6.80; SD=4.01; n=1324) (t=-3.11; df=1662; p=0.002). Primary caregivers of native Dutch children reported significantly less psychological control (mean=-7.16; SD=3.56; n=1390) than those of non-western (mean=-2.48; SD=5.49; n=152) and western (mean=-5.85; SD=4.82; n=123) immigrants (F=102.81; df=2;p<0.001). Similarly, high-educated primary caregivers reported significantly less psychological control (mean=-7.38; SD=3.64; n=520) than those of medium-educated (mean=-6.73; SD=4.09; n=737) and low-educated primary caregivers (mean=-5.67; SD=4.40; n=343) (F=18.89; df=2; p<0.001). There were no significant differences in psychological control between boys and girls, or between one-parent and two-parent families.

Multivariate linear regression analyses

As the interaction term for support, behavioural control and psychological control was significantly correlated with child BMI z-scores (p=0.011), we proceeded with regression models in which the association between parenting styles (instead of separate parenting dimensions) and child BMI z-scores were tested.
In the first set of regression analyses we tested whether parenting styles were correlated with child BMI z-scores, unadjusted and adjusted for potential confounders. Table 2.2 shows that rejecting parenting is the only parenting style that was significantly related to child BMI z-scores (β=0.101; p<0.001, model 1), also when adjusted for parental BMI, child ethnicity and primary caregiver's education level (β=0.074, p<0.01, model 2). In the adjusted model, maternal BMI, paternal BMI and child ethnicity (non-western immigrant versus native Dutch) were statistically significant. Inclusion of the control variables increased the explained variance of the model by about 15%.
In the second set of regression analyses we tested whether socio-demographic variables moderated the relationship between rejecting parenting and child BMI. Separate interaction terms for child ethnicity, child age and primary caregiver's education level were added to the regression equation. None of the interaction terms was significant.

Table 2.1 Correlations between parenting dimensions, parental Body Mass Index (BMI), socio-demographic variables and child BMI (n=1,665)

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Support	10.95	2.45											
2. Behavioural control	9.56	4.23	0.333**										
3. Psychological control	-6.64	4.11	-0.149**	0.010									
4. Maternal BMI	24.17	3.87	-0.017	-0.018	0.068**								
5. Paternal BMI	25.72	3.12	0.047	-0.042	0.067*	0.225**							
6. Child age	8.18	0.46	-0.022	0.016	0.077**	0.016	0.028						
7. Child gender[a]	0.49	0.50	0.024	0.011	-0.023	0.003	0.001	-0.050*					
8. Child ethnicity: western migrant vs Dutch	0.07	0.26	0.008	0.000	0.054*	-0.054*	0.036	0.037	-0.026				
9. Child ethnicity: non-western migrant vs Dutch	0.09	0.29	-0.007	0.020	0.321**	0.045	0.028	0.055*	0.026	-0.090**			
10.Primary caregiver's education level[b]	1.11	0.73	-0.038	0.006	-0.150**	-0.112**	-0.150**	-0.154**	-0.041	0.093**	-0.108**		
11. Family structure[c]	0.91	0.28	-0.011	-0.008	-0.031	0.025	0.029	0.026	-0.015	0.212**	-0.085**	-0.001	
12.Child BMI (z-scores)	0.18	0.88	-0.011	-0.015	0.088**	0.269**	0.254**	0.043	0.037	0.043	0.200**	-0.079**	-0.104**

Note: SD = standard deviation; [a] 0=boy, 1=girl; [b] 0=low-level education, 1=medium-level education, 2=high-level education; [c] 0=one-parent family, 1=two-parent family. * p<0.05, ** p<0.01

Table 2.2 Results of multivariate linear regression analyses of parenting style on child Body Mass Index (BMI), adjusted for parental BMI and socio-demographic variables (n=1,307)

Variable	Child BMI: model 1[1]		Child BMI: model 2[2]	
	β	R^2	β	R^2
Rejecting parenting (n=239) (low support, low behavioural control, high psychological control)	0.101***	0.010	0.074**	0.155
Authoritative parenting (n=252) (high support, high behavioural control, low psychological control)	-0.044	0.002	-0.014	0.149
Permissive parenting (n=230) (high support, low behavioural control, low psychological control)	-0.042	0.002	-0.037	0.151
Authoritarian parenting (n=125) (low support, high behavioural control, low psychological control)	-0.029	0.001	0.000	0.149
Neglecting parenting (n=221) (low support, low behavioural control, low psychological control)	-0.006	0.000	0.017	0.149

Note: β = standardized regression coefficient; R^2 = explained variance of model; * p<0.05, ** p<0.01, *** p<0.001

[2] Association between parenting style, e.g. rejecting vs non-rejecting, and child BMI (Z-scores)

[3] Model 1 + adjusted for maternal BMI, paternal BMI, child ethnicity (western migrant versus Dutch and non-western migrant versus Dutch) and primary caregiver's education level (medium-level versus low level and high-level versus low-level)

2.5 Discussion

This study shows that 'psychological control' explains a part of the association between parenting and child weight. The finding that rejecting parenting - the only parenting style that is characterized by high psychological control - was associated with a higher child BMI underlines the importance of including psychological control in parenting measures in the study of childhood overweight. Including moderating influences in the analyses did not clarify the relationship between parenting and child weight.

As demonstrated in the review by Ventura & Birch, research on parenting and child weight that took into account the parenting dimensions support and behavioural control has produced inconsistent findings[15]. However, these studies used different measures of parenting style, different methods of data collection and were largely cross-sectional in design. The only longitudinal study in their review showed that authoritative parenting had a preventive influence on overweight. A recent longitudinal study of Berge et al.[35] showed a similar result: maternal authoritative parenting predicted lower BMI in sons and daughters. Authoritative parenting is also reported to be a protective factor for other problem behaviours[21]. Although we hypothesized that the parenting dimensions of support and behavioural control, and the authoritative parenting style would negatively correlate with child weight, they were in fact not correlated. The present study indicates that psychological control may be a crucial dimension within parenting research, and that parenting style should be measured three-dimensionally[14,17-20].
Because researchers have tended to neglect the dimension of psychological control in studies on the relationship between parenting and child weight, our results on psychological control could be compared with

only one study. In their cross-sectional study, Zeller et al.[36] found no relationship between psychological control and child BMI. However, they used a different measure of parenting style and conducted their study in a clinical setting compared to our community sample.
Because broader parenting research has shown psychological control to be a risk factor for problem behaviours[21], and an indicator for poor parenting quality[27] we hypothesized that psychological control would be positively associated with child weight. The positive association of rejecting parenting with child BMI may indicate that strong parental psychological control is a potential risk factor for child overweight. Note that psychological control is a distal factor, which is expressed in the small effect size of the association and low variance explained.

The reasons for the potential risk of psychological control on overweight need to be further explored. Adjustment for parental BMI, ethnicity and parent's education level did not alter the relationship substantially, suggesting that the association between rejecting parenting and child BMI is not driven by unmeasured variables that have to do with cultural influences. Psychological control is suppressive and more likely to undermine a child's autonomy and ability to self-regulate matters such as food intake[13]. Emotional eating might be linked to psychological control and overweight. Indeed, Snoek et al.[17] found adolescent's reports of high psychological control to be associated with higher emotional eating. Emotional eating, in turn, is reported to be related to higher BMI z-scores in children[37,38]. It is important to include the potential mediating role of children's eating style and parental feeding style in future studies[15,39].

Barber et al. studied psychological control in adolescent samples and found no empirical evidence indicating at what age psychological control becomes a reliable and stable aspect of parental control[40]. We tested the moderating effect of child age, which was non-significant. However, in our sample the age range was 8 to 10 years; the age effect on psychological control might have become apparent had our sample covered a broader age range, or if the relationship had been studied longitudinally (which is suggested for future studies).
Recently, Topham et al.[41] tested the moderating influence of SES on the association between parenting style and child BMI, and concluded that SES interacts with permissive parenting to predict child obesity. This finding underlines that socio-economic subcultures should not be ignored in the study of childhood obesity[42]. Although we did not find moderation effects of child ethnicity and primary caregiver's education level, in the adjusted analyses a non-western ethnicity was significantly and positively associated with child weight, stressing that more insight is also needed into ethnic subcultures to improve the focus of programs aimed at reducing overweight.

Strengths & limitations

Our study emphasizes the need for studies on parenting to include the impact of psychological control on child weight. To our knowledge, our study is only the second one to have taken psychological control into account when examining the association between parenting and child weight[36], and the first that makes use of the rejecting parenting style. In addition, rather than using self-administered data, we measured the children's height and weight to calculate their BMI. Finally, we could overcome the shortcoming of previous studies that did not adjust for maternal/paternal BMI[15]. The importance of including these potential confounders is illustrated by the fact that, in this study, maternal/paternal BMI were most strongly correlated with child BMI.
A limitation of our study is the cross-sectional design. Child weight might influence the parent's way of parenting, or the relationship between parenting and child weight might be bi-directional. To further elucidate cause and effect, a longitudinal study design is needed. Recent longitudinal studies on the relationship between parenting and child weight have shown that parenting influences child weight[35,43]. As parenting is defined as a general constellation of attitudes, rather than attitudes specifically related to diet and physical activity, we assume bi-directionality will more likely be found in the relationship between more specific parental feeding practices and child weight.
Another limitation of the present study is that we measured parenting style using the Dutch translation[27] of an instrument based on earlier work by Steinberg et al.[7,28], which has not been validated in a Dutch sample. However, the instrument is frequently used in many studies worldwide[27,44-46] and shows good internal consistency (α>0.7). In addition, we measured parenting style in one parent, and not in both[47,48]. However, we asked the primary caregiver to report on parenting, assuming that the primary caregiver is the most committed to child rearing.
Finally, one third of the invited schools and 62% of the invited parent-child dyads participated in our study. As mentioned before, the school response rate was equal among rural and urban schools. Moreover, the prevalence of overweight and obesity in our sample was comparable to Dutch prevalence rates among children. Therefore, we believe that our sample was a good representation of parents and their children, and that the results are not biased through selective participation.

Conclusion

By adding the dimension of psychological control to the concept of parenting, this study has elucidated the mechanisms whereby parenting may affect child weight. By showing that 'rejecting parenting' is associated with a higher child weight, we stress the need for longitudinal research in which parenting style is measured three-dimensionally. Potential mediating effects of parental feeding style and children's eating style, as well as age moderation, should be included in these studies.

2.6 References

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chapter 3

association

Associations of parental feeding styles with child snacking behaviour and weight in the context of general parenting

Associations of parental feeding styles with child snacking behaviour and weight in the context of general parenting

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3.1 Abstract

Objective
To examine cross-sectional and longitudinal (one-year follow-up) associations of parental feeding styles with child snacking behaviour and weight in the context of general parenting, taking into account the multi-dimensionality of the controlling feeding style.

Design
Linear regression analyses were performed. Parents completed a questionnaire to measure five feeding style dimensions (Instrumental Feeding, Emotional Feeding, Encouragement, Overt Control and Covert Control), and children's fruit, energy-dense snack and sugar-sweetened beverage (SSB) intake. Children's height and weight were measured to calculate their BMI z-scores. Moderation by parenting style was tested by adding interaction terms to the regression analyses.

Setting
Observational study in the Netherlands.

Subjects
Parent-child dyads (n=1,275) participating in the INPACT study; children were (on average) 9 years of age.

Results
Instrumental and Emotional Feeding were negatively related to child fruit intake one year later and positively to (changes in) child energy-dense snack intake. Encouragement was negatively related to child energy-dense snacking and SSB intake one year later. Overt Control was cross-sectionally and prospectively related to (changes in) child energy-dense snacking and SSB intake in a negative direction. Covert Control showed similar associations with child energy-dense snacking and SSB intake as Overt Control. Although Covert Control was also positively related to child fruit intake and (changes in) child BMI z-scores, bootstrapping analyses revealed only a differential effect of Overt Control and Covert Control on child BMI z-scores one year later, with Covert Control displaying a stronger, positive association. Moderation analyses showed that some significant associations between parental feeding styles and outcome measures were dependent on the degree of psychological control and behavioural control.

Conclusions
Instrumental and Emotional Feeding may have a detrimental impact on children's snacking behaviour, while Encouragement, Overt and Covert Control may lead to less energy-dense snacking and less SSB intake. Overt and Covert Control have differential effects on child BMI z-scores one year later, which supports the idea that they should be treated as separate constructs. Prospective studies with a longer follow-up may elucidate the causal pathways between the various feeding styles and children's snacking behaviour and weight, as well as the moderating influences of psychological and behavioural control.

3.2 Introduction

The prevalence of childhood overweight and obesity is increasing rapidly[1,2]. Consumption of energy-dense (snack) food and sugar-sweetened beverages (SSBs) contributes to childhood overweight and obesity[3]. In children, energy-dense snacking and SSB intake have shown large increases over time[4]. In contrast, it is widely acknowledged that children consume less fruit than is recommended[5–9], whereas fruit consumption is associated with a healthy body weight[10–12]. Because snacking habits established in childhood often track through to adulthood[13,14], unhealthy snacking (energy-dense snacks and SSB intake) should be discouraged and fruit snacking promoted at an early age. However, effective promotion of healthy eating requires understanding of the factors determining these behaviours.

The home environment is a critical context for the development of children's snacking behaviour[15–17]. Parents play a key role in shaping the home environment, e.g. by using specific feeding styles. Parental feeding styles can be measured in various ways (e.g. [18,19]). Four commonly used aspects of parental feeding are Instrumental Feeding (i.e. using food to regulate a child's behaviour), Emotional Feeding (i.e. using food to temper a child's emotions), Encouragement to eat, and Control over eating[18]. Insight into such parental influences on children's snacking behaviour and weight may help the development of interventions targeted at parents[20–22]. However, data on parental feeding styles in relation to child snacking behaviour and BMI are inconsistent (see [23]), e.g. there is evidence for positive associations, no associations and inverse associations of controlling feeding styles with child energy-dense snacking and weight.

Explanations for such conflicting results include study design (e.g. experimental vs. observational studies and the cross-sectional nature of most studies) and the variety of parental feeding style measures used. The present study examines two ways to elucidate the relationship between parental feeding styles and child snack intake/weight, i.e. multi-dimensionality of parental feeding style constructs and higher-order moderation of general parenting.

The four feeding styles commonly distinguished are complex and multi-dimensional constructs (e.g.[23,24]). For example, Ogden et al. [24] found evidence for expanding the existing conceptualisation of parental control into Overt and Covert Control. So far, parental control has mainly been operationalized in Overt Control, which is parental control over child food intake such that it can be detected by the child, e.g. by being firm about how much the child should eat. On the other hand, Covert Control is a way of parental control which is undetectable for the child, e.g. avoiding buying/having sweets/crisps in the home. In the study by Ogden et al., Overt Control was found to be unrelated to energy-dense snacking in children, while Covert Control was negatively associated with child snack intake. This implies that adding the construct of Covert Control may elucidate the relationship between a controlling feeding style and child energy-dense snacking. However, studies are needed to replicate such findings, and to examine whether Overt and Covert Control also have differential effects on other snacking behaviours and weight.

The relationship between parental feeding styles and child snacking/weight has mainly been studied in an isolated perspective by not incorporating a broader parenting context. However, based on research and ecological systems theory[25], there is a trend to integrate general parenting as a potential higher-order moderator in studies on parenting practices, e.g. to clarify mechanisms related to the impact of specific parenting on child consumption and weight (e.g.,[21,26-30]). This implies that the impact of parental feeding styles on child snacking and weight may differ depending on the parents' general parenting style. A parenting style generates the environmental/emotional context for child rearing, and can be operationalized into three dimensions: involvement, behavioural control and psychological control[31]. Behavioural control was found to have a positive impact on the relationship between parental modelling of fruit intake and child fruit intake (i.e. a more pronounced positive association between parental and child fruit intake among children of parents who consumed relatively large amounts of fruit) and psychological control a negative (i.e. a more pronounced positive association between parental and child fruit intake among children of parents who consumed relatively little fruit)[9]. This raises the question whether psychological control, seen as a risk factor for problem behaviour in general[32,33], also moderates the associations between parental feeding styles and child snacking/weight in an unfavourable way, and whether behavioural control moderates the associations in a favourable way.

Associations between parental feeding styles and child snacking/weight are generally examined in cross-sectional studies, whereas longitudinal studies are sparse[21,34-36]. Therefore, in the present study we examined cross-sectional and longitudinal (one-year follow up) associations of parental feeding styles with child snacking (fruit intake, energy-dense snacking and SSB intake) and child weight in a community-based sample of (on average) 9-year-old children. We also examined whether adding Covert Control to the generally accepted concept of Overt Control may elucidate the relationship between a controlling feeding style and child snacking/weight. Finally, we examined whether the potential associations between parental feeding styles and child snacking/weight would be moderated by general parenting.

3.3 Methods

Study design and procedure

Data for the current study were retrieved from the longitudinal IVO Nutrition and Physical Activity Child cohorT (INPACT). INPACT was conducted according to the Declaration of Helsinki and all procedures were approved by the [name of the ethics committee removed for blinding]. Written informed consent was obtained from all participants.

INPACT is an observational study focusing on modifiable determinants of overweight in the home environment of primary school children in the Netherlands, with emphasis on parental influences. The study included four assessments, in which qualified research assistants measured the children's height/weight at school, and primary caregivers completed a questionnaire at home. Questionnaires recorded data on dietary intake of the child, and potentially relevant home environmental factors, including parenting style dimensions, parental feeding style dimensions and socio-demographic variables. Assessments took place with a one-year time interval, and started in the autumn of 2008 (baseline).

INPACT was conducted among primary school children in southern Netherlands (Eindhoven area).

All general primary schools in the area were invited to participate in the INPACT study. Of the 265 schools invited, 91 took part. The response rate from rural and urban schools was equal. The primary caregivers of third-grade students (aged ✣ 8 years) were invited to participate in the cohort study, together with their child. Of the 2,948 parent-child dyads invited, 1,839 (62.4%) gave informed consent to participate in the INPACT study for four years.

The present study was based on data from 2008 (baseline), 2009 and 2010. Socio-demographic variables and parenting style dimensions were measured at baseline, parental feeding style dimensions were measured in 2009 when the children were (on average) 9 years of age, while child fruit intake, snack intake, SSB intake and weight were measured in 2008, 2009 and 2010. Parent-child dyads who completed the parent questionnaires from baseline to 2010, and had valid child height/weight data in 2009 and 2010 were included in the present study, resulting in 1275 parent-child dyads (69% of the original cohort). Logistic regression analyses on selective dropout from baseline to 2010 showed that non-western and western immigrant parent-child dyads dropped out more often. There was no selective dropout regarding child age/gender and parental education level.

Measures

Parental feeding styles

Parental feeding styles were parent-reported and measured using a validated Dutch translation[1](23) of the Parental Feeding Style Questionnaire (PFSQ), designed and validated by Wardle and colleagues[18]. This 27-item measure assessed four feedings style dimensions: Instrumental Feeding, Emotional Feeding, Encouragement to eat, and Control over eating. The original measure, as well as the Dutch translation, have adequate to good internal consistency[18,23]. The control dimension of the PFSQ assessed Overt Control. Covert Control over eating was measured with three items, based on a five-item measure of Covert Control designed by Ogden et al.[24]; this measure of Covert Control has adequate internal consistency (Cronbach's alpha of the original five-item measure = 0.79). Missing data on the parental feeding style items (1.4% at the highest for an Encouragement item) were imputed using the mean value of respondents without a missing value. Table 3.1 presents additional information on the five parental feeding style dimensions in our sample.

Children's snacking behaviour

Child fruit, energy-dense snack and SSB intake were measured with a questionnaire based on validated Food Frequency Questionnaires[37,38]. The primary caregivers reported how many days in a normal week their children consumed *in between* meals: 1) fruit (fresh, bottled and/or canned; no juice), 2) savoury snacks (e.g. potato crisps, peanuts and sausage rolls), 3) sweet snacks (e.g. candies, chocolates and candy bars), 4) cake or large biscuits, and 5) SSBs. Answering categories ranged from 'none or less than 1 day a week' to '7 days a week'. They also reported the number of servings consumed by their children on such a day. For fruit, answering categories ranged from '0 pieces per day' to 'more than 3 pieces per day', by increments of half a piece of fruit. Reported consumption of more than 3 pieces per day (n=12) was recoded as 4 pieces. For savoury snacks, sweet snacks and cake or large biscuits, answering categories ranged from 0 to 10 servings a day. For SSBs, answering categories ranged from '0 glasses per day' to 'more than 5 glasses per day', by increments of half a glass. It was specified that one glass equals 200 ml; one can equals 330 ml or 1.5 glasses; one bottle equals 500 ml or 2.5 glasses. Reported consumption of more than 5 glasses per week (n=7) was recoded as 6 glasses. Total child fruit and SSB intake were

Table 3.1 Descriptives and scale information of parental feeding styles and parenting style dimensions

Category	Concept	Measurement year (n)	# items	Example item	Answering scale[4]	Cronbach's α[5]	Mean score (SD)	Range of scores
Parental feeding style	Instrumental Feeding	2009 (1547)	4	'I reward my child with something to eat when s/he is well behaved.'	A	0.71	1.6 (0.6)	1.0-4.3
	Emotional Feeding	2009 (1547)	5	'I give my child something to eat to make him/her feel better when s/he has been hurt'	A	0.85	1.4 (0.5)	1.0-3.8
	Encouragement	2009 (1547)	8	'I encourage my child to try foods that s/he has not tasted before.'	A	0.79	3.7 (0.6)	1.3-5.0
	Overt Control	2009 (1547)	10	'I decide how many snacks my child should have.'	A	0.75	4.4 (0.4)	2.2-5.0
	Covert Control	2009 (1547)	3	'I avoid buying unhealthy food in the supermarket.'	A	0.67	3.0 (0.7)	1.0-5.0
							Sum score (SD)	
Parenting style dimensions	Support	2008 (1839)	7	'When my child gets a low grade in school, I offer to help him/her'	B	0.71	11.0 (2.4)	1.7-14.0
	Behavioural control	2008 (1839)	7	'I try to know where my child goes after school'	B	0.72	9.5 (4.2)	-5.0-14.0
	Psychological control	2008 (1839)	8	'I make my child feel guilty when he/she gets a low grade in school'	B	0.72	-6.7 (4.1)	-16.0-16.0

[4] Answering scale A: never (1) to always (5); answering scale B: completely disagree (-2) to completely agree (+2).

[5] The reliability of the parental feeding style scales was assessed by calculating Cronbach's α values (internal consistency) and (average) corrected item-total correlations, which indicate the degree to which an individual item relates to the total scale score. Corrected item-total correlations ≥ 0.30 are regarded as good and ≤ 0.15 as unreliable[69]. Average corrected item-total correlations were good and ranged from 0.41 to 0.67. One corrected item-total correlation was < 0.3 (0.21 for an Overt Control item).

expressed in servings per week and calculated by multiplying frequency and quantity. Total child energy-dense snack intake was also expressed in servings per week and calculated by multiplying frequencies of savoury snacks, sweet snacks and cakes with their corresponding quantities, and summing these scores. Missing values on these measures were not imputed due to the low number of missing values (1.0% at the highest, for child snacking).

Children's weight

Child BMI was based on the child's weight (kg)/height (m)^2 as measured by the qualified research assistants. Children were measured at school according to standard procedures in light clothing without shoes, to the nearest 0.1 kg and 0.1 cm. BMI z-scores were calculated[39] based on age and gender-specific values from the 1997 National Growth Study in the Netherlands[40].

Parenting style

Parenting style was measured using the Dutch translation[41] of an instrument based on earlier work by Steinberg et al.[42,43], and used in many studies worldwide[26,41,44,45]. With 22 items, the instrument assessed the parenting-style dimensions of support, behavioural control and psychological control (Table 3.1).

Demographics and other potential confounders

Measured potential confounders included child's gender, age and ethnic background, parental education level, parental fruit, energy-dense snack and SSB intake, and parental BMI. To assess the child's ethnic background, the primary caregiver reported the country of origin of both parents. According to standard procedures of Statistics Netherlands[2][46], a child was classified as native Dutch if both parents were born in the Netherlands, as a western immigrant if at least one parent was born outside the Netherlands but inside Europe, North America, Oceania, Indonesia or Japan, and as a non-western immigrant if at least one parent was born in Turkey, Africa, Latin America or Asia.

The primary caregiver also reported on his/her highest level of education. According to international classification systems[47], parental education level was defined as low (primary school and lower vocational/lower general secondary education), medium (intermediate vocational education, higher general secondary education and university preparatory), high (higher vocational education and university) or non-defined.

Parental fruit, energy-dense snack and SSB intake were measured and calculated in the same way as child fruit, energy-dense snack and SSB intake. To assess parental BMI, the primary caregiver reported his/her own height/weight, and that of his/her partner. He/she also reported whether he/she and the partner were the child's biological parents. Maternal and paternal BMI (for biological parents only) were calculated on the basis of their answers ($n_{\text{maternal BMI}}$ = 1204, 5.6% missing; $n_{\text{paternal BMI}}$ = 1058, 17.0% missing).

To maintain statistical power, missing values on maternal and paternal BMI were imputed using the group mean.

Strategy for analyses

To describe the study population, we computed means, standard deviations (SDs) and/or proportions for the socio-demographic variables, parental feeding style dimensions, parenting style dimensions, child snacking behaviour and child BMI z-scores.

To explore associations between the key study variables, Pearson's correlations between parental feeding style dimensions (assessed in 2009), parenting style dimensions (assessed in 2008), child fruit intake in 2010, energy-dense snacking in 2010, SSB intake in 2010 and BMI z-scores in 2010 were computed. Next, separate linear regression analyses were performed to establish the longitudinal relationship between parental feeding style dimensions and child snacking/child BMI z-scores in 2010, adjusted for child age, gender, ethnic background and parental education level. In models with child snacking as dependent variable (e.g. child fruit consumption), we also controlled for child BMI in 2009 and parental snacking in 2010 (i.e. parental fruit consumption). In models with child BMI z-scores as dependent variable, we controlled for the socio-demographic variables and parental BMI in 2010. In these models, underweight children in 2009 (91 of 1275 children) were excluded to prevent distortion of the results (for underweight children, an increase in BMI would be favourable whereas it would be unfavourable for normal, overweight and obese children). International cut-off scores were used to determine whether a child was underweight[39].

To determine whether parental feeding style dimensions predicted changes in child snacking and BMI z-scores between 2009 and 2010, we repeated the linear regression analyses, additionally adjusted for child snacking in 2009 and child BMI z-scores in 2009, respectively. Finally, to explore whether longitudinal associations between parental feeding style dimensions in 2009 and child snacking/weight in 2010 were similar to cross-sectional associations, we performed cross-sectional linear regression analyses (parental feeding style dimensions and child snacking/weight in 2009), applying the same adjustment procedure as in the longitudinal analyses.

In the final set of regression analyses we examined whether parenting-style dimensions moderated significant longitudinal associations between parental feeding styles and (changes in) child snacking/child weight. Moderation was tested by adding interaction terms to the regression analyses. If interaction terms were significant (significance level of 0.1)[48], stratified analyses were conducted by dichotomizing the sample on the relevant parenting dimension (median-split).

All analyses were conducted using IBM SPSS Statistics version 19.0.

3.4 Results

In 2008, at baseline (n=1,839), 7% of the children were underweight, 79% had normal weight and 14% were overweight (of which 3% obese). The age of the children was 8 (77%) or 9 (20%) years (range 7-10, mean=8.2, SD=0.5 years). Boys (50.5%) and girls (49.5%) were represented in almost equal numbers. Of all children, 17% were from a non-Dutch ethnic background (with one or both parents born abroad), of which 9% from non-western countries and 8% from western countries. Of all primary caregivers, 21% had finished education at a low level, 45% at a medium level, 32% at a high level, and 2% at a non-specified level (see Measures section for classification system used). Of the primary caregivers 1% was underweight, 66% had a normal weight and 33% were overweight (of which 9% obese). Parental feeding style and parenting style dimensions are described in Table 3.1. Parental feeding styles were measured in 2009, when the children were (on average) 9 years of age. Children had an average weekly fruit consumption of 7.3 (SD=4.2) pieces in 2009 and 6.9 pieces in 2010 (SD=4.3), an average weekly energy-dense snack intake of 9.8 pieces in 2009 (SD=5.8) and 9.9 pieces in 2010 (SD=6.1), an average weekly SSB intake of 9.2 glasses in 2009 (SD=8.2) and 8.9 glasses in 2010 (SD=8.2), and an average BMI z-score of 0.2 (SD=0.9) in both 2009 and 2010 when underweight children were excluded.

Table 3.2 Pearson's correlations of key study variables (n=1275)

	n	1	2	3	4	5	6	7	8	9	10	11
PFSQ constructs (assessed in 2009)												
1. Instrumental Feeding	1275											
2. Emotional Feeding	1275	0.64***										
3. Encouragement	1275	0.04	-0.03									
4. Overt Control	1275	-0.26***	-0.39***	0.28***								
5. Covert Control	1275	0.11***	0.01	0.24***	0.09**							
Parenting style dimensions (assessed in 2008)												
6. support	1274	-0.11***	-0.10***	0.17***	0.14***	-0.01						
7. behavioural control	1274	-0.04	-0.03	0.05	0.05	0.02	0.33***					
8. psychological control	1274	0.28***	0.25***	-0.16***	-0.17***	0.00	-0.14***	0.01				
Dependent variables in 2010												
9. child fruit intake	1272	-0.06*	-0.03	0.07*	-0.02	0.15***	0.04	0.08**	-0.03			
10. child snacking	1265	0.11***	0.14***	-0.11***	-0.16***	-0.17***	-0.02	0.02	0.02	0.01		
11. child SSB intake	1267	-0.01	-0.01	-0.06*	-0.07*	-0.14***	-0.03	-0.06*	-0.02	-0.05	0.21***	
12. child BMI z-scores[6]	1184	0.06	0.03	-0.04	-0.02	0.13***	-0.02	-0.04	0.10***	0.01	-0.10***	-0.06*

Note: PFSQ, Parental Feeding Style Questionnaire; SSB, sugar-sweetened beverage.
Correlation is significant at the: *0.05 level (2-tailed), ** 0.01 level (2-tailed), *** 0.001 level (2-tailed).

Pearson's correlations between the key study variables are reported in Table 3.2. It showed, amongst others, a positive correlation between Overt and Covert Control ($r=0.09$, $p<0.01$), a negative association between child energy-dense snacking and child BMI z-scores in 2010 ($r=-0.10$, $p<0.001$) and a negative association between child SSB intake and child BMI z-scores in 2010 ($r=-0.06$, $p<0.05$). Results of the regression analyses with child snacking/child BMI z-scores in 2010 as dependent variable (Table 3.3, column 'β_{2010}') showed negative associations of Instrumental and Emotional Feeding with child fruit intake, and positive associations with child energy-dense snack intake. Encouragement was negatively associated with child energy-dense snack and SSB intake, Overt Control was also negatively associated with child energy-dense snack and SSB intake, while Covert Control was positively associated with child fruit intake, negatively with child energy-dense snack and SSB intake, and positively with child BMI z-scores. Effect sizes of the cross-sectional associations between parental feeding styles with child snacking/child BMI z-scores (Table 3.3, column 'β_{2009}') were generally similar to those for 2010, but fewer of the cross-sectional associations reached statistical significance.

[6] underweight children excluded

Results of regression analyses with child snacking/child BMI z-scores in 2010 as dependent variable in which we additionally adjusted for child snacking/child BMI z-scores in 2009 (Table 3.3, column '$\beta_{2010\text{-}2009}$'), showed that Instrumental Feeding predicted a small decrease in child fruit consumption between 2009 and 2010 ($\beta=-0.05$, $p<0.05$), a small increase in energy-dense snacking ($\beta=0.08$, $p<0.01$) and a minimal increase in child BMI z-scores ($\beta=0.02$, $p<0.05$). Emotional Feeding predicted a small increase in child energy-dense snacking ($\beta=0.07$, $p<0.01$), while Encouragement predicted a small decrease in child energy-dense snacking between 2009 and 2010 ($\beta=-0.07$, $p<0.01$). Both Overt Control and Covert Control predicted small decreases in child energy-dense snack and SSB intake (Overt Control: $\beta_{snacking}=-0.07$, $p<0.01$ and $\beta_{SSB\ intake}=-0.07$, $p<0.05$; Covert Control: $\beta_{snacking}=-0.06$, $p<0.01$ and $\beta_{SSB\ intake}=-0.08$, $p<0.01$), while Covert Control also predicted a minimal increase in child BMI z-scores between 2009 and 2010 ($\beta=0.02$, $p<0.05$).

Table 3.3 Associations of parental feeding styles (2009) with child fruit intake, snack intake, SSB intake and BMI z-scores in 2009, in 2010 and in 2010, controlled for 2009 values

	Child fruit intake[7]			Child snacking[8]			Child SSB intake[9]			Child BMI z-scores[10]		
	β_{2009}[11]	β_{2010}[12]	$\beta_{2010\text{-}2009}$[13]	β_{2009}[11]	β_{2010}[12]	$\beta_{2010\text{-}2009}$[13]	β_{2009}[11]	β_{2010}[12]	$\beta_{2010\text{-}2009}$[13]	β_{2009}[14]	β_{2010}[15]	$\beta_{2010\text{-}2009}$[16]
Instrumental Feeding	-0.04	-0.09**	-0.05*	0.05	0.08**	0.08**	-0.03	-0.01	0.01	-0.01	0.01	0.02*
Emotional Feeding	-0.03	-0.05*	-0.03	0.10***	0.11***	0.07**	-0.03	0.00	-0.01	-0.04	-0.03	0.01
Encouragement	0.01	0.03	0.02	-0.03	-0.08**	-0.07**	-0.02	-0.05*	-0.05	-0.04	-0.04	0.01
Overt Control	0.01	0.00	-0.02	-0.13***	-0.13***	-0.07**	-0.07*	-0.09**	-0.07*	0.03	0.03	0.00
Covert Control	0.06*	0.06*	0.03	-0.11***	-0.11***	-0.06**	-0.05	-0.08***	-0.08**	0.10***	0.12***	0.02*
p-value (two-sided) of bootstraps	>0.1	>0.1	0.07	>0.1	>0.1	>0.1	>0.1	>0.1	>0.1	0.07	0.02	>0.1

Note: SSB, sugar-sweetened beverage; β, standardized regression coefficient; SES, socio-economic status.
In secondary analyses, bootstraps were performed, testing H_0: $\beta_{Overt\ control} = \beta_{Covert\ control.}$ If p>0.1, Overt Control and Covert Control have no differential effect; if p<0.05, Overt Control and Covert Control have a differential effect; 0.05<p<0.1 signals a trend towards a differential effect.
Correlation is significant at the: *0.05 level (two-sided), **0.01 level (two-sided), *** 0.001 level (two-sided).

Based on the results of the regression analyses, secondary analyses were performed to test the potential differential effect of Overt Control and Covert Control on child snacking behaviour and weight. In bootstrapping analyses, by constructing 1000 replicas of the observed dataset, it was tested whether $\beta_{covert\ control}$ was significantly different from $\beta_{overt\ control}$ (p<0.05). Bootstrapping analyses revealed that Overt Control and Covert Control had differential effects on child BMI z-scores in 2010, with Covert Control displaying a stronger, positive association. In addition, a trend (0.05<p<0.1) was found for child BMI z-scores in 2009 and for changes in fruit intake between 2009 and 2010, with Covert Control displaying a positive change in fruit intake (Table 3.3).

[7] n=1248 for 2009, n=1245 for 2010 and n=1244 for 2010-2009; n deviates from sample size in Table 2 because of missing values on control variables
[8] n=1230 for 2009, n=1233 for 2010 and n=1217 for 2010-2009; n deviates from sample size in Table 2 because of missing values on control variables
[9] n=1248 for 2009, n=1239 for 2010 and n=1238 for 2010-2009; n deviates from sample size in Table 2 because of missing values on control variables
[10] n=1163 for 2009, 2010 and 2010-2009; n deviates from sample size in Table 2 because of missing values on control variables; underweight children in 2009 were excluded from analyses with child BMI z-scores as dependent variable. Repeated analyses including underweight children resulted in similar findings.
[11] models adjusted for age, gender, SES, ethnicity, child BMI and parental fruit/snack/SSB intake in 2009; β = standardized regression coefficient
[12] models adjusted for age, gender, SES, ethnicity, child BMI in 2009 and parental fruit/snack/SSB intake in 2010
[13] models adjusted for age, gender, SES, ethnicity, child BMI in 2009, parental fruit/snack/SSB intake in 2009 and 2010, and additionally child fruit/snack/SSB intake in 2009
[14] models adjusted for age, gender, SES, ethnicity, and parental BMI in 2009
[15] models adjusted for age, gender, SES, ethnicity and parental BMI in 2010
[16] models adjusted for age, gender, SES, ethnicity, parental BMI in 2009 and 2010, and additionally child BMI z-scores in 2009

Table 3.4 Associations of parental feeding styles with child dietary intake, stratified by psychological control and behavioural control

Child fruit intake (n=1246)[17]	Behavioural control	β	$p_{interaction\ term}$
Instrumental Feeding	Low	-0.05	0.063
	High	-0.11**	
Child snacking (n=1232)[17]	Psychological control	β	
Emotional Feeding	Low	0.06	0.077
	High	0.15**	
Covert Control	Low	-0.14***	<0.001
	High	-0.01	
Child SSB intake (n=1241)[17]	Behavioural control	β	
Overt Control	Low	-0.11**	0.074
	High	-0.05	

Note: SSB, sugar-sweetened beverage; β, standardized regression coefficient
Moderation was tested on significant longitudinal associations between parental feeding style subscales and (changes in) child intake/child BMI z-scores in 2010 (Table 3, column 'β_{2010}' and column '$\beta_{2010\text{-}2009}$'). Stratified analyses were only conducted for significant interaction terms. Stratified analyses were conducted by dividing the sample on the relevant parenting dimension in two (median-split) and three groups, but stratification into two groups proved to be sufficient.
Correlation is significant at the: **0.01 level (two-sided), ***0.001 level (two-sided).

[17] n deviates from sample sizes in Table 2 because of missing values on control variables.

Moderation analyses on significant longitudinal associations between parental feeding styles and (changes in) child snacking/child weight, and subsequent stratified analyses revealed that the negative association between Instrumental Feeding and child fruit consumption was present only if primary caregivers scored relatively high on behavioural control, while the negative association between Overt Control and child SSB intake was present only when primary caregivers scored relatively low on behavioural control (Table 3.4). In addition, the positive association between Emotional Feeding and child energy-dense snack intake was present only in children of parents who conducted high levels of psychological control, while the negative association between Covert Control and child energy-dense snacking was present only in children of parents who conducted low levels of psychological control (Table 3.4). The parenting style dimension of support did not moderate any of the significant longitudinal associations between parental feedings styles and child snacking/weight.

3.5 Discussion

Our study is one of the few to take into account the multidimensionality of parental feeding constructs, i.e. parental control over eating. Unlike previous findings[24], in the present study Overt Control and Covert Control had no differential effect on (changes in) child energy-dense snack intake, as both were negatively related to child snack intake. However, they were differentially related to child BMI z-scores, while a trend was observed for changes in child fruit intake between 2009 and 2010. These new findings support the conclusion of Ogden et al.[24] that Overt Control and Covert Control are separate constructs. In our study, Covert Control was positively related to child BMI z-scores, both cross-sectionally and prospectively, but the effect size of the predicted *change* in BMI z-scores during one year was almost zero. This suggests that Covert Control might be an effective parental strategy in response to child weight problems. This latter idea is not new[24] and is in line with data showing that parents modify their feeding practices (i.e. pressure to eat, restriction and monitoring) in response to the child's (perceived) weight, dietary behaviours and/or eating style[36,49–51]. In addition to the supportive effect of Overt Control and Covert Control on decreasing snack (and SSB) intake, Covert Control was also supportive in increasing child fruit intake. This suggests that parents who exert higher levels of Covert Control might replace the home availability of unhealthy snacks by home availability of fruit, which is positively related to fruit intake[15,20,22,52].
Consistent with previous findings[23], Encouragement was negatively related to child energy-dense snack intake, indicating that parental encouragement might be influenced by health beliefs: parents encourage their children's interest in and curiosity for a variety of healthy foods, resulting in the consumption of less unhealthy foods[23,49].
Although Covert Control may be responsive to child weight, Instrumental Feeding and Emotional Feeding are less likely to be so because these styles are used for non-nutritive purposes. In previous studies, a positive association was found between Instrumental/Emotional Feeding and child energy-dense snack intake, indicating that parental use of energy-dense snacks as rewards may increase a child's preference for the 'rewarding' food[53,54], which is expected to promote overeating of these products in children[23]. Our longitudinal findings on Instrumental Feeding (and to a lesser extent on Emotional Feeding) support this by assuming that these feeding styles might have a detrimental effect on child fruit intake, energy-dense snack intake and weight in the long run.

Prospective studies with a longer follow-up, in which all measures are assessed at baseline and follow-up, are needed to elucidate the causal pathways between various parental feeding styles and children's snacking behaviour and weight. To our knowledge, Webber et al.[36] were the first to study bidirectional longitudinal associations between a range of parental feeding styles and child adiposity, and concluded that monitoring and pressure to eat were responsive to the child's weight status. A next step is to test whether these responsive feeding styles lead to desired changes in child weight.

An increasing number of studies on parenting practices and child weight/intake include general parenting as a potential higher-order moderator [9,30,55,56], thus incorporating a broader, non-food specific parenting context. To our knowledge, ours is the first study to relate parental feeding styles to child snacking and weight and include general parenting as higher-order moderator, implying that the impact of parental feeding styles on child snacking and weight may differ depending on the parent's general parenting style. It is shown that some significant associations between parental feeding styles and outcome measures depend on the degree of psychological control and behavioural control. As hypothesized, a high level of psychological control was unfavourable for child snacking; this voided the negative association between Covert Control and child energy-dense snacking, and presented a positive association between Emotional Feeding and child energy-dense snacking. These findings demonstrate that it is not advisable for parents to use this method of control[9,32,33]. Unexpectedly, our results indicate that low (instead of high) levels of behavioural control void the unfavourable negative association between Instrumental Feeding and child fruit intake, and increase the favourable negative association between Overt Control and child SSB intake. However, because of the large number of interaction terms tested, our moderation results should be interpreted with caution and more studies are needed before firm conclusions can be drawn.

Although our study has the strength of combining parental feeding styles, snack intake, weight and parenting style in one study, which is exceptional in this field of research[21], some limitations should be mentioned. First, we measured snack intake based on FFQ which may evoke social desirability bias and lead to overestimation of fruit consumption and underestimation of energy-dense snack and SSB intake in parents and children[57,58], especially in overweight subjects (e.g. [59,60]). Selective misreporting may explain the unexpected, negative correlations between energy-dense snacking and SSB intake on the one hand and child BMI z-scores on the other. However, there is evidence that selective misreporting in overweight children does not occur when *parents* report their child's food intake[61], which is the case in our study. Reversed causality might be an alternative explanation for the negative correlations, implying that parents of children with a normal weight do not react on their child's energy-dense snacking and SSB intake (i.e. they do not get a signal that the amounts of energy-dense snacking are unhealthy), while parents of overweight children do. Second, although parent-reported child snack intake may not lead to *selective* misreporting, parents might under-estimate actual snacking intake of their children, as they are exposed to school food environments that parents may not be fully aware of. Because Dutch primary school children bring their own snacks and food to school, underestimating of snacking intake had probably no (large) effect on our results. A third limitation is that our prospective study had a short follow-up of one year and did not measure parental feedings styles at both time points. Because of that, the benefits of a longitudinal approach could not be fully exploited. Fourth, we used an adapted version of Ogden's Covert

Control scale. We combined two original items ('avoiding buying biscuits and cakes' and 'avoiding buying sweets and crisps') into one item on avoiding buying unhealthy foods. Moreover, we skipped one item on 'avoiding going to cafes or restaurants with your children which sell unhealthy food'. A reduction in scale items from five to three might explain a lower Cronbach's alpha value of the adapted scale (0.67) compared to the original one (0.79)[62]. However, the internal consistency of the adapted scale was still acceptable (0.67)[62,63] and our scale showed similar associations with child energy-dense snack intake as the original Covert Control scale. Fifth, parents reported on their general parenting style and feeding style, while there is evidence that child-reported parenting measures are more strongly related to child weight-related outcomes[56,64,65]. However, child reports demand high literary skills of children, which cannot be expected from (on average) 9-year-old children. Finally, dropout analyses showed selective dropout on ethnicity; however, as this was not a main predictor and was controlled for, this probably had no effect on our results.

Conclusion

The current study indicates that both Instrumental Feeding and Emotional Feeding may have a detrimental impact on children's snacking behaviour by decreasing fruit intake and increasing energy-dense snack intake. In contrast, Encouragement, Overt and Covert Control may lead to less energy-dense snacking and less SSB intake. Overt and Covert Control appeared to have a differential effect on child BMI z-scores, which supports the idea that Overt Control and Covert Control should be treated as separate constructs. Psychological control by parents had a detrimental impact on child energy-dense snack intake, i.e. voiding the protective effect of Covert Control on child snacking, while strengthening the positive association between Emotional Feeding and child snacking. Finally, our results suggested that Covert Control may be responsive to child weight, while Instrumental Feeding may cause an increase in child weight. Prospective studies with a longer follow-up are needed to clarify the causal pathways between the various parental feeding styles and children's snacking behaviour and weight.

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chapter 4

consumption

Parental and child fruit consumption in the context of general parenting, parental education and ethnic background

Parental and child fruit consumption in the context of general parenting, parental education and ethnic background

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4.1 Abstract

This study examines the association between parental and child fruit consumption in the context of general parenting, parental education and ethnic background.
A cross-sectional study was performed among 1,762 parent-child dyads. Mean age of the children was 8 years. One parent completed a questionnaire to measure their own and their child's fruit consumption, parenting style, education level and ethnicity. In mediation and moderation analyses, child fruit consumption was regressed on parental fruit consumption, parenting style, parental education and ethnicity.
Participating children consumed on average 7.5 pieces of fruit per week. Fourteen percent met the recommended Dutch norm of two pieces of fruit per day. Parental and child fruit consumption were positively associated. The association was more pronounced under higher levels of psychological control and behavioural control, and among ethnic groups. Additionally, parental education and child fruit consumption were positively associated. Parental fruit consumption partially mediated this association.
Interventions are needed to increase child fruit consumption. Interventions should focus on increasing parental fruit consumption and positive parental modelling, with particular focus on low-SES families. Additionally, interventions that combine positive modelling with positive general parenting skills (e.g. increasing behavioural control) may be more effective than interventions that focus on parental modelling alone.

4.2 Introduction

Diets rich in fruit are associated with important health protective effects, including a healthy body weight[1–4]. It is widely acknowledged that children consume less fruit than is recommended[5–8], and that dietary habits established in childhood track through to adulthood[9,10]. Because it is important to increase fruit consumption at an early age, detailed understanding of the determinants of children's fruit consumption is needed.

The home environment is a critical context for the development of eating behaviours[11]. Parents are primarily responsible for shaping the home environment, e.g. by creating availability of and accessibility to foods, by expressing norms and values, by setting rules and regulations, and with their own behaviour. Therefore, examining parental factors and their potential relationship with children's fruit intake is important to understand child fruit consumption[12–14]. Review studies on (parental) correlates of child fruit consumption showed a consistent and positive association between parental fruit intake and child fruit intake[12,15,16], which is often interpreted as observational learning or modelling (Social Learning Theory)[17].

The association between parental fruit intake and child fruit intake has generally been studied in an isolated perspective by examining the primary (direct) relation. There is no insight into the potential underlying mechanisms of the association between parental and child fruit intake with higher-level contextual correlates, such as parenting style, parental education and ethnic background. Therefore, this study explores the relationship between parental and child fruit intake in the context of these higher-level parental factors. We constructed a research model in which parental and child fruit intake as well as parenting style, parental education and ethnic background were incorporated (Figure 4.1). According to social-cognitive theories such as the Theory of Triadic Influence[18], parenting style, parental education and ethnic background were conceptualised as distal parental factors. These factors could be mediated by parental fruit consumption in explaining child fruit consumption, assuming that the distal parental factors 'cause' parental fruit consumption, which in turn 'causes' child fruit consumption (path a * path b, Figure 4.1). In addition, in line with the ecological systems theory[19] and suggestions from others (e.g., [13,20-23], we conceptualised parenting style, parental education and ethnic background as potential higher-order moderators, implying that the impact of parental modelling (i.e. parental fruit intake) on child fruit intake can vary depending on these higher-level conditions (path d, Figure 4.1).

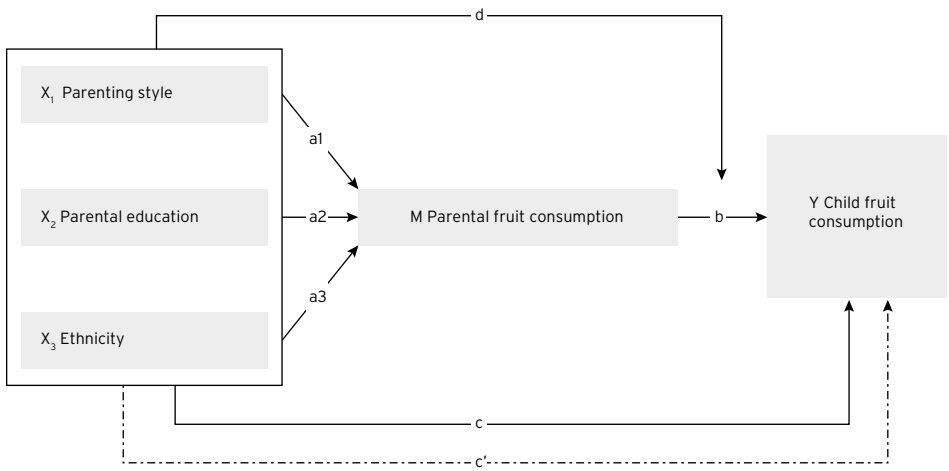

Figure 4.1: conceptual research model for mediation (path a * b) and moderation (path d)
X1 t/m X3: contextual factors (or predictor variables); Y: outcome variable; M: mediator variable; a1 t/m a3: association between contextual factors (X1 t/m X3) and potential mediator (M); b: association between potential mediator (M) and outcome variable (Y); c: overall association (total effect) between contextual factors (X1 t/m X3) and outcome variable (Y); c': direct effect (controlled for M) of contextual factors (X1 t/m X3) on outcome variable (Y); d: interaction between contextual factors (X1 t/m X3) and potential mediator (M) in predicting outcome variable (Y)

Parenting style or general parenting can be defined as '*a constellation of attitudes toward the child that are communicated to the child and that, taken together, create an emotional climate in which the parent's behaviours are expressed*'[24]. In research it is usually operationalized in two dimensions (support and behavioural control)[24,25], but the concept originally consists of three underlying dimensions: support, behavioural control and psychological control. Support (or involvement) refers to parental responsiveness and connectedness to the child. Behavioural (or strict) control refers to the regulation of the child's behaviour through firm and consistent discipline. Psychological control refers to the regulation of the child's behaviour through psychological means such as love withdrawal and guilt induction, e.g. behaving in a cool and unfriendly way when a child misbehaves or making a child feel guilty when it gets low grades in school. Psychological control is a more manipulative, suppressive form of control[25-30] and is seen as a risk factor for problem behaviour[31-33]. Researchers have increasingly called for the dimension of psychological control to be included in parenting research[31,33-37], e.g. to clarify inconsistent findings relating parenting to dietary behaviours[36]. Therefore, we included psychological control and operationalized parenting style in three dimensions: support, behavioural control and psychological control.

The main aim of this study was to explore whether contextual factors influence the relationship between parental and child fruit consumption, to ultimately make recommendations for better-targeted prevention interventions. We examined two potential pathways through which contextual factors could influence this relationship, by examining contextual factors as distal parental factors and as potential moderators of the relationship between parental and child fruit consumption. Based on our research model, we formulated the following research questions: 1) are parental and child fruit consumption correlated?; 2) are parenting style, parental education and ethnic background mediated determinants for parental fruit consumption in relation to child fruit consumption? and 3) are parenting style, parental education and ethnic background moderators of the relationship between parental fruit consumption and child fruit consumption?

4.3 Methods

Study design and procedure

A cross-sectional study was conducted as part of the INPACT study, which consists of 1,840 parent-child dyads. INPACT (IVO Nutrition and Physical Activity Child cohorT) is an observational study (initiated in 2008) focusing on modifiable determinants of overweight in the home environment of children in the Netherlands (aged 8-12 years), with a specific emphasis on parental influences.
After approval for the INPACT study was obtained from the Ethical Committee of the Erasmus Medical Center Rotterdam, the first wave of data collection took place in the autumn of 2008 at Dutch primary schools in southern Netherlands (Eindhoven area). In recruiting the schools we collaborated with the Municipal Health Authority for Eindhoven and surrounding area (GGD Brabant-Zuidoost). The Municipal Health Authority invited all general primary schools in their service area to participate in the INPACT study. Of the 265 schools invited, 91 took part. The response rate from rural and urban schools was equal. The primary caregivers of third- grade students (aged about 8 years) were invited to participate in the cohort study, together with their child. Of the 2,948 parent-child dyads invited, 1,840 (62.4%) gave informed consent to participate in the INPACT study for four years.
The present study was based on the first wave of data collection. The primary caregiver filled in a questionnaire at home, recording data on dietary behaviours of the child, and potentially relevant home environmental factors, including the primary caregiver's dietary behaviours, the three parenting dimensions, and socio-demographic variables. Of the 1,840 participating parent-child dyads, 1,762 were included in the present study (96%). We excluded parent-child dyads with no or invalid data on demographics (child age, child gender, child ethnicity and primary caregiver's education level), parental fruit consumption and/or child fruit consumption.

Sample characteristics

The age of most participating children was 8 (77%) or 9 (20%) years (range 7-10 years, mean = 8.18 years, SD = 0.46). Boys (51%) and girls (49%) were represented in almost equal numbers. Most of the primary caregivers who completed the questionnaire were female (92%) and lived with a partner (92%). Of the primary caregivers, 22% had finished education at a low level (primary school and lower vocational/lower general secondary education), 45% at medium level (intermediate vocational education, higher general

secondary education and university preparatory) and 33% at a high level (higher vocational education and university). Of all children, 16% were from a non-Dutch ethnic background with one or both parents born abroad: 9% from non-western countries (n=156); 7% from western countries (n=127). Participating children consumed on average 7.5 pieces of fruit per week (SD=4.25) and their primary caregivers 7.4 (SD=5.25) pieces. A minority (14%) of the participating children met the recommended Dutch norm of at least 14 pieces of fruit per week (Richtlijnen Voedselkeuze, 2009), while 21% of their parents did.

Measures

Child fruit consumption (outcome variable)

Child fruit consumption was measured with a questionnaire that was based on validated Food Frequency Questionnaires[38,39]. The primary caregivers reported how many days a week (a normal week) their children consumed fruit (fresh, bottled and/or canned; no juice), with answering categories ranging from 'none or less than 1 day a week' to '7 days a week'. Additionally, they reported the number of pieces of fruit consumed by their children on such a day. Answering categories were: '0 pieces per day', '0.5 piece per day', '1 piece per day', '1.5 pieces per day', '2 pieces per day', '2.5 pieces per day', '3 pieces per day' and 'more than 3 pieces per day'. Reported consumption of more than 3 pieces per day (n=12) was recoded as 4 pieces. Total child fruit consumption was expressed in pieces per week and calculated by multiplying frequency and quantity. For descriptive purposes only, child fruit consumption was dichotomised into those who consumed less than 14 pieces per week and those who consumed 14 or more pieces per week, according to the recommended Dutch norms of two pieces of fruit per day[40].

Contextual factors: parenting style, parental education and ethnic background

The parenting style of the primary caregiver was measured using the Dutch translation[41] of an instrument based on earlier work by Steinberg et al.[25,42], which is used in many studies worldwide[20,41,43,44]. This 22-item measure assessed three parenting-style dimensions (support, behavioural control and psychological control) using a response scale ranging from -2 (completely disagree) to +2 (completely agree). Support was measured with seven items, such as 'When my child gets a low grade in school, I offer to help him/her' (α=0.71). These items were combined in one variable by summing the item scores [range -14 (low) to +14 (high)]. Behavioural control was also measured with seven items, such as 'I know exactly what my child does in his/her free time' and 'I try to know where my child goes after school' (α=0.72). As recommended by Stattin & Kerr[45], it measured both parental knowledge and behavioural monitoring. After summing the item scores, the behavioural control variable ranged from -14 (low) to +14 (high). Psychological control was measured with eight items, such as 'I make my child feel guilty when he/she gets a low grade in school' (α=0.72). This variable ranged from -16 (low) to +16 (high).
Based on these three parenting-style dimensions, five parenting styles have been established: the authoritative (high support, high behavioural control, low psychological control), permissive (high support, low behavioural control, low psychological control), authoritarian (low support, high behavioural control, low psychological control), rejecting (low support, low behavioural control, high psychological control), and neglecting (low support, low behavioural control, low psychological control) parenting style (e.g. [46,47]. For mediation analyses, we constructed these five parenting styles by dichotomising the sample on each dimension (median-split) and examining the three variables simultaneously. In moderation analyses we used the three separate, continuous parenting dimensions in order to make full use of our data (cf. [23,48]. Parental education was measured by the education level of the primary caregiver and defined as low (primary school and lower vocational/lower general secondary education), medium (intermediate vocational education, higher general secondary education and university prep) or high (higher vocational education and university), according to international classification systems[49].
Ethnic background was defined by the parents' country of birth, according to standard procedures of Statistics Netherlands[50]. If both parents were born in the Netherlands the child was classified as native Dutch, if at least one parent was born outside the Netherlands but inside Europe (including former Yugoslavia and the Soviet Union, North America, Oceania, Indonesia or Japan), the child was classified as a western immigrant and if at least one parent was born in Turkey, Africa, Latin America or Asia the child was classified as a non-western immigrant. By differentiating between western and non-western immigrants we aimed to cover cultural differences that may importantly influence behaviour[51].

Parental fruit consumption

Primary caregiver's fruit consumption was measured, calculated and dichotomised in the same way as child fruit consumption.

Potential confounders

Child age and gender were assessed as potential confounders. Child age was measured in years by subtracting the date of questionnaire completion from child birth date. Ethnic background and parental education were included as control variables in models in which they were not a predictor variable.

Strategy for analyses

To describe the study population and differences between subgroups, we computed means, standard deviations (SDs) and/or proportions for the socio-demographic variables and parenting styles. We also calculated median scores and interquartile ranges in pieces per week on child and parental fruit consumption for these variables. As fruit consumption variables showed a skewed distribution, differences between groups were analysed with a Mann-Whitney test (age, sex and parenting styles) or a Kruskal Wallis test (parental education and ethnic background). Multivariate linear regression analyses were performed to establish 1) the relationship between parental fruit consumption and child fruit consumption, 2) primary associations between contextual factors and child fruit consumption (Figure 4.1, path c), 3) mediated effects (Figure 4.1, path a * path b), and 4) moderated effects (Figure 4.1, path d). In the regression analyses, child fruit consumption and parental fruit consumption were entered as continuous variables. Data were log-transformed by ln(x) due to the skewed distribution[52,53]. To include children and primary caregivers who consumed zero pieces of fruit per week (n=39 for children; n=118 for primary caregivers), a week consumption of 0 was recoded as 0.25[54]. The unstandardized regression coefficients (Bs) obtained in the analyses using the log transformed variables were back-transformed (e^B) to present relative differences in fruit consumption in pieces per week.
The contextual factors were entered in the regression analyses as dummy variables. Five dummy variables were constructed to measure parenting style: authoritative parenting (0=no; 1=yes), authoritarian parenting (0=no; 1=yes), permissive parenting (0=no; 1=yes), neglecting parenting (0=no; 1=yes) and

rejecting parenting (0=no; 1=yes). Two dummy variables were constructed to measure parental education, with a low education as reference group. The reference group for ethnic background was native Dutch.

Primary associations

Separate regression analyses were performed to establish primary relationships of parental fruit consumption, parenting style, parental education and ethnic background with child fruit consumption, adjusted for age, gender, parental education and/or ethnicity (see above: potential confounders).

Mediation analyses

Mediation analyses examined whether parental fruit consumption mediated the relationship between the contextual parental factors and child fruit consumption. According to MacKinnon, a mediator has to be associated with the predictor variable and with the outcome variable[55]. If these two conditions were met when tested in regression analyses, mediated effects and proportions mediated were calculated. The product-of coefficients method (a*b) was used to calculate mediated effects, and the significance of mediation was tested with a Sobel-test[55]. Proportions mediated were calculated as the mediated effect divided by the total effect ([a*b]/c).

Moderation analyses

In the final set of regression analyses we examined whether parenting-style dimensions, parental education and ethnic background moderated the relationship between parental fruit consumption and child fruit consumption (Figure 4.1, path d). Moderation was tested by adding interaction terms to the regression analyses with a significance level of 0.1[56]. If interaction terms were significant, stratified analyses were conducted. In order to make full use of our data, continuous parenting-style dimensions, instead of parenting styles, were used in parenting interaction terms[23,48].

All analyses were conducted using SPSS version 17.0.

4.4 Results

Descriptive statistics and median scores on child and parental fruit consumption

Table 4.1 summarizes means, SDs and/or proportions for the socio-demographic variables and parenting styles, combined with calculated median scores and interquartile ranges in pieces per week on child fruit consumption and parental fruit consumption.

Median fruit consumption for children was 7.0 pieces per week (25th-75th percentile: 5.0-10.5) and for parents 6.0 pieces per week (25th-75th percentile: 5.0-10.5). Analyses of median scores on child fruit consumption showed that rejecting parenting was the only parenting style that significantly differed in median child fruit consumption: children of rejecting parents consumed less fruit (median=6.0; 25th-75th percentile: 4.0-9.0) than children of non-rejecting parents (median=7.0; 25th-75th percentile: 5.0-10.5). For children as well as their parents, median fruit consumption was higher when they were higher educated. Western immigrant children consumed more fruit (median=7.0; 25th-75th percentile: 5.0-14.0) than native Dutch children (median=7.0; 25th-75th percentile: 5.0-10.0), while parents of non-western immigrant children consumed more fruit (median=7.0; 25th-75th percentile: 4.0-14.0) than parents of native Dutch children (median=6.0; 25th-75th percentile: 3.0-10.5). Children aged 7 and 8 years consumed significantly more fruit (median=7.0; 25th-75th percentile: 5.0-10.5) than children aged 9 and 10 years (median=6.0; 25th-75th: percentile 4.0-10.0). Parents of children aged 7 and 8 years did not differ in fruit consumption from parents of children aged 9 and 10 years. There were no significant differences in child and parental fruit consumption between boys and girls.

Table 4.1 General characteristics of the study population and median scores (pieces/week) on child and parental fruit consumption (n=1,762)

	n	Proportion / mean (SD)	Child fruit consumption: median (25th – 75th percentile)[19]	p-value[20]	Parental fruit consumption: median (25th – 75th percentile)[19]	p-value[20]
Total sample	1762		7.0 (5.0 - 10.5)		6.0 (3.4 - 10.5)	
Authoritative parenting style:				n.s.		n.s.
yes	341	19.4%	7.0 (5.0 - 10.5)		7.0 (3.0 - 13.3)	
no	1421	80.6%	7.0 (5.0 - 10.5)		6.0 (3.8 - 10.5)	
Authoritarian parenting style:				n.s.		n.s.
yes	155	8.8%	7.0 (5.0 - 10.5)		7.0 (4.0 - 12.0)	
no	1607	91.2%	7.0 (5.0 - 10.5)		6.0 (3.0 - 10.5)	
Permissive parenting style:				n.s.		n.s.
Yes	321	18.2%	7.0 (5.0 - 10.0)		6.0 (3.0 - 10.5)	
No	1441	81.8%	7.0 (5.0 - 10.5)		6.0 (3.5 - 10.5)	
Neglecting parenting style:				n.s.		n.s.
Yes	285	16.2%	6.0 (5.0 - 9.0)		6.0 (4.0 - 10.5)	
No	1477	83.8%	7.0 (5.0 - 10.5)		6.0 (3.0 - 10.5)	
Rejecting parenting style:				0.005		n.s.
Yes	339	19.2%	6.0 (4.0 - 9.0)		6.0 (3.0 - 10.5)	
No	1423	80.8%	7.0 (5.0 - 10.5)		6.0 (4.0 - 10.5)	
Parental education:				0.000[21]		0.000[21]
low-level education	387	22.0%	6.0 (4.0 - 10.0)		5.0 (3.0 - 10.0)	
medium-level education	800	45.4%	7.0 (5.0 - 10.0)		6.0 (3.0 - 10.5)	
high-level education	575	32.6%	7.0 (5.0 - 10.5)		7.0 (4.0 - 12.0)	
Ethnic background:				0.005[22]		0.025[23]
native Dutch	1479	83.9%	7.0 (5.0 - 10.0)		6.0 (3.0 - 10.5)	
non-Western immigrant	156	8.9%	7.0 (4.0 - 10.5)		7.0 (4.0 - 14.0)	
western immigrant	127	7.2%	7.0 (5.0 - 14.0)		7.0 (3.5 - 14.0)	

	n	Proportion / mean (SD)	Child fruit consumption: median (25th – 75th percentile)[19]	p-value[20]	Parental fruit consumption: median (25th – 75th percentile)[19]	p-value[20]
Child age (years):		8.18 (0.49)		0.005		n.s.
7 & 8 years	1407		7.0 (5.0 - 10.5)		6.0 (4.0 - 10.5)	
9 & 10 years	355		6.0 (4.0 - 10.0)		6.0 (3.0 - 10.5)	
Child gender:				n.s.		n.s
Boys	893	50.7%	7.0 (5.0 - 10.5)		7.0 (4.0 - 10.5)	
Girls	869	49.3%	7.0 (5.0 - 10.0)		6.0 (3.0 - 10.5)	

Primary associations

Table 4.2 shows significant total (i.e. not adjusted for the mediator) and direct (i.e. adjusted for the mediator) effects of parental fruit consumption and the contextual factors on child fruit consumption. Adjusted for age, gender, parental education and ethnicity, parental fruit consumption and child fruit consumption were positively associated (B=0.22; p<0.001; Table 4.2, total effects). The relative difference (RD) was 1.17 (p<0.001), if the parent would double his/her fruit intake. Of the contextual parental factors, rejecting parenting, parental education and ethnicity (western immigrant versus native Dutch children) were significantly associated with child fruit consumption (Table 4.2, total effects). Children of rejecting parents consumed 12% less fruit than children of non-rejecting parents, children of highly educated parents consumed 23% more fruit than children of low educated parents, children of middle educated parents consumed 12% more fruit than children of low educated parents, and western immigrant children consumed 17% more fruit than native Dutch children.

Mediation analyses: parental fruit consumption as a mediator

As part of the mediation analyses, we tested whether contextual factors that were significantly associated with child fruit consumption were also associated with parental fruit consumption (path a1 to a3). For children of rejecting parents and western immigrant children, path a was non-significant (Table 4.3) and thus the criteria for mediation analysis were not met for these variables. However, parental education (high vs. low and middle vs. low) was significantly associated with parental fruit consumption. Highly educated parents consumed 47% more fruit than low educated parents, and middle educated parents consumed 27% more fruit than low educated parents (Table 4.3). As parental fruit consumption was also significantly associated with child fruit consumption (path b), the criteria for mediation analysis were met. The last two columns of Table 4.3 show the estimated mediated effects and the proportion of the total effect that was mediated. The mediated effects for both parental education comparisons were significant. The proportion mediated was around 45%, implying that parental fruit consumption explained about 45% of the association between parental education and child fruit consumption.

[19] ranges for child fruit consumption and parental fruit consumption: 0.25-28 pieces per week
[20] comparing groups, using the Mann-Whitney test (age, sex and parenting styles) or the Kruskal-Wallis test (ethnicity and parental education)
[21] low < medium < high
[22] western immigrants and native Dutch different at p=0.003
[23] non-western immigrants and native Dutch different at p=0.013

Table 4.2 Associations of parental fruit consumption, parenting style, parental education and ethnic background with child fruit consumption (pieces/week): total and direct effects (n=1762)

	Total effects (c)[24]					Direct effects (c')[25]				
Predictor	B	95% CI	R^2	RD	95% CI	B	95% CI	R^2	RD	95% CI
Parental fruit intake	0.22***	0.19; 0.26	0.13	1.17***[26]	1.14; 1.19					
Rejecting parenting (yes/no)	-0.12**	-0.21; -0.04	0.03	0.88**	0.81; 0.97	NA			NA	
Parental education (high/low)	0.20***	0.11; 0.30	0.03	1.23***	1.11; 1.35	0.17*	0.02; 0.21	0.13	1.12*	1.02; 1.23
Parental education (middle/low)	0.12*	0.03; 0.21	0.03	1.12*	1.03; 1.23	0.06	-0.02; 0.15	0.13	1.07	0.98; 1.16
Ethnicity (western immigrants/ native Dutch)	0.16*	0.02; 0.29	0.03	1.17*	1.02; 1.34	NA			NA	

Note: NA: not applicable, parental fruit consumption is not a significant mediator
* p<0.05, ** p<0.01, *** p<0.001
Table displays only significant total effects, B = unstandardised regression coefficient, R^2 = explained variance of model
RD = relative difference = e^B. It indicates the relative change in child fruit consumption in pieces a week between comparison and reference group

Table 4.3 Results from the mediation analyses with parental fruit consumption as mediator and child fruit consumption (pieces/week) as outcome variable (n=1,762)

Predictor	B path a[27]	95% CI	RD path a[28]	95% CI	Mediated effect a*b[29]	% mediated (a*b/c)[30]
Rejecting parenting (yes/no)	-0.03	-0.15; 0.10	0.97	0.86; 1.11	NA	NA
Parental education (high/low)	0.39***	0.25; 0.53	1.47***	1.28; 1.69	0.09***	42.8
Parental education (middle/low)	0.24***	0.11; 0.36	1.27***	1.11; 1.44	0.05***	45.3
Ethnicity (western immigrants/native Dutch)	0.06	-0.14; 0.25	1.06	0.87; 1.28	NA	NA

Note: NA: not applicable, parental fruit consumption is not a significant mediator
* p<0.05, ** p<0.01, *** p<0.001
Table displays only contextual factors that were significantly associated with child fruit consumption

[24] Regression model adjusted for child gender, age, ethnic background and parental education
[25] Regression model adjusted for child gender, age, ethnic background and parental education, additionally adjusted for significant mediator 'parental fruit consumption'
[26] As both parental fruit consumption and child fruit consumption were log transformed, the relative difference was calculated as $e^{B*\ln(2)}$, indicating the relative change in child fruit consumption in pieces a week for a doubling in parental fruit consumption
[27] Association between predictor and mediator (parental fruit consumption); B = unstandardised regression coefficient
[28] RD = relative difference = e^B. It indicates the relative change in parental fruit consumption in pieces a week between comparison and reference group
[29] Regression coefficient of path b with parental education as predictor variable: 0.22 (CI: 0.19, 0.26; p<0.001).
[30] Percentage mediated calculated with the c-value for total effects, see Table 2

Moderation analyses: contextual factors as moderators

In the moderation analyses we tested whether the parenting dimensions support, behavioural control and psychological control, parental education and ethnic background modified the association between parental fruit consumption and child fruit consumption. Of the parenting dimensions, psychological control and behavioural control were found to moderate the parental fruit/child fruit association ($p_{interaction\ term}$ 0.005 and 0.077, respectively). Stratified analyses (Table 4.4) revealed that the positive association was most pronounced in the highest quartile of psychological control (R^2=19.8% vs. R^2=9.5% in lowest quartile) and in the two highest quartiles of behavioural control (R^2=19.0/18.2% vs. R^2=11.2/11.1% in lowest quartiles). In addition, the relationship between parental and child fruit intake differed depending on ethnic background ($p_{interaction\ term}$ 0.051): the positive association was more pronounced in non-western and western immigrants than in native Dutch ($R^2_{non\text{-}western\ immigrants}$=19.2%; $R^2_{western\ immigrants}$=25.0% and $R^2_{native\ Dutch}$=10.8). Parental education and parental support did not moderate the association between parental and child fruit intake.

4.5 Discussion

This study, which analysed the association between parental and child fruit intake in the context of higher-level parental factors, shows that parental fruit consumption, parental education and a western immigrant background were positively associated with child fruit consumption. A new finding is that the relation between parental education and child fruit consumption was mediated by parental fruit consumption. We also demonstrated that the association between parental and child fruit consumption depends on higher-order moderators: the positive association was more pronounced under higher levels of psychological control, higher levels of behavioural control, and in non-western and western immigrants. Finally, we found that rejecting parenting was negatively associated with child fruit intake, but not mediated by parental fruit intake.

In line with review studies and recent studies on parental correlates of child fruit intake[12,14-16,57], we found a positive association between parental and child fruit consumption. Moreover, because we found that only 14% of the children and 21% of the parents consumed in accordance with the recommended Dutch norm of at least 2 pieces of fruit per day[40], improving parental fruit intake may be a useful approach for promoting fruit intake in children. Our results indicate that if parents would double their fruit consumption (which for most parents would mean complying with the guideline of two pieces of fruit per day), their child's fruit consumption would increase by 17%. Although this potential increase in child fruit consumption may not seem large, a change in parental fruit consumption is feasible on a population basis[58] and can contribute to increasing child fruit consumption to some extent. Interventions aimed at improving parental fruit consumption may become even more effective if parents are made aware of their role as a role model, and of how important a positive parental role model is for their child's health behaviour and health in general[14,59]. To increase parental awareness, a mass-media campaign (commercials on television, posters on billboards, etc.) could be executed with an appealing slogan stating that children imitate. In more personal intervention sessions, parents could perform role model plays with good and bad behaviour to see how this influences their children's behaviour.

Of the contextual factors studied, parental education, ethnicity, psychological control and behavioural control were related to parental and child fruit intake, either as mediated factor or as moderator. This demonstrates that contextual factors can influence the relationship between parental and child fruit consumption through a mediated pathway, as hypothesized in social cognitive models such as the Theory of Triadic Influence (i.e. distal parental factors 'causing' parental fruit consumption, which in turn 'causes' child fruit consumption), as well as through a moderated pathway, as derived from ecological systems theory (i.e. contextual factors as higher order moderators). A major challenge for future empirical studies regarding child dietary behaviour will be to document under what conditions higher order environmental moderation is most or least likely to occur (see also[21,60]).

The positive association between parental education and child fruit consumption, also found in a recent longitudinal study by Jones et al.[8], was explained by parental fruit consumption for about 45%. This finding may underline the previously stressed importance of targeting interventions at improving parental fruit intake, and that low educated parents need particular attention. Improving parental behaviour (i.e. increasing parental fruit intake) among low educated families may eventually contribute to diminishing socio-economic health inequalities. Although a western immigrant background and rejecting parenting were associated with child fruit consumption, the associations were not mediated by parental fruit consumption. To improve our understanding of the relationship between parental and child fruit consumption, other potential parental higher-level conditions should also be included in future studies. Parental nutritional knowledge and availability/accessibility of fruit are related to fruit consumption[61-63] and may be, together with parental feeding styles and healthy-eating policies, important contextual factors.

There is evidence that more global, higher-level factors such as parenting style and socio-demographic factors can provide a context for more specific parental behaviours in relation to child behaviour[23,48]. In our study, the relationship between parental modelling (i.e. parental fruit intake) and child fruit intake differed depending on the levels of psychological control, behavioural control and ethnic background. Thus, our results are consistent with the evidence that higher-level parental factors can function as a contextual factor in which parental influences on child fruit intake occur, and need attention in future studies[64]. Gaining more insight into the relationships within certain subgroups (such as SES groups and ethnic groups), can improve the focus of programs aimed at increasing child fruit consumption. The moderating influence of psychological control demonstrated that the positive association between parental and child fruit intake was most pronounced among children who were subject to the highest levels of psychological control; these were children of rejecting parents. As rejecting parenting was negatively associated with child fruit consumption, the most pronounced association was among children with the lowest fruit consumption. An explanation for a more pronounced relation when children were subject to higher levels of psychological control could therefore be found in modelling. Because rejecting parents conduct low levels of involvement and behavioural control (including few explicit rules), the impact of modelling, in our case its negative impact, could be relatively large[59,65]. The influence of this negative role model of rejecting parents is not supportive for healthful child behaviour; this may justify aims to prevent this parenting style, which is seen as a risk factor for problem behaviour in general[31-33].

Table 4.4 Moderation analyses: association between parental and child fruit consumption, stratified by quartiles of psychological control, behavioural control and ethnicity (n=1,762)

Quartiles of psychological control[31]	B[32]	95% CI	RD[33]	95% CI	Child fruit consumption: median (25th–75th perc.)[34]	Child fruit norm (% yes)	Parental fruit consumption: median (25th–75th perc.)[34]	Parent fruit norm (% yes)	R^2 (%)[35]
1. (lowest)	0.18***	0.12; 0.24	1.13***	1.09; 1.18	7.0 (5.0 - 10.0)	12.6	7.0 (4.0 - 10.5)	22.8	9.5
2.	0.23***	0.17; 0.28	1.17***	1.13; 1.21	7.0 (5.0 - 10.5)	15.3	6.0 (4.0 - 12.0)	22.6	16.2
3.	0.18***	0.12; 0.24	1.13***	1.08; 1.18	7.0 (5.0 - 10.0)	14.1	6.0 (3.0 - 10.5)	18.4	13.4
4. (highest)	0.31***	0.23; 0.39	1.24***	1.18; 1.31	7.0 (4.25 - 10.5)	15.4	6.0 (3.0 - 10.0)	18.7	19.8
Quartiles of behavioural control[36]									
1.	0.19***	0.14; 0.24	1.14***	1.10; 1.18	6.0 (5.0 - 9.0)	10.9	6.0 (3.0 - 10.0)	19.9	11.2
2.	0.19***	0.12; 0.26	1.14***	1.08; 1.20	7.0 (5.0 - 10.5)	13.1	7.0 (4.0 - 10.5)	19.6	11.1
3.	0.27***	0.21; 0.33	1.20***	1.16; 1.25	7.0 (5.0 - 10.5)	14.0	6.0 (4.0 - 10.5)	19.1	19.0
4.	0.26***	0.19; 0.33	1.20***	1.14; 1.25	7.0 (5.0 - 10.5)	21.9	7.0 (3.5 - 14.0)	26.5	18.2
Ethnic background									
Native Dutch	0.21***	0.18; 0.24	1.16***	1.13; 1.18	7.0 (5.0 - 10.0)	12.5	6.0 (3.0 - 10.5)	19.7	10.8
Non-western immigrant	0.32***	0.20; 0.44	1.25***	1.15; 1.35	7.0 (4.0 - 10.5)	21.2	7.0 (4.0 - 14.0)	28.8	19.2
Western immigrant	0.29***	0.17; 0.40	1.22***	1.13; 1.32	7.0 (5.0 - 14.0)	27.6	7.0 (3.5 - 14.0)	25.2	25.0

Note: * p<0.05, ** p<0.01, *** p<0.001

The positive relationship between parental and child fruit consumption was more pronounced among children who were subject to the highest levels of behavioural control. Especially in the highest quartile, the percentage of parents complying with the norm of two pieces of fruit per day was relatively large (26.5% vs 19.1-19.9%), indicating that these parents have a relatively high fruit consumption and could thus function as positive role models. This makes focusing on increasing behavioural control in combination with increasing parental fruit consumption a potentially interesting aspect of intervention programs[66]. The moderating influence of ethnicity showed a more pronounced association between parental and child fruit intake among western and non-western immigrant children compared to native Dutch.

[31] Ranges for psychological control per quartile: (1) -14 through -10, n=433; (2) -9.99 through -7, n=548; (3) -6.99 through -4, n=434; (4) -3.99 through +14, n=337

[32] Regression model adjusted for child sex, child age, child ethnicity and parental education; B = unstandardised regression coefficient

[33] RD = relative difference = $e^{B*\ln(2)}$. As both parental and child fruit consumption are log transformed, the results indicate the relative change in child fruit consumption in pieces a week for a doubling in parental fruit consumption.

[34] ranges for child fruit consumption and parental fruit consumption: 0.25-28 pieces per week

[35] R^2 = explained variance of model

[36] Ranges for behavioural control per quartile: (1) -14 through =+7, n=543; (2) +7.01 through +11, n=404; (3) +11.01 through +13, n=472; (4) +13.01 through +14, n=343

Furthermore, we found a higher fruit consumption in western (17% higher consumption, significant) and non-western immigrant children (11% higher consumption; non-significant) than among native Dutch children. Together with the finding that the percentage of parents complying with the norm of two pieces of fruit per day was relatively large among migrant groups (28.8% for non-western and 25.2% for western immigrants) compared to native Dutch (19.7%), this indicates that immigrant parents are a better fruit consumption role model for their children than native Dutch parents. The reason for the higher fruit consumption in migrant groups may be related to cultural differences[51]. For example, in southern-European countries fruit is abundant and easily available/accessible, resulting in a habit of fruit eating (they indeed have the highest fruit consumption of Europe[67], which is carried into the host country when migrating.

Strengths & limitations

An important aspect of our study is that we moved beyond the isolated perspective of looking at primary associations of environmental factors with behaviour, and created a model of parent-level influences in which moderation and mediation processes were integrated to better understand the mechanism underlying child fruit consumption. In addition, as far as we know, no other studies on child fruit consumption have measured parenting style three-dimensionally[64].

A limitation of our study is that we analysed cross-sectional data. The relationship between parental fruit consumption and child fruit consumption might be bi-directional. Current literature offers few insights into the bidirectional processes through which parents and children constantly shape and reshape each other through their mutual actions and reactions[68,69]. To further elucidate cause and effect, longitudinal analyses are needed. In addition, we used a food frequency questionnaire to measure fruit consumption, which may evoke social desirability bias and lead to overestimation of fruit consumption[70,71] in parents and children. This implies that actual fruit consumption and the percentage of children and parents meeting fruit recommendations could be lower, thus further emphasising the need for interventions to increase fruit consumption in children and parents.

Conclusion

Parental and child fruit consumption were positively associated. The association was more pronounced under higher levels of psychological control, higher levels of behavioural control and among ethnic groups. In addition, parental education and child fruit consumption were positively associated. Parental fruit consumption partially mediated the association between parental education and child fruit consumption (45% explained). These findings provide updated input for future interventions. Interventions are needed as only 14% of the children in our study met the recommended Dutch norms for fruit intake. Interventions should focus on increasing parental fruit consumption, and make parents aware of their role as a role model. Parents who consume sufficient amounts of fruit are a positive role model for their children, and this positive modelling should be encouraged.

In interventions, special attention should be given to increasing parental and child fruit consumption in families with low educated parents. In addition, interventions that combine positive modelling with positive general parenting skills (e.g. diminishing psychological control and increasing behavioural control) may have a stronger effect than interventions that focus only on food-related parenting practices.

4.6 References

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chapter 5

clustering

Clustering of diet- and activity-related parenting practices: cross-sectional findings of the INPACT study

Clustering of diet- and activity-related parenting practices: cross-sectional findings of the INPACT study

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5.1 Abstract

Background

Various diet- and activity-related parenting practices are positive determinants of child dietary and activity behaviour, including home availability, parental modelling and parental policies. There is evidence that parenting practices cluster *within* the dietary domain and *within* the activity domain. This study explores whether diet- and activity-related parenting practices cluster *across* the dietary and activity domain. Also examined is whether the clusters are related to child and parental background characteristics. Finally, to indicate the relevance of the clusters in influencing child dietary and activity behaviour, we examined whether clusters of parenting practices are related to these behaviours.

Methods

Data were used from 1480 parent-child dyads participating in the Dutch IVO Nutrition and Physical Activity Child cohorT (INPACT). Parents of children aged 8-11 years completed questionnaires at home assessing their diet- and activity-related parenting practices, child and parental background characteristics, and child dietary and activity behaviours. Principal component analysis (PCA) was used to identify clusters of parenting practices. Backward regression analysis was used to examine the relationship between child and parental background characteristics with cluster scores, and partial correlations to examine associations between cluster scores and child dietary and activity behaviours.

Results

PCA revealed five clusters of parenting practices: 1) high visibility and accessibility of screens and unhealthy food, 2) diet- and activity-related rules, 3) low availability of unhealthy food, 4) diet- and activity-related positive modelling, and 5) positive modelling on sports and fruit. Low parental education was associated with unhealthy cluster 1, while high(er) education was associated with healthy clusters 2, 3 and 5. Separate clusters were related to both child dietary and activity behaviour in the hypothesized directions: healthy clusters were positively related to obesity-reducing behaviours and negatively to obesity-inducing behaviours.

Conclusion

Parenting practices cluster *across* the dietary and activity domain. Parental education can be seen as an indicator of a broader parental context in which clusters of parenting practices operate. Separate clusters are related to both child dietary and activity behaviour. Interventions that focus on clusters of parenting practices to assist parents (especially low-educated parents) in changing their child's dietary and activity behaviour seems justified.

5.2 Introduction

Diets rich in fruit and vegetables and an active lifestyle are associated with important health protective effects, including protection against some types of cancer, cardiovascular diseases, type 2 diabetes and overweight[1,2]. There is considerable evidence that children consume less fruit and vegetables than is recommended[3-7] and that they do not meet physical activity (PA) recommendations[8]. Because diet- and activity-related habits established in childhood often track through to adulthood[9-11], these energy balance-related behaviours (EBRBs) should be improved at an early age. Improvement of these behaviours requires understanding of the factors determining children's EBRBs.

The home environment is a critical context for the development of children's eating and activity behaviours[12-14]. Parents play a key role in shaping the home environment. In review studies on parental correlates of child fruit and vegetable consumption, the most consistently supported positive determinants of child and adolescent intake are parental dietary intake, parental modelling, home availability and accessibility, family rules, parental encouragement and parental education[12,15-18]. In addition, parental fat intake is a consistent and positive correlate of child fat intake[15]. Important positive parental correlates for child and adolescent PA are parental support, parental encouragement, paternal PA, maternal education level and family income[12,19,20]. Conceptually, such parental correlates can be divided into parenting practices (i.e. content-specific acts of parenting[21], such as rules about dietary intake or activity behaviour) and more general or distal parental factors (e.g., parental education and family income). The latter can be conceptualised as potential background variables or higher-order moderators of the relationship between parenting practices and child behaviour[7]. The current study focuses on clustering of parenting practices in relation to more distal parental factors.

There is some evidence that parenting practices co-occur or 'cluster'. Gubbels et al.[22] found evidence for clustering of diet-related restrictive parenting practices, namely a cluster characterised by prohibition of the intake of various snacks and soft drinks, and a separate cluster characterised by prohibition of cookies and cake. A study by Gattshall et al.[23] showed interdependencies between diet-related parenting practices for fruit and vegetables, and between PA-related parenting practices, i.e. availability, accessibility, parental role modelling and parental policies. However, they did not study interdependencies between diet- and activity-related parenting practices. To our knowledge, no studies have used a clustering approach to examine both diet- and activity-related parenting practices, while studies on this topic are needed to elucidate whether parenting practices cluster across the dietary and activity domain (e.g. parental rule setting regarding snacks and screen time). Clustering across domains could point to a broader parental context in which the clusters of parenting practices operate, e.g. a parental context of health beliefs. The potential synergy between parenting practices that occur in clusters could result in more efficient interventions aimed at improving diet- and activity-related parenting practices, by applying an integrated approach that addresses multiple parenting practices simultaneously[24].

To elucidate how clusters of parenting practices may arise, it is important to examine factors related to the potential clusters of parenting practices. These factors can be both child- and parent-related. In previous studies, child gender[25,26], weight[26-30], food neophobia[31] and eating style (hungry or picky)[26], as well as parental body mass index (BMI), education level, parenting style, employment, ethnicity and parental age[22,26,27,31-37] were related to diet-related parenting practices, while child gender and activity style (active or not)[26], parental education level and working hours per week were related to activity-related parenting practices[26]. To test the magnitude of their relevance, it is also important to relate potential clusters of parenting practices to child dietary and activity behaviours. We chose to relate them to obesity-reducing, i.e. child fruit intake, child active commuting to school, child outdoor playing and child sports participation, as well as obesity-inducing behaviours, i.e. child snack and sugar-sweetened beverage (SSB) intake, and child screen time[38].

The aim of this study was to examine clustering of parenting practices across the dietary and activity domain in parents of children aged 8-11 years. Children and their parents were recruited from rural and urban general primary schools in southern Netherlands. Apart from clustering of parenting practices, we examined whether these potential clusters are associated with child- and parent-related factors, and with child dietary and activity behaviours. Based on earlier studies we included child gender, age, ethnicity and weight, and parental BMI, education level and parenting style as factors that could potentially be associated with the clusters. We hypothesised that the parenting practices would cluster *within* and *across* the dietary and activity domain, and that healthy clusters would positively relate to obesity-reducing behaviours and negatively to obesity-inducing behaviours.

5.3 Methods

Study design, setting, participants and procedure

Data for this study were retrieved from the IVO Nutrition and Physical Activity Child cohorT (INPACT), for which approval was obtained from the Ethical Committee of the Erasmus MC (University Medical Center Rotterdam). INPACT is an observational study (initiated in 2008) focusing on modifiable determinants of overweight in the home environment of children aged 8-12 years in the Netherlands. INPACT was conducted among primary school children in southern Netherlands (Eindhoven area). In recruiting the schools in 2008, we collaborated with the Municipal Health Authority for Eindhoven and surrounding area (GGD Brabant-Zuidoost). The Municipal Health Authority invited all general primary schools in their service area to participate in the INPACT study. Of the 265 schools invited, 91 took part; the response rate from rural and urban schools was equal. The primary caregivers of third-grade students (aged ± 8 years) were invited to participate in the cohort study, together with their child. Of the 2948 parent-child dyads invited, 1839 (62.4%) gave written informed consent to participate in the INPACT study for four years. The study included four assessments, each separated by a one-year time interval, and started in the autumn of 2008 (baseline). In the assessments, primary caregivers completed a questionnaire at home, children completed a questionnaire at school, and qualified research assistants measured the children's height and weight at school. The present study was based on data from 2008 (baseline) and 2009 (second assessment). Parents reported on child and parental background characteristics (2008), on their energy balance-related behaviours (2009). In addition, child BMI z-scores from 2008 were used, which were based on measured height and weight. Parent-child dyads with complete data from baseline to 2009 were included in the present study, resulting in 1480 parent-child dyads (80% of the original cohort). Logistic regression analyses on selective dropout from baseline to 2009 showed that parent-child dyads who were not native Dutch dropped out more often. There was no selective dropout regarding child age/gender and parental education level.

Sample characteristics

At baseline (n=1839), 7% of the children were underweight, 79% had a normal weight and 14% were overweight, of which 3% were obese. The prevalence of overweight and obesity was similar to Dutch prevalence rates among primary school children[39]. The age of the children was 8 (77%) or 9 (20%) years (range 7-10 years, mean=8.2 years, SD=0.5). Boys (50.5%) and girls (49.5%) were represented in almost equal numbers. Of all children, 17% were from a non-Dutch ethnic background with one or both parents born abroad, of which 9% from non-western countries and 8% from western countries. Primary caregivers were predominantly female (92%). Of all primary caregivers, 21% had finished education at a low level, 45% at a medium level, 32% at a high level, and 2% at a non-specified level. Of the primary caregivers, 1% was underweight, 66% had a normal weight and 33% were overweight, of which 9% were obese.

Measures

Diet- and activity-related parenting practices

Diet- and activity-related parenting practices were assessed with questionnaire items derived from the Dutch translation of the validated Home Environment Survey (HES)[23]. The home environment can be divided into a physical, socio-cultural, political and economic environment[40]; the HES assesses all of these, except for the economic home environment. The physical environment includes availability and accessibility of fruit, vegetables, snacks, SSBs and PA equipment (bicycle, roller skates, ball, etc.), the political environment includes a scale for healthy eating parental policies (e.g. eating breakfast together with a child) and PA parental policies (e.g. encouraging a child to be physically active), and the socio-cultural environment includes a scale for healthy eating parental role modelling and PA parental role modelling. As suggested by Gattshall et al.[23] , we included a separate scale for parental role modelling of sedentary behaviour. In addition to Gattshall's items on accessibility of PA equipment we included items on accessibility of sedentary equipment (television and computer). Moreover, we divided all accessibility measures into visibility ('could be seen') and accessibility ('could easily be reached') (Table 5.1), as visibility can function as a cue to action (Health Belief Model[41]), and thus be an important factor for influencing behaviour. The HES assesses the physical environment for specific foods and PA equipment, while the political and socio-cultural environment are measured in a generic way (e.g. healthy eating policies/role modelling). In order to include specific measures, we also assessed parental rules for child dietary and activity behaviours as part of the political environment, and parental dietary and activity behaviours (role modelling) as part of the socio-cultural environment. These were assessed with questionnaire items derived from the Endorse study[42] (Table 5.1).

For all parenting practice measures, a higher score implied more policies/rules, role modelling, availability, etc. Table 5.1 presents additional information on measurement year, number of items, example items, response options, Cronbach's alphas, and the means and standard deviations (SDs) of the various parenting practices assessed.

Table 5.1 Descriptives and scale information of key study variables (n=1839 for 2008 and n=1547 for 2009)

Concept	Measurement year	Questions (reference period: in the past 30 days)	Answering scale	Cronbach's α	Median score (25th-75th perc.) / % yes	Range of scores
Diet-related parenting practices: physical home environment						
Fruit availability	2008	How often do you have fruits available at home?	never (1) to always (5)		5.0 (5.0-5.0)	1.0-5.0
Fruit visibility	2008	Do you store fruits at home in a place where your child can easily see them, e.g. in a fruit bowl	never (1) to always (5)		5.0 (4.0-5.0)	1.0-5.0
Fruit accessibility	2008	Do you store fruits at home in a place that is easily accessible for your child?	never (1) to always (5)		5.0 (5.0-5.0)	1.0-5.0
Snack availability	2008	How often do you have sweet and savoury snacks available at home?[37]	never (1) to always (5)		4.5 (4.0-5.0)	1.0-5.0
Snack visibility	2008	Do you store sweet and savoury snacks at home in a place where your child can easily see them?[37]	never (1) to always (5)		2.0 (1.5-3.0)	1.0-5.0
Snack accessibility	2008	Do you store sweet and savoury snacks at home in a place that is easily accessible for your child?[37]	never (1) to always (5)		3.5 (2.5-5.0)	1.0-5.0
SSB availability	2008	How often do you have SSBs available at home?	never (1) to always (5)		5.0 (4.0-5.0)	1.0-5.0
SSB visibility	2008	Do you store SSBs at home in a place where your child can easily see them?	never (1) to always (5)		3.0 (2.0-5.0)	1.0-5.0
SSB accessibility	2008	Do you store SSBs at home in a place that is easily accessible for your child?	never (1) to always (5)		4.0 (3.0-5.0)	1.0-5.0
Diet-related parenting practices: political home environment						
Fruit rules	2008	Do you have a rule at home that your child should eat, in principle, 2 pieces of fruit per day?	no (0) or yes (1)		24.5	
Snack rules	2008	Do you have a rule at home about how much and when your child is allowed to snack?[38]	no (0) or yes (1)		69.5[39] 15.2[40]	
SSB rules	2008	Do you have a rule at home about how much and when your child is allowed to drink SSBs?[38]	no (0) or yes (1)		58.6[39] 15.5[40]	
Healthy eating policies	2008	7 items, e.g., 'How often do you eat breakfast with your child?'	never (1) to always (5)	0.60	4.1 (3.7-4.4)	1.1-5.0
Diet-related parenting practices: socio-cultural home environment						
Parental fruit intake	2008	Based on Food Frequency Questionnaires[41]			6.0 (3.3-10.5)	0-28 pieces
Parental snack intake	2008	Based on Food Frequency Questionnaires			6.0 (3.0-9.0)	0-35 pieces
Parental SSB intake	2008	Based on Food Frequency Questionnaires			1.0 (0.0-6.0)	0-42 glasses
Healthy eating role modelling	2009	12 items, e.g. 'How often do you eat healthy meals or snacks while your child is around?'	never (1) to always (5)	0.70	4.0 (3.8-4.2)	2.4-5.0

Activity-related parenting practices: physical home environment						
Availability of PA equipment and play spaces	2008	Which of the following toys/ equipment does your child have? (list of 15 items, including skateboard, bicycle, skipping rope and outside play area)	no (0) or yes (1)		9.0 (7.0-10.0)	2-15
PA equipment visibility	2008	Do you store your child's active toys out of sight when he/she is not using them? (reversed item)	never (1) to always (5)		4.0 (3.0-5.0)	1.0-5.0
PA equipment accessibility	2008	2 items, e.g., Do you store your child's active toys in a place that is easily accessible for your child? (child needs no help getting them out)	never (1) to always (5)	0.72	5.0 (5.0-5.0)	1.0-5.0
Screen equipment availability in bedroom	2008	2 items: Does your child have a television/computer in his bedroom?	no (0) or yes (1)		7.5[39] 21.2[40]	
Screen equipment visibility	2008	2 items, e.g., Do you store your computer out of sight when it is not used? (reversed item)	never (1) to always (5)		4.5 (3.0-5.0)	1.0-5.0
Screen equipment accessibility	2008	2 items, e.g., Is the television mostly turned on at your place?	never (1) to always (5)		3.5 (3.0-4.0)	1.0-5.0
Activity-related parenting practices: political home environment						
Active transport rules	2008	Do you have a rule at home that your child, in principle, should go to school on foot or by bicycle?	no (0) or yes (1)		76.4	
Sports rules	2008	Do you have a rule at home that your child, in principle, should sport/be physically active?	no (0) or yes (1)		82.1	
Screen time rules	2008	4 items, e.g. Do you have a rule at home about how much your child is allowed to watch television?	no (0) or yes (1)		0.8 (0.3-1.0)	0-1
Physical activity policies	2008	5 items, e.g. How often do you verbally encourage your child to be physically active?	never (1) to always (5)	0.57	3.8 (3.4-4.2)	1.6-5.0
Activity-related parenting practices: socio-cultural home environment						
Parental active commuting days	2009	Two questions based on SQUASH[72], one about number of days per week walking to work and one about number of days per week cycling to work	number of days per week for each question (open questions)		0.0 (0.0-3.0)	0-7 days
Parental sports days	2009	Based on SQUASH; parents could indicate 4 types of sports they performed,	number of days per week for each sport indicated (open questions)		1.0 (0.0-2.0)	0-14 days
Parental PA apart from active commuting and sports	2009	Six questions based on SQUASH; number of days of walking, cycling, gardening and doing small jobs during leisure time per week, and number of days of physically heavy work and physically heavy housework per week	number of days per week for each question (open questions)		8.0 (5.0-12.0)	0-28 days
Parental screen days	2008	Two questions based on SQUASH, one about number of days per week watching television and one about number of days per week using the computer	number of days per week for each question (open questions)		10.0 (8.0-13.0)	0-14 days
Physical activity role modelling	2009	6 items, e.g. How often does your child see you being physically active (e.g. walking, cycling, playing sports)?	never (1) to always (5)	0.52	3.5 (3.3-3.7)	1.7-4.8
Sedentary behaviour role modelling	2009	2 items, e.g. How often does your child see you watching television?	never (1) to always (5)	0.48	3.0 (3.0-3.5)	1.0-5.0

Note: PA: physical activity SSB: sugar-sweetened beverage

Child dietary and activity behaviours

Child fruit, snack and SSB intake in 2009 were assessed using several items from a validated Food Frequency Questionnaire (FFQ) designed to accurately assess energy intake of Dutch children aged 2–12[43,44]. The validation study showed a correlation coefficient between the original questionnaire and the doubly labelled water method of 0.62. The way in which child fruit intake is assessed in this FFQ corresponds with earlier validated FFQs for fruit and vegetable intake[45,46]. The primary caregivers reported how many days in a normal week their children consumed 1) fruit (fresh, bottled and/or canned; no juice), 2) savoury snacks (e.g. potato crisps, peanuts and sausage rolls) in between meals, 3) sweet snacks (e.g. candies, chocolates and candy bars) in between meals, 4) cake or large biscuits in between meals, and 5) SSBs. Answering categories ranged from 'none or less than 1 day a week' to '7 days a week'.

[37] Separate questions for sweet snacks and for savoury snacks
[38] Separate questions for 'how much' and for 'when'
[39] % 'yes' on both questions
[40] % 'yes' on one of the two questions
[41] Parental fruit, snack and SSB intake were assessed in the same way as child fruit, snack and SSB intake (see Methods section)

Additionally, they reported the number of servings consumed by their children on such a day. For fruit, answering categories ranged from '0 pieces per day' to 'more than 3 pieces per day', by increments of half a piece of fruit. Reported consumption of more than 3 pieces per day (n=12) was recoded as 4 pieces. For savoury snacks, sweet snacks and cake or large biscuits, answering categories ranged from 0 to 10 servings a day. For SSBs, answering categories ranged from '0 glasses per day' to 'more than 5 glasses per day', by increments of half a glass. It was specified that one glass equals 200 ml; one can equals 330 ml or 1.5 glasses; one bottle equals 500 ml or 2.5 glasses. Reported consumption of more than 5 glasses per day (n=7) was truncated to 6 pieces. Total child fruit and SSB intake were expressed in servings per week and calculated by multiplying frequency and quantity. Total child snack intake was also expressed in pieces per week and calculated by multiplying frequencies of savoury snacks, sweet snacks and cakes with their corresponding quantities, and summing these scores. Missing values on child fruit, snack and SSB intake were not imputed, because of the low number of missing values (1.0% at the highest, for child snacking).
Children's activity behaviours were also reported by the primary caregiver, and based on a standard questionnaire for assessing children's activity behaviour used in Dutch Youth Health Care[47]. Parents reported on how many days in a normal week their children 1) went to school on foot or by bicycle (active transport to school), 2) played outside, and 3) participated in a sport at a sports club. Children's sedentary screen-time behaviour was assessed in a similar way with separate questions for watching television (including videos and DVDs) and playing on the computer. Total child screen time was calculated by summing television days and computer days, ranging from 0 to 14 days (e.g., if parents reported their child to watch television for 7 days per week and to play on the computer for 5 days per week, the child scored 12).

Child and parental background characteristics

Data on demographics were primarily collected in the parent questionnaire of 2008. Child age was measured in years by subtracting the date of questionnaire completion from the child's birth date.
To assess the child's ethnic background, the primary caregiver reported the country of origin of both parents. According to standard procedures of Statistics Netherlands[48], a child was classified as native Dutch if both parents were born in the Netherlands, as a western immigrant if at least one parent was born outside the Netherlands but inside Europe, and as a non-western immigrant if at least one parent was born in Turkey, Africa, Latin America or Asia. The primary caregiver also reported on his/her highest level of education. According to international classification systems[49], parental education level was defined as low (primary school and lower vocational/lower general secondary education), medium (intermediate vocational education, higher general secondary education and university prep), high (higher vocational education and university), or non-defined. To assess parental BMI, the primary caregiver reported his/her own height and weight. He/she also reported whether he/she was the child's biological parent. Parental BMI (for biological parents only) was calculated on the basis of these answers.
Parenting style was measured using the Dutch translation[50] of an instrument based on earlier work by Steinberg et al.[51,52], which is used in many studies worldwide[50,53-55]. This 22-item measure assessed three parenting-style dimensions: support (e.g. 'When my child gets a low grade in school, I offer to help him/her'), behavioural control (e.g. 'I know exactly what my child does in his/her free time' and psychological control (e.g. 'I make my child feel guilty when he/she gets a low grade in school') (see [56] for additional information on the parenting style instrument used).

In addition to questionnaire data, child BMI was based on the child's height and weight: i.e. weight (kg)/height $(m)^2$, as measured by the qualified research assistants in 2008. Children were measured at school according to standard procedures in light clothing without shoes, to the nearest 0.1 kg and 0.1 cm. Weight was measured with an electronic flat scale (Seca 840; Beenhakker, Rotterdam, the Netherlands) and height with a mobile measuring ruler (Seca 214; Beenhakker, Rotterdam, the Netherlands). BMI z-scores were calculated[57] based on age and gender-specific values from the 1997 National Growth Study in the Netherlands[58].

Strategy for analyses

All analyses were performed using IBM SPSS Statistics version 19.0. Cases with missing values were excluded per analysis. To describe the study population, we computed medians, interquartile ranges and percentages for socio-demographic variables and child dietary and activity behaviours.
Principal component analysis (PCA) with oblique rotation was performed to examine clustering of diet-related and activity-related parenting practises. Oblique rotation was chosen because of the expected association between the extracted components[59]. A scree plot was used to determine the number of components. Items with absolute component loadings larger than 0.4 were considered part of the component, in line with previous research[59]. Cluster scores were computed for each child as each parenting practice measure multiplied by their corresponding component loading[60]. The parenting practice cluster scores were then used as separate dependent variables in backward linear regression analyses, to examine the relationship with parental characteristics (parental education level, parental BMI at baseline and parenting style dimensions) and child characteristics (gender, age, ethnicity and BMI z-score at baseline). Partial correlation was used to assess the associations between cluster scores and child dietary and activity behaviours. These analyses were corrected for the child and parent background characteristics mentioned above.

5.4 Results

Children had an average weekly fruit consumption of 7.4 pieces (SD=4.2; range: 0-28), an average weekly snack intake of 9.7 pieces (SD=5.8; range: 0-35) and an average weekly SSB intake of 9.1 glasses (SD=8.3; range: 0-42). Only 15% of the children met the recommended Dutch norm of at least 14 pieces of fruit per week[61]. On average, children went to school on foot or by bicycle on 4.3 days per week (SD=1.3; range: 0-5), played outside on 6.6 days per week (SD=0.8, range: 0-7), participated in a sport at a sports club on 2.5 days per week (SD=1.3; range: 0-7), watched television on 6.7 days per week (SD=0.89, range: 0-7) and played on the computer on 4.7 days per week (SD=2.0; range 0-7). Of all children, 75% commuted to school in an active way all 5 days of the school week, 77% played outside all 7 days of the week, 86% watched television all 7 days of the week and 32% played on the computer all 7 days of the week.

PCA revealed 5 parenting practice clusters (Table 5.2). The first cluster included a high *visibility* and *accessibility* of SSB and snacks, a high availability of screens in the child's bedroom and a low score on parental healthy eating policies ('high visibility and accessibility of screens and unhealthy food' cluster). The second cluster included snack and SSB rules, screen-time rules and sports rules ('diet- and activity-related rules'

cluster). The third cluster combined a low availability of snacks and SSBs with a low accessibility of snacks and SSBs ('low availability of unhealthy food' cluster). The fourth cluster included parental modelling of healthy eating, as well as low parental sedentary modelling, low parental snack intake and high accessibility of PA equipment ('diet- and activity-related positive modelling' cluster). The final cluster combined high parental sports days and high parental fruit intake with positive PA modelling ('positive modelling on sports and fruit' cluster). The five parenting practice clusters explained 32.0% of the variance in the original items. Cluster 1 and 2 were negatively correlated (r=-0.16), while cluster 2 and 4 (r=0.17) and 4 and 5 (r=0.12) were positively correlated. The remaining combinations of clusters were not related (r<0.10).

Table 5.2 Component loadings of principal component analysis on diet- and activity-related parenting practices (n=1059, missings listwise)

Parenting practices	Cluster 1: High visibility and accessibility of screens and unhealthy food	Cluster 2: Diet- and activity-related rules	Cluster 3: Low availability of unhealthy food	Cluster 4: Diet- and activity-related positive modelling	Cluster 5: Positive modelling on sports and fruit
SSB visibility	**0.768**	0.100	-0.091	0.050	0.028
Snack visibility	**0.736**	0.116	-0.145	0.026	0.023
Healthy eating policies	**-0.496**	0.137	-0.262	0.160	0.077
Screen equipment availability in bedroom	**0.440**	-0.068	0.075	0.046	-0.148
Screen equipment accessibility	0.329	-0.180	-0.128	-0.224	0.059
Availability of PA equipment and play spaces	-0.320	0.033	-0.213	0.000	0.249
Parental SSB intake	0.250	-0.039	-0.222	-0.148	-0.191
Snack rules	0.049	**0.753**	-0.099	-0.117	-0.030
SSB rules	-0.007	**0.734**	-0.057	-0.016	-0.038
Screen time rules	-0.036	**0.698**	0.068	-0.083	-0.006
Sports rules	-0.111	**0.426**	-0.126	0.016	0.167
Active transport rules	0.040	0.347	-0.215	0.193	-0.013
PA policies	0.140	0.297	0.132	0.084	0.272
Parental active commuting days	0.022	0.187	0.086	-0.022	-0.028
Snack availability	-0.086	0.000	**-0.674**	-0.022	-0.005
SSB availability	0.079	-0.036	**-0.649**	0.021	-0.106
SSB accessibility	**0.478**	-0.043	**-0.513**	0.038	-0.016
Snack accessibility	**0.424**	0.032	**-0.510**	-0.053	0.044
Healthy eating role modelling	-0.080	-0.015	-0.003	**0.604**	0.030
Sedentary behaviour role modelling	0.090	-0.118	-0.068	**-0.564**	0.287
Parental snack intake	-0.078	0.097	-0.349	**-0.462**	-0.110
PA equipment accessibility	0.004	-0.046	-0.243	**0.403**	0.218
PA equipment visibility	0.063	-0.067	-0.038	0.384	0.021
Parental PA days apart from active commuting and sports	0.012	-0.023	-0.031	0.373	0.065
Parental screen days	0.028	-0.107	-0.224	-0.361	0.108
Screen equipment visibility	0.168	-0.117	0.045	-0.226	0.216
Parental sports days	-0.116	0.010	0.094	-0.207	**0.547**
PA role modelling	-0.081	0.002	0.002	0.193	**0.541**
Parental fruit intake	-0.079	0.129	0.195	0.027	**0.445**
Fruit availability	-0.166	0.039	-0.212	0.011	0.358
Fruit accessibility	0.079	-0.165	-0.136	0.139	0.330
Fruit rules	0.118	0.268	0.178	0.154	0.316
Fruit visibility	0.274	0.010	0.253	0.002	0.283

Note: PA: physical activity; SSB: sugar-sweetened beverage
Data printed **bold** indicate absolute component loadings larger than 0.4 (= part of the component)
Variance explained by component 1 = 10.6%; variance explained by component 2 = 6.4%; variance explained by component 3 = 5.7%; variance explained by component 4 = 5.0% and variance explained by component 5 = 4.3%

Results of the regression analyses with the cluster scores as dependent variables (Table 5.3) showed that parents of non-western and western immigrant children, parents with a higher BMI, lower education and parents who used higher levels of psychological control scored significantly higher on the 'high visibility and accessibility of screens and unhealthy food' cluster. The 'diet- and activity-related rules' cluster was positively associated with a high parental education and with higher levels of behavioural control. Parents of non-western and western immigrant children as well as high-educated parents scored significantly higher on the 'low availability of unhealthy food' cluster. The 'diet- and activity-related positive modelling' cluster was positively associated with child BMI z-scores, negatively with parental BMI and psychological control, and positively with behavioural control. Finally, middle and high-educated parents and parents who used higher levels of behavioural control scored significantly higher on sports- and fruit-related positive modelling (cluster 5).

Table 5.3 Child and parental characteristics related to cluster scores (standardized regression coefficients backward regression), n=981[42]

	Cluster 1: High visibility and accessibility of screens and unhealthy food[43]	Cluster 2: Diet- and activity-related rules[44]	Cluster 3: Low availability of unhealthy food[45]	Cluster 4: Diet- and activity-related positive modelling[46]	Cluster 5: Positive modelling on sports and fruit[47]
Child characteristics:					
Ethnicity: non-western (1) vs native Dutch (0)	0.20***		0.23***		
Ethnicity: western (1) vs native Dutch (0)	0.10**		0.14***		
Child BMI z-score at baseline (2008)				0.08*	
Parental background characteristics:					
Parental BMI	0.12***			-0.10**	
Education: middle (1) vs low (0)	-0.17***				0.10*
Education: high (1) vs low (0)	-0.25***	0.15***	0.15***		0.20***
Parenting style dimensions:					
Psychological control	0.11***			-0.12***	
Behavioural control		0.14***		0.18***	0.10**

As shown in Table 5.4, partial correlations revealed that the cluster high in visibility and accessibility of screens and unhealthy food was negatively associated with child fruit intake, and positively with child snack intake, SSB intake and screen time. The diet- and activity-related rules cluster was positively associated with child fruit intake and child active transport, but negatively associated with child snack and SSB intake and child screen time. The cluster of low availability of unhealthy food showed negative associations with child snack and SSB intake as well as with child active transport and screen time. Positive parental modelling on dietary, PA and sedentary behaviour (cluster 4) showed positive associations with child fruit intake, child active transport and child outdoor playing, and negative associations with child snack and SSB intake and with child screen time. Positive parental modelling on sports and fruit was positively associated with child fruit intake and sports, as well as with child outdoor playing, and negatively with child SSB intake.

[42] child characteristics: gender, age, ethnicity, BMI z-score; parental characteristics: parental education level, parental BMI; parenting style dimensions;
* correlation is significant at the 0.05 level (2-tailed); ** correlation is significant at the 0.01 level (2-tailed);
*** correlation is significant at the 0.001 level (2-tailed)

[43] R^2=0.14

[44] R^2=0.03

[45] R^2=0.09

[46] R^2=0.07

[47] R^2=0.04

5.5 Discussion

This study investigated the clustering of parenting practices across the dietary and activity domain. We also examined whether these clusters are associated with child- and parent-related factors, and with child dietary and activity behaviours. As hypothesised, we found evidence for clustering *within* the dietary domain (e.g. clustering of SSB- and snack-related parenting practices) and *within* the activity domain (e.g. clustering of screen time rules and sports rules), which is in line with the few studies that reported on interdependencies between diet-related parenting practices[22,23] and between activity-related parenting practices[23]. A new finding is that parenting practices cluster *across* domains: four out of five clusters included both diet- and activity-related parenting practices. In addition, parenting practices cluster on the type of home environment: two clusters represented the physical home environment ('high visibility and accessibility of screens and unhealthy food' and 'low availability of unhealthy food'), one represented the political home environment (the 'diet- and activity-related rules' cluster) and the two parental modelling clusters represented the socio-cultural home environment. These new findings are very relevant in terms of broadening the scientific knowledge base on the topic of parenting practices.

In the present study, parental modelling was assessed in two ways: using role modelling scales of the HES[23] and parent's own behaviour. The diet- and activity-related positive modelling cluster (cluster 4) included two parental role modelling scales. They referred to parental healthy eating and sedentary behaviour *that was directly observed by the child*[23] (see example items in Table 5.1). This might imply the assessment of a more conscious way of parenting (a parenting practice) than when parental modelling is assessed by a parent's own behaviour.
The diet- and activity-related positive modelling cluster (cluster 4) was more likely to be found in parents of heavier children who are lighter themselves, and express more behavioural control and less psychological control. This suggests that this might be a parental strategy in response to their child's higher weight, particularly in normal weight parents. Similarly, diet- and activity-related positive modelling may be a stable parental strategy, reflecting normal weight parents' own way of living[62], based on health beliefs. Finally, it may not be a parental strategy aimed at healthy dietary and activity behaviour in children, but rather a more unconscious way of parenting based on, for example, habits formed in early life. Similarly, the 'diet- and activity-related rules' cluster (cluster 2) might be a parental strategy based on health beliefs, but rule setting in the dietary and activity domain could also be part of a broader parental context of rule setting, based on, for example, parenting beliefs of strictness and involvement. This is supported by the finding that cluster 2 was positively related to behavioural control, which is an indicator of parental involvement.

Table 5.4 Associations between clusters of diet and activity-related parenting practices and child dietary and activity behaviours (partial correlation coefficients), n=1013[48]

Cluster	Child fruit intake	Child snack intake	Child SSB intake	Child active transport to school	Child outdoor playing	Child sports participation at a sports club	Child screen time
1: High visibility and accessibility of screens and unhealthy food	-0.08*	0.07*	0.10**	-0.04	-0.01	0.01	0.11**
2: Diet- and activity-related rules	0.08**	-0.08*	-0.12***	0.15***	0.02	0.03	-0.11**
3: Low availability of unhealthy food	0.06	-0.19***	-0.11***	-0.09**	-0.01	-0.05	-0.11**
4: Diet- and activity-related positive modelling	0.11***	-0.26***	-0.15***	0.20***	0.14***	0.01	-0.19***
5: Positive modelling on sports and fruit	0.30***	-0.04	-0.07*	0.05	0.12***	0.16***	0.03

Note: SSB: sugar-sweetened beverage

There is evidence that parental education level indicates a broader parental context in which parenting practices operate[7,63]. A non-supportive parental context might be reflected in cluster 1, the unhealthy cluster of making screens and unhealthy food visible and accessible at home, which was more likely to be found in low-educated parents, but also in minority groups, parents with a higher BMI and parents who use more psychological control (all found to be associated with a higher child weight and/or unhealthy lifestyle (e.g., [15,56,64]). In contrast, healthy clusters are generally more likely to be found in high(er)-educated parents. These findings are consistent with the well-established relationship between socioeconomic position and health, stating that the socioeconomically better-off do better on most measures of health status[65]. Our findings also suggest that low-educated parents are an important target group for intervention development aimed at improving clustered parenting practices. However, because of the explorative nature of our study, the results cannot yet be translated into far reaching implications for public health. Before interventions can be developed, more studies are needed to elucidate how clusters of parenting practices arise (e.g. whether execution of parenting practices is a deliberate or a more unconscious process, whether parents adapt their practices or not and based on which indicators) and how they can be influenced, especially in low-educated parents. Apart from individual factors (e.g. a lack of knowledge and skills about parenting or a lack of health consciousness), exploring the social context of low-educated parents may elucidate why they have less-favourable parenting practices than high-educated parents. Ways in which the social context of low-educated parents can place constraints on their individual choices is by shaping social norms and by providing less opportunity to engage in healthy behaviours. This may influence their own health behaviour[66], but also their health-related parenting practices. For example, group norms may ensure that low-educated parents pursue other values than health values, and because of neighbourhood safety problems, they may not encourage their children to play outside. To better understand parenting practices in low-educated parents, future studies should explore the influence of the social context.

To indicate the magnitude of their relevance, we examined whether the five clusters were related to child dietary and activity behaviour. We found that the separate clusters were related to both child dietary behaviour and child activity behaviour and, overall, in the hypothesised direction: the 'high visibility and accessibility of screens and unhealthy food' cluster was positively related to obesity-inducing behaviour (i.e. child snack intake, SSB intake and screen time) and negatively to obesity-reducing behaviour (i.e. child fruit intake), while the remaining healthy clusters were negatively related to obesity-inducing behaviour and positively to obesity-reducing behaviour. The strongest associations were found in the positive modelling clusters. Diet- and activity-related positive modelling was found to have the strongest associations with child snack intake, SSB intake, active transporting to school, outdoor playing and screen time, while positive modelling on sports and fruit was strongest related to child fruit intake and child sports participation. This underlines the potential of a clustered approach of parental modelling in the dietary and activity domain as a parental strategy to (subtly) improve children's dietary and activity behaviour. However, in low-educated parents this implies changing their own behaviour, which may be harder to accomplish than, for example, introducing parental rules in the dietary and activity domain. As the diet- and activity-related rules cluster was positively related to cluster 4, setting rules might eventually be an indirect way to change parental role modelling in a positive way.

Our study has the strength of combining diet- and activity-related parenting practices, higher-order parental factors and child dietary and activity behaviours in one study, which is exceptional in this field of research[18]. In addition, our clustering approach, which is new in studies on parenting practices, seems to have potential as a starting point for interventions to assist parents in changing their child's dietary and activity behaviour. Such interventions could be more efficient because of the synergic effect of a clustered approach. Nevertheless, some limitations should be mentioned. First, diet- and activity-related parenting practices were reported by the primary caregiver (mostly the mother), while research shows that, for example, for child PA paternal and not maternal role modelling is the main determinant[20]. Future studies should (ideally) include both parents to examine whether fathers and mothers have a differential influence on child dietary and activity behaviour. Second, there was low variability in responses for some parenting practices, e.g. fruit availability and accessibility, which might explain why these parenting practices are not part of a cluster. However, this could also be explained by analytical choices, namely choosing a cut-off point for component loadings of 0.4. Although this is in line with recommendations[67], cut-off points in previous studies ranged from 0.2 to 0.6[68]. If, for example, a cut-off point of 0.3 had been used in our study, fruit availability, fruit accessibility as well as fruit rules would have been included in the positive modelling on sports and fruit cluster. Third, Cronbach's alpha values of some of our parenting practices scales were relatively low. Although a Cronbach's alpha ≥.6 is generally considered acceptable[69], some

[48] Adjusted for child characteristics (gender, age, ethnicity and BMI z-score at baseline) and parental characteristics (parental education level, parental BMI at baseline and parenting style dimensions). Child dietary and activity behaviours were assessed in 2009 (=second assessment).

authors advocate different cut-off points. Finally, child dietary and activity behaviours were proxy reports of primary caregivers, which may evoke social desirability bias and lead to overestimation of obesity-reducing behaviours and underestimation of obesity-inducing behaviours[70-72]. In addition, child activity behaviours were reported in days per week which may not accurately reflect behaviour duration or energy expenditure, especially for outdoor playing and screen time.

Conclusions

The current study shows that parenting practices cluster on the type of home environment (i.e. physical, political and socio-cultural) while cutting across the dietary and activity domain. Several parental characteristics were related to the separate clusters, of which parental education level could be seen as an indicator of a broader parental context in which the clusters of parenting practices operate. A low parental education level was associated with the only unhealthy cluster, while a high(er) education level was associated with healthy clusters. Separate clusters were related to both child dietary behaviour and child activity behaviour in the hypothesised directions, indicating the relevance of the clusters in influencing child behaviour. Interventions that focus on clusters of parenting practices to assist parents, especially low-educated parents, in changing their child's dietary and activity behaviour seems justified, but more studies are needed to further elucidate how clusters arise and how they can be influenced.

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chapter 6

associations

Associations of children's appetitive traits with weight and dietary behaviours in the context of general parenting

Associations of children's appetitive traits with weight and dietary behaviours in the context of general parenting

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6.1 Abstract

Background
Individual variations in child weight can be explained by genetic and behavioural susceptibility to obesity. Behavioural susceptibility can be expressed in appetite-related traits, e.g. food responsiveness. Research into such behavioural factors is important, as it can provide starting points for (preventive) interventions.

Objectives
To examine associations of children's appetitive traits with weight and with fruit, snack and sugar-sweetened beverage intake, and to examine whether parenting style interacts with appetite in determining child weight/intake.

Methods
Data were used from 1275 children participating in the INPACT study in 2009-2010, with a mean age of 9 years in 2009. Their height and weight were measured to calculate body mass index (BMI). Parents completed a questionnaire to measure children's appetitive traits, children's dietary intake and parenting style. Child BMI z-scores, fruit, snack and sugar-sweetened beverage intake were regressed on appetitive traits. Moderation by parenting style was tested by adding interaction terms to the regression analyses.

Results
Food-approaching appetitive traits were positively, and food-avoidant appetitive traits were negatively related to child BMI z-scores and to child fruit intake. There were no or less consistent associations for snack and sugar-sweetened beverage intake. Authoritative parenting voided the negative association between food fussiness and fruit intake, while neglecting parenting strengthened the positive association between food-approaching appetitive traits and weight.

Conclusions
Early assessment of appetitive traits could be used to identify children at risk for overweight. As parenting style can moderate the associations between appetitive traits and weight/intake in a favourable way, parents are a promising target group for preventive interventions aimed at influencing the effect of appetitive traits on children.

6.2 Introduction

The prevalence of overweight and obesity among children has increased rapidly over the last decades[1]. On the population level, part of the explanation can be found in the obesogenic environment[2], which is characterized by constant availability of cheap energy-dense food and advancement of sedentary life-styles. However, the changed environment cannot explain individual variations in body weight in children, which exist and will persist. There is evidence for genetic susceptibility[2,3] and behavioural susceptibility to obesity, the latter reflected in appetite-related traits[4]. Experimental studies using behavioural tests, as well as large-scale observational studies using questionnaires, show that food-approaching appetitive traits (e.g. food responsiveness) are positively associated with child overweight, while food-avoidant appetitive traits (e.g. food fussiness) are negatively associated with child overweight[5–7]. Observational studies have shown that these associations were graded: individual variations in appetite were related to body weight in general and not exclusively to overweight or obesity[8–15]. This implies that early assessment of appetitive traits could identify 'food approaching' children, who have a higher risk of becoming obese and for whom prevention interventions could be developed to modify their eating style.

Observational studies on children's appetitive behaviours have used various instruments, including the Dutch Eating Behaviour Questionnaire (DEBQ)[10], the Children's Eating Behaviour Inventory (CEBI)[16] and the Child Eating Behaviour Questionnaire (CEBQ)[17]. These studies almost exclusively examined associations with child (over)weight[4–6,9,11–13,16,18–20] and seldom with child dietary behaviours[21–24]. However, to understand the mechanisms by which appetitive traits affect child weight it is important to include them.

Some studies on children's appetitive behaviours incorporated parental feeding practices [18,25,26]. Insight into such parental influences on appetite is promising for intervention development targeted at parents, as parents play a key role in shaping the food home environment[27,28], e.g. by creating availability of and accessibility to foods, by setting norms and values, and by their own behaviour (modelling). However, parents also influence their child's behaviour in a more general way by expressing a certain parenting

style, which generates the environmental and emotional context for child rearing[29]. A recent review showed that children raised in authoritative homes, characterized by high involvement and high control, ate more healthy and had lower body mass index (BMI) levels than children raised in authoritarian, permissive or neglectful homes[30]. The review also mentioned findings from moderation studies, indicating that parenting style has a differential impact on children's weight-related outcomes, depending on (for example) child characteristics. This is in line with the ecological systems theory[31] and implies that the impact of children's appetitive traits on dietary intake and weight may differ depending on the parents' parenting style. Because authoritative parenting is seen as a protective factor for unhealthy eating and overweight, it may also affect the relationship between children's appetitive trait and weight/intake in a favourable way, e.g. by attenuating or voiding the positive relationship between a food-approaching appetite and weight.

Studies on heritability of appetitive behaviours support a strong genetic component[32], and appetite can be seen as a stable personality trait[33]. This suggests that appetitive traits influence child intake/weight, rather than that they are consequences of a child's intake/weight. This observation is supported by a limited number of longitudinal studies in which baby's appetitive traits were prospectively related to weight gain (see e.g.[34]). To our knowledge, no prospective studies have incorporated child intake to explore whether the strength of associations changes over time, and whether child appetite traits predict changes in child intake.

The present study examines cross-sectional and longitudinal (one-year follow-up) associations of children's appetitive traits with weight and with dietary behaviours in a large, community-based sample of children aged 8-11 years. We chose to include obesity-reducing, i.e. child fruit intake, as well as obesity-inducing dietary behaviours, i.e. child snack and sugar-sweetened beverage (SSB) intake[35]. We also examined whether the potential associations between children's appetite and weight/intake are moderated by parenting style. It was hypothesized that 1) food-approaching traits would positively relate to child fruit intake, snack intake, SSB intake and weight, while food-avoidant traits would negatively relate to these measures, and that 2) the potential associations would be moderated by authoritative parenting in a favourable way; e.g. authoritative parenting would attenuate or void the potential positive association between food responsiveness and child snacking, and the potential negative association between food fussiness and fruit intake.

6.3 Methods

Study design, participants and procedure, including ethics statement

Data for this study were retrieved from the longitudinal IVO Nutrition and Physical Activity Child cohorT (INPACT), for which approval was obtained from the Ethical Committee of the Erasmus MC (University Medical Center Rotterdam). INPACT is an observational study (initiated in 2008) focusing on modifiable determinants of overweight in the home environment of children in the Netherlands aged 8-12 years.
The study included four assessments, in which qualified research assistants measured the children's height and weight at school, and primary caregivers completed a questionnaire at home. Questionnaires recorded data on dietary intake of the child, child appetitive behaviours, and potentially relevant home environmental factors, including the primary caregiver's dietary intake, parenting style and socio-demographic variables. Assessments took place with a one-year time interval, and started in the autumn of 2008 (baseline).
INPACT was conducted among primary school children in southern Netherlands (Eindhoven area).
In recruiting the schools in 2008, we collaborated with the Municipal Health Authority for Eindhoven and surrounding area (GGD Brabant-Zuidoost). The Municipal Health Authority invited all general primary schools in their service area to participate in the INPACT study. Of the 265 schools invited, 91 took part. The response rate from rural and urban schools was equal. The primary caregivers of third-grade students (aged ± 8 years) were invited to participate in the cohort study, together with their child. Of the 2948 parent-child dyads invited, 1839 (62.4%) gave written informed consent to participate in the INPACT study for four years.
The present study was based on data from 2008 (baseline), 2009 (second assessment) and 2010 (third assessment). Socio-demographic variables and general parenting style were measured at baseline.
The child's appetitive behaviour was measured in 2009, while child fruit intake, snack intake, SSB intake and weight were measured in 2009 and 2010. Parent-child dyads who completed the parent questionnaires from baseline to 2010, and had valid child height and weight data in 2009 and 2010 were included in the present study, resulting in 1275 parent-child dyads (69% of the original cohort). Logistic regression analyses on selective dropout from baseline to 2010 showed that parent-child dyads who were not native Dutch dropped out more often. There was no selective dropout regarding child age/gender and parental education level.

Sample characteristics

At baseline (n=1839), 7% of the children were underweight, 79% had a normal weight and 14% were overweight, of which 3% obese. The prevalence of overweight and obesity was similar to Dutch prevalence rates among primary school children[36]. The age of the children was 8 (77%) or 9 (20%) years (range 7-10, mean=8.2, SD=0.5 years). Boys (50.5%) and girls (49.5%) were represented in almost equal numbers. Of all children, 17% were from a non-Dutch ethnic background with one or both parents born abroad, of which 9% from non-western countries and 8% from western countries. Of all primary caregivers, 21% had finished education at a low level, 45% at a medium level, 32% at a high level, and 2% at a non-specified level (see Measures section for classification system used). Of the primary caregivers 1% was underweight, 66% had a normal weight and 33% were overweight, of which 9% were obese.

Measures

Children's appetitive behaviour

Appetitive behaviour was measured using a validated Dutch translation[12] of the Children's Eating Behaviour Questionnaire (CEBQ), designed by Wardle et al.[17]. This 35-item measure assessed eight appetitive traits: food responsiveness (FR), enjoyment of food (EF), emotional overeating (EOE) and desire to drink (DD) as 'food-approaching' appetitive traits, and satiety responsiveness (SR), slowness in eating (SE), emotional undereating (EUE) and food fussiness (FF) as 'food-avoidant' appetitive traits.

Table 6.1 Descriptives and scale information of child eating behaviours and parenting style dimensions

Category	Concept	Measurement year (n)	# items: example item	Answering scale[49]	Cronbach's α[50]	Mean (SD)	Range of scores
Child Eating Behaviours	Food Responsiveness	2009 (1547)	5: 'Given the choice, my child would eat most of the time.'	A	0.79	1.9 (0.7)	1.0 to 5.0
	Enjoyment of Food	2009 (1547)	4: 'My child enjoys eating.'	A	0.79	3.4 (0.7)	1.0 to 5.0
	Emotional Overeating	2009 (1547)	4: 'My child eats more when anxious.'	A	0.75	1.6 (0.6)	1.0 to 4.8
	Desire to Drink	2009 (1547)	3: 'My child is always asking for a drink.'	A	0.83	2.0 (0.7)	1.0 to 5.0
	Satiety Responsiveness	2009 (1547)	5: 'My child gets full before his/her meal is finished.'	A	0.73	2.6 (0.6)	1.0 to 4.8
	Slowness in Eating	2009 (1547)	4: 'My child eats slowly.'	A	0.80	2.5 (0.8)	1.0 to 5.0
	Emotional Undereating	2009 (1547)	4: 'My child eats less when s/he is upset.'	A	0.78	2.3 (0.8)	1.0 to 5.0
	Food Fussiness	2009 (1547)	6: 'My child decides that s/he does not like food, even without tasting it.'	A	0.89	2.8 (0.9)	1.0 to 5.0
						Sum score (SD)	
Parenting style dimensions	Support	2008 (1839)	7: 'When my child gets a low grade in school, I offer to help him/her'	B	0.71	11.0 (2.4)	1.7 to 14.0
	Behavioural control	2008 (1839)	7: 'I try to know where my child goes after school'	B	0.72	9.5 (4.2)	-5.0 to 14.0
	Psychological control	2008 (1839)	8: 'I make my child feel guilty when he/she gets a low grade in school'	B	0.72	-6.7 (4.1)	-16.0 to 16.0

The original measure, as well as the Dutch translation, proved to possess adequate to good internal consistency[12,17]. The CEBQ is generally regarded as the most comprehensive instrument to assess children's eating styles, and correlates well with behavioural tests designed to measure such appetitive traits[6]. Missing data on the CEBQ items (1.6% at the highest) were imputed using the mean value of respondents without a missing value. Table 6.1 presents additional information on number of items, example items, response options, Cronbach's alphas, and means and standard deviations (SDs) of the appetitive behaviours.

Children's intake

Child fruit, snack and SSB intake were measured with a questionnaire that was based on validated Food Frequency Questionnaires[37,38]. The primary caregivers reported how many days in a normal week their children consumed 1) fruit (fresh, bottled and/or canned; no juice), 2) savoury snacks (e.g. potato crisps, peanuts and sausage rolls) in between meals, 3) sweet snacks (e.g. candies, chocolates and candy bars) in between meals, 4) cake or large biscuits in between meals, and 5) SSBs. Answering categories ranged from 'none or less than 1 day a week' to '7 days a week'. Additionally, they reported the number of servings consumed by their children on such a day. For fruit, answering categories ranged from '0 pieces per day' to 'more than 3 pieces per day', by increments of half a piece of fruit. Reported consumption of more than 3 pieces per day (n=12) was recoded as 4 pieces. For savoury snacks, sweet snacks and cake or large biscuits, answering categories ranged from 0 to 10 servings a day. For SSBs, answering categories ranged from '0 glasses per day' to 'more than 5 glasses per day', by increments of half a glass. It was specified that one glass equals 200 ml; one can equals 330 ml or 1.5 glasses; one bottle equals 500 ml or 2.5 glasses. Reported consumption of more than 5 glasses per week (n=7) was recoded as 6 glasses. Total child fruit and SSB intake were expressed in servings per week and calculated by multiplying frequency and quantity. Total child snack intake was also expressed in servings per week and calculated by multiplying frequencies of savoury snacks, sweet snacks and cakes with their corresponding quantities, and summing these scores. Missing values on child fruit, snack and SSB intake were not imputed, because of the low number of missing values (1.0% at the highest, for child snacking).

Children's weight

Child BMI was based on the child's height and weight: i.e. weight (kg)/height $(m)^2$, as measured by the qualified research assistants. Children were measured at school according to standard procedures in light

[49] Answering scale A: never (1) to always (5); answering scale B: completely disagree (-2) to completely agree (+2).

[50] The reliability of the child eating behaviour scales was assessed by calculating Cronbach's alphas (internal consistency) and (average) corrected item-total correlations, which indicate the degree to which an individual item relates to the total scale score. Corrected item-total correlations above 0.30 are regarded as good and below 0.15 as unreliable. Average corrected item-total correlations in our study were good and ranged from 0.56 to 0.71. None of the corrected item-total correlations was below 0.3 (lowest value was 0.37 for a Satiety Responsiveness-item).

clothing without shoes, to the nearest 0.1 kg and 0.1 cm. BMI z-scores were calculated[39] based on age and gender-specific values from the 1997 National Growth Study in the Netherlands[40].

Parenting style

Parenting style was measured using the Dutch translation[41] of an instrument based on earlier work by Steinberg et al.[42,43], which is used in many studies worldwide[41,44-46]. This 22-item measure assessed three parenting-style dimensions: support, behavioural control and psychological control (see Table 6.1 for details). Based on these dimensions, we constructed five parenting styles by dichotomising the sample on each dimension (median-split) and by examining the three dimensions simultaneously[47,48]: the authoritative (high support, high behavioural control, low psychological control), permissive (high support, low behavioural control, low psychological control), authoritarian (low support, high behavioural control, low psychological control), rejecting (low support, low behavioural control, high psychological control) and neglecting (low support, low behavioural control, low psychological control) parenting style.

Confounders

Measured confounders included child's gender, age and ethnic background, parental education level, parental fruit, snack and SSB intake, and parental BMI. To assess the child's ethnic background, the primary caregiver reported the country of origin of both parents. According to standard procedures of Statistics Netherlands[49], a child was classified as native Dutch if both parents were born in the Netherlands, as a western immigrant if at least one parent was born outside the Netherlands but inside Europe (including former Yugoslavia and the Soviet Union), North America, Oceania, Indonesia or Japan, and as a non-western immigrant if at least one parent was born in Turkey, Africa, Latin America or Asia. The primary caregiver also reported his/her highest level of education. According to international classification systems, parental education level was defined as low (primary school and lower vocational/lower general secondary education), medium (intermediate vocational education, higher general secondary education and university preparatory), high (higher vocational education and university), or non-defined. Parental fruit, snack and SSB intake were measured and calculated in the same way as child fruit, snack and SSB intake. To assess parental BMI, the primary caregiver reported his/her own height and weight, and that of his/her partner. He/she also reported whether he/she and the partner were the child's biological parents. Maternal and paternal BMI (for biological parents only) were calculated on the basis of their answers ($n_{maternal\ BMI}$ = 1204, 5.6% missing; $n_{paternal\ BMI}$ = 1058, 17.0% missing). To maintain statistical power, missing values on maternal and paternal BMI were imputed using the group mean.

Strategy for analyses

To describe the study population, we computed means, SDs and/or proportions for the socio-demographic variables, CEBQ scales, parenting style dimensions, child dietary behaviours and child BMI z-scores. Separate linear regression analyses were performed to establish the longitudinal relationship between CEBQ scales and child intake/child BMI z-scores in 2010, adjusted for child age, gender, ethnic background and parental education level. In models with child intake as dependent variable (e.g. child fruit consumption), we also controlled for child BMI in 2009 and parental intake in 2010 (i.e. parental fruit consumption). In models with child BMI z-scores as dependent variable, we controlled for the socio-demographic variables and parental BMI in 2010. In these models, underweight children in 2009 (91 of 1275 children) were excluded to prevent distortion of the results (for underweight children, an increase in BMI would be favourable, while it would be unfavourable for normal, overweight and obese children). International cut-off scores were used to determine whether a child was underweight[39].

To determine whether CEBQ scales predicted changes in child intake and BMI z-scores between 2009 and 2010, we repeated the linear regression analyses, additionally adjusted for child intake in 2009 and child BMI z-scores in 2009, respectively. Finally, to explore whether the longitudinal associations between CEBQ scales in 2009 and child intake/weight in 2010 were similar to cross-sectional associations, we also performed cross-sectional linear regression analyses (CEBQ scales and child intake/weight in 2009), applying the same adjustment procedure as in the longitudinal analyses.

In the final set of regression analyses we examined whether parenting style moderated significant longitudinal associations between CEBQ scales and (changes in) child intake/child weight. Moderation was tested by adding interaction terms to the regression analyses. If interaction terms were significant ($p<0.05$), stratified analyses were conducted.

All analyses were conducted using SPSS version 18.0.

6.4 Results

CEBQ and parenting style dimensions are described in Table 6.1. Children had an average weekly fruit consumption of 7.3 (SD=4.2) pieces in 2009 and 6.9 (SD=4.3) pieces in 2010, an average weekly snack intake of 9.8 (SD=5.8) pieces in 2009 and 9.9 (SD=6.1) pieces in 2010, an average weekly SSB intake of 9.2 (SD=8.2) glasses in 2009 and 8.9 (SD=8.2) glasses in 2010, and an average BMI z-score of 0.2 (SD=0.9) in both 2009 and 2010 when underweight children were excluded.

Results of the regression analyses with child intake/child BMI z-scores in 2010 as dependent variable (Table 6.2, column 'β_{2010}') showed that all food-approaching subscales were positively associated with child BMI z-scores. The food-approaching subscales FR and EF were positively associated with child fruit intake, but EF was negatively associated with child snack intake. DD was positively associated with child snack intake. All food-avoidant subscales were negatively associated with child BMI z-scores and child fruit intake, but SR was positively associated with child snacking and SE positively associated with child SSB intake. Results of the regression analyses with child intake/child BMI z-scores in 2009 as dependent variable (Table 6.2, column 'β_{2009}') were generally similar to those for 2010. Results of regression analyses with child intake/child BMI z-scores in 2010 as dependent variable in which we additionally adjusted for child intake/child BMI z-scores in 2009 (Table 6.2, column '$\beta_{2010\text{-}2009}$'), showed that EF predicted a small increase in child fruit consumption between 2009 and 2010, and that SE predicted a small increase in child SSB intake between 2009 and 2010.

Table 6.2 Associations (standardized regression coefficient) of child eating behaviours (2009) with child fruit intake, snack intake, SSB intake and BMI z-scores in 2009, in 2010 and in 2010, controlled for 2009 value

	Child fruit intake[51]			Child snacking[52]			Child SSB intake[53]			Child BMI z-scores[54]		
	β_{2009}[55]	β_{2010}[56]	$\beta_{2010\text{-}2009}$[57]	β_{2009}[55]	β_{2010}[56]	$\beta_{2010\text{-}2009}$[57]	β_{2009}[55]	β_{2010}[56]	$\beta_{2010\text{-}2009}$[57]	β_{2009}[58]	β_{2010}[59]	$\beta_{2010\text{-}2009}$[60]
Food responsiveness (FR)	0.06*	0.06*	0.02	0.05	0.03	0.03	0.03	0.00	-0.01	0.33***	0.31***	0.00
Enjoyment of food (EF)	0.13***	0.15***	0.06**	-0.06*	-0.06*	-0.02	-0.01	-0.02	-0.02	0.17***	0.17***	0.01
Emotional overeating (EOE)	-0.01	-0.03	-0.03	0.07**	0.03	0.01	0.01	-0.02	-0.01	0.18***	0.18***	0.01
Desire to drink (DD)	-0.08**	-0.05	0.01	0.09***	0.07*	0.02	0.07**	0.04	0.03	0.11***	0.10***	0.00
Satiety responsiveness (SR)	-0.17***	-0.12***	0.00	0.09***	0.06*	0.00	0.05	0.04	0.03	-0.17***	-0.16***	0.01
Slowness in eating (SE)	-0.10***	-0.08**	-0.01	0.05	0.02	-0.02	0.02	0.07**	0.07**	-0.15***	-0.13***	0.02
Emotional undereating (EUE)	-0.07**	-0.07**	-0.02	0.01	-0.01	-0.01	0.01	-0.01	0.00	-0.09**	-0.09**	-0.01
Food fussiness (FF)	-0.16***	-0.14***	-0.02	0.05	0.05	0.02	0.03	0.04	0.03	-0.08**	-0.08**	0.00

Note: SSB, sugar-sweetened beverage; β, standardized regression coefficient;
Correlation is significant at the: *0.05 level (two-sided), **0.01 level (two-sided), *** 0.001 level (two-sided).

Moderation analyses and subsequent stratified analyses revealed that the negative associations of FR, EOE and DD with child BMI z-scores one year later were strengthened when parents had a neglecting parenting style (see Figure 6.1a-c). The negative association between FF and child BMI z-scores was only present in children of permissive parents (Figure 6.1d). The negative association between FF and child fruit consumption was not present in children of authoritative parents, and the negative association between EUE and child fruit consumption was not present in children of permissive parents (Figure 6.1e and 6.1f).

[51] n=1248 for 2009, n=1245 for 2010 and n=1244 for 2010-2009; n deviates from sample size in table 2 because of missing values on control variables
[52] n=1230 for 2009, n=1233 for 2010 and n=1217 for 2010-2009; n deviates from sample size in table 2 because of missing values on control variables
[53] n=1248 for 2009, n=1239 for 2010 and n=1238 for 2010-2009; n deviates from sample size in table 2 because of missing values on control variables
[54] n=1163 for 2009, 2010 and 2010-2009; n deviates from sample size in table 2 because of missing values on control variables; underweight children in 2009 were excluded from analyses
[55] models adjusted for age, gender, SES, ethnicity, child BMI and parental fruit/snack/SSB intake in 2009; β = standardized regression coefficient
[56] models adjusted for age, gender, SES, ethnicity, child BMI in 2009 and parental fruit/snack/SSB intake in 2010
[57] models adjusted for age, gender, SES, ethnicity, child BMI in 2009, parental fruit/snack/SSB intake in 2009 and 2010, and child fruit/snack/SSB intake in 2009
[58] models adjusted for age, gender, SES, ethnicity and parental BMI in 2009
[59] models adjusted for age, gender, SES, ethnicity and parental BMI in 2010
[60] models adjusted for age, gender, SES, ethnicity, parental BMI in 2009 and 2010, and child BMI z-scores in 2009

6.5 Discussion

This study examined cross-sectional and longitudinal associations between children's appetitive traits and fruit intake, snack intake, SSB intake and weight in a large, community-based sample of children in the Netherlands aged 8-11 years. It also examined whether parenting style interacted with appetite in determining child weight/intake. It replicated previous findings of positive, graded associations between food-approaching CEBQ scales and weight, and negative, graded associations between food-avoidant CEBQ scales and weight[9,11–15], with the weakest associations for the EUE and FF scales.

To our knowledge, only four observational studies have related children's appetitive behaviours to child intake, of which two used the DEBQ[22,23] and two the CEBQ[21,24]. These studies broadly support the hypothesized positive associations between food-approaching appetitive traits (external eating, desire to drink and enjoyment of food) with obesity-inducing behaviours (intake of SSBs and sweets) and obesity-reducing behaviours (intake of fruits and vegetables), as well as the hypothesized negative associations between food-avoidant appetitive traits (restrained eating and food neophobia) with obesity-inducing and obesity-reducing behaviours. We replicated these findings for fruit, i.e. fruit intake appeared to be positively related to food responsiveness and enjoyment of fruit, and negatively to all food-avoidant scales. However, for SSB and snack intake there were no or less consistent associations.

Because appetitive traits are known to possess a strong genetic component[32] and can be seen as stable personality traits[33], we do not expect a reverse influence of child intake/weight on appetitive behaviours. However, there is evidence that almost all parents respond to children's appetitive traits [26] and that food responsiveness and maternal restriction are positively associated[25]. Thus, parents of food-approaching children may restrict their children on snack and SSB intake (and not on fruit intake), resulting in none

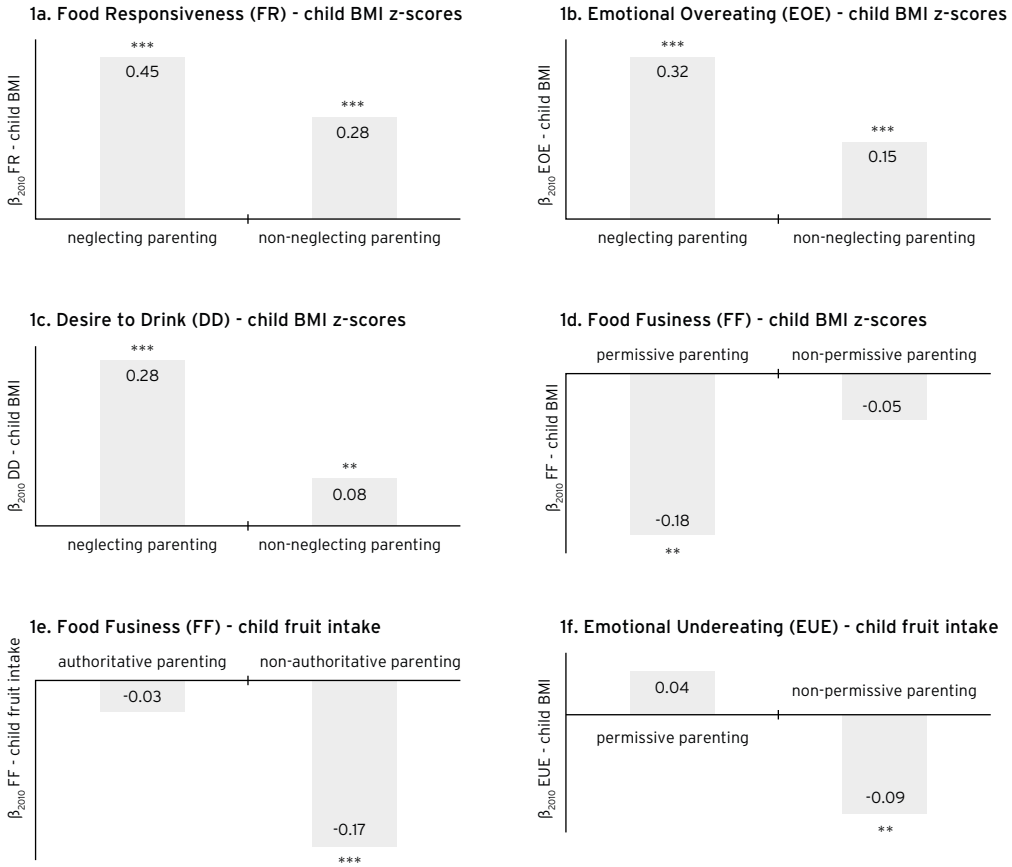

Figure 6.1 Significant moderating effects of parenting styles on the longitudinal associations between CEBQ subscales and child intake/child BMI z-scores in 2010[61]

[61] Moderation testing was performed on significant longitudinal associations between CEBQ scales and (changes in) child intake/child weight (Table 2, column 'β_{2010}' and column '$\beta_{2010\text{-}2009}$').
$p_{\text{interaction term Figure 1a}}$=0.023; $p_{\text{interaction term Figure 1b}}$=0.082; $p_{\text{interaction term Figure 1c}}$=0.018; $p_{\text{interaction term Figure 1d}}$=0.068; $p_{\text{interaction term Figure 1e}}$=0.020; $p_{\text{interaction term Figure 1f}}$=0.038.
* correlation is significant at the 0.05 level (2-tailed); ** correlation is significant at the 0.01 level (2-tailed); *** correlation is significant at the 0.001 level (2-tailed).

or inconsistent associations between food-approaching appetite behaviours with snack and SSB intake, and positive associations with fruit intake. In addition, measurement errors may play a role in inconsistent (or lack of) findings regarding snack and SSB intake.

In general, diets rich in fruit are associated with a healthy body weight[50–52]; however, the food-approaching children in our study combined a higher fruit intake with a higher weight, which may indicate that these children have a greater appetite in general (also during meals) resulting in a higher total energy intake. Studies are needed in which dietary behaviours as well as total energy intake are accurately measured, to improve our understanding of e.g. the mechanisms by which appetitive traits affect weight.

Our results show that child appetitive behaviours that were associated with child intake/weight in 2009 were generally also associated with child intake/weight one year later, in 2010. However, the appetitive traits did not predict changes in child weight and hardly in child intake between 2009 and 2010; this might be explained by the follow-up period of one year, which may have been too short to express the potential gradual effect of appetitive traits on changes in child weight and intake. This explanation is supported by the finding that there was only a minimal change in average child weight and dietary behaviours between 2009 and 2010, and that almost all associations between appetitive traits and changes in child fruit, snack and SSB intake, were (although non-significant) in the same direction as the cross-sectional associations. However, another explanation is that the effect of appetitive traits on food intake/weight does not cumulate over time. Given the high tracking for weight, it is likely that food-approaching children have been growing on a higher BMI percentile and remain at that level. To establish which of these two potential explanations is most valid, requires prospective studies with a longer follow-up period. Such studies would profit from the operationalization of research models in which child dietary behaviours are modelled as mediators of the effect of appetitive traits on weight development.

We hypothesized that authoritative parenting would moderate significant associations between children's appetite and intake/weight in a favourable way. This was supported by one finding: authoritative parenting appeared to reduce the negative effect of food fussiness on fruit consumption. We also found that neglecting parenting (characterized by low parental support and low behavioural and psychological control), strengthened the positive relation between food-approaching appetitive traits and weight. These findings underline the importance of acknowledging interaction between general parenting and child characteristics in explaining children's food intake/weight[30]. Our results also show that inconsistencies exist regarding the optimal parenting context for child food intake/weight. Such results are also reflected in previous studies that have examined interaction between general parenting and specific parenting (e.g. restrictive feeding practices) in explaining children's food intake and weight (see[30] for a review). The operation of moderation processes of general parenting indicates the importance of distal determinants of behaviour, that, to date, have typically been operationalized as confounders in causal chain determinants research. In contrast, we emphasize a contextual rather than causal chain orientation in examining effects of parenting on child food intake and weight.

Our findings, supported by a recent report that children are influenced by their parents' feeding practices[25], suggest that parents are able to influence their child's behaviour and weight, and can contribute to providing a supportive home environment for healthy child behaviour and weight. Parents of food-approaching children (i.e. children who are more vulnerable to the obesogenic environment) could help in preventing their child's obesogenic behavioural phenotype to be expressed in high intake and weight. More insight is needed in which parental factors are essential in shaping a healthy home environment. Apart from general parenting styles and parental feeding styles, feeding practices such as availability of healthy and unhealthy foods at home, parental modelling and healthy eating parental policies should be included in future studies as potential moderators.

Although our study has the strength of combining child appetitive traits, dietary intake, weight and parenting style in one study, which is exceptional in this field of research[53], some limitations should be mentioned. First, we measured child BMI objectively, whereas dietary behaviours were measured based on Food Frequency Questionnaires, reported by parents. This may evoke social desirability bias and lead to overestimation of fruit consumption and underestimation of snacks and SSB intake[54,55]. Had selective underreporting of snack and SSB intake indeed occurred (e.g. in food-approaching and overweight children) this would have resulted in an underestimation of the associations. Second, because our prospective study had a short follow-up period of one year and did not measure appetitive traits at both time points, the benefits of a longitudinal approach could not be fully exploited. Third, in the absence of normative data regarding parenting style dimensions, the parenting styles we constructed are relative (i.e. authoritative parents in our sample are authoritative compared to other parents in our sample). Finally, dropout analyses showed selective dropout on ethnicity; however, as this was not a main predictor and was controlled for, this probably had no effect on our results.

Conclusion

Food-approaching appetitive traits were positively, while food-avoidant appetitive traits were negatively associated with child BMI z-scores and fruit intake. There were no (or less consistent) associations between appetitive traits and snack or SSB intake. Early assessment of appetitive traits could be used to identify food-approaching children, who are more vulnerable to the obesogenic environment and susceptible to overweight. Authoritative parenting appeared to influence fruit consumption of fussy eaters in a favourable way, while neglecting parenting appeared to influence child weight in a negative way. This makes parents a promising target group for preventive interventions aimed at influencing the effect of appetitive traits on child weight and dietary intake. However, more prospective studies with accurate measures of child appetitive traits, dietary behaviours, BMI and parenting style are needed to improve our understanding of the mechanisms by which appetitive traits affect dietary intake and weight.

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chapter 7

clustering

Clustering of food and activity preferences in primary school children

Clustering of food and activity preferences in primary school children

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7.1 Abstract

This study examined clustering of food and activity preferences in Dutch primary school children. It also explored whether the preference clusters are associated with child and parental background characteristics and with parenting practices. Data were used from 1480 parent-child dyads participating in the IVO Nutrition and Physical Activity Child cohort (INPACT). Children aged 8-11 years reported their preferences for food (e.g. fruit, sweet snacks) and activities (e.g. biking, watching television) at school with a newly-developed, visual instrument designed for primary school children. Parents completed a questionnaire at home. Principal component analysis was used to identify preference clusters. Backward regression analyses were used to examine the relationship between child and parental characteristics with cluster scores. We found 1) a clustering of preferences for unhealthy foods and unhealthy drinks, 2) a clustering of preferences for various physical activity behaviours, and 3) a clustering of preferences for unhealthy drinks and sedentary behaviour. Boys had a higher cluster score than girls on all three preference clusters. In addition, physical activity-related parenting practices were negatively related to unhealthy preference clusters and positively to the physical-activity-preference cluster. The next step is to relate our preference clusters to child dietary and activity behaviours, with special attention to gender differences. This may help in the development of interventions aimed at improving children's food and activity preferences.

7.2 Introduction

Diets rich in fruit and vegetables and an active lifestyle are associated with important health protective effects, including protection against some types of cancer, cardiovascular diseases, type 2 diabetes and overweight[1,2]. It is widely acknowledged that children consume less fruit and vegetables than is recommended[3-7] and that they do not meet physical activity (PA) recommendations[8], especially when they get older[9]. To improve children's health by improving their dietary and activity habits, detailed understanding of the determinants of children's dietary and activity behaviours is needed.

Nutritional research shows that food preferences are an important determinant of children's food intake[10-15]. Food preferences are partly heritable, but also develop when children are exposed to a variety of food items, textures, tastes, and flavours as they grow[16-19]. Children's food preferences are associated with individual and parental characteristics, such as child age and gender[20,21], socio-economic status, parental body mass index (BMI)[22] and parenting practices, including modelling and restricting/controlling food choices[23,24]. Furthermore, there is increasing evidence that a dislike of foods can be transformed into liking by exposure and parental modelling[17,25].

Although little is known about the development of activity preferences in children[26-28], there is evidence that activity preferences are also associated with children's PA and sedentary behaviour[29-31]. Because food and activity preferences are related to behaviour and have the potential to be changed, research to improve our understanding of (the development of) such preferences is warranted.

Behavioural research in children shows a co-occurrence (or 'clustering') of dietary and activity behaviours in healthy (e.g. sporty-healthy eating) and unhealthy (e.g. sedentary-snacking) patterns[32-39]. Behavioural clustering may result from clustering of preferences for such behaviours. Only a few studies have examined children's food and activity preferences simultaneously[30,40-42]. Although none of these studies explicitly aimed to examine preference clustering, the results of one study indicated a positive correlation between children's preferences for healthy nutrition and preferences for PA[42], and one study found an indication for a sedentary-snacking preference cluster in children from obese/overweight families[40]. To elucidate how children's food and activity preferences cluster, more studies are needed that specifically explore this topic.

Several methods can be used to assess children's food or activity preferences, including questionnaires (self-reported and parent-reported)[14,29,40,43,44], laboratory tasks in which children are asked to taste and rank real foods[45,46], and visual instruments, including picture-sorting techniques[30,47], photo-pair comparisons[41,42] and preference rating of photographs[48,49]. The most commonly used and most reliable measure for food preferences is the laboratory task, combining tasting and ranking. However, because this method is inconvenient outside a controlled setting it is impractical for use in observational studies, whereas visual instruments are a convenient alternative[41,46,48]. We found two visual instruments integrating both food and activity preferences, each with their own limitations. Sherwood's picture-sorting technique[30], in which 64 food and 34 activity items are presented as pictures on cards and children are asked to sort the cards based on their preferences, has the advantage of ranking but is relatively time consuming and not appli-

cable in questionnaires. In Calfas' photo-pair comparison, children are presented with 15 photo-pairs[41]. One photograph is of a healthy food or activity, and the other unhealthy. Of the pair, children are asked to indicate which food/activity they prefer. Although suitable for application in questionnaires, this measure lacks rank ordering, which is reliable in food preference studies[46,50]. Therefore, based on the strengths of existing measures, we developed a self-reporting, visual instrument for primary school children in which food and activity preferences are rank-ordered by means of pair comparison, and which can be used in surveys.

The purpose of this study was to examine clustering of food and activity preferences in a community-based sample of children aged 8-11 years. Children reported their preferences at school with our newly-developed, visual instrument. We hypothesized that we would find healthy (e.g. sporty-healthy eating) and unhealthy (e.g. sedentary-snacking) preference clusters. We also examined whether the preference clusters are associated with child and parental background characteristics, and with parenting practices.

7.3 Methods

Study design, participants and procedure

Data for this study were retrieved from the longitudinal IVO Nutrition and Physical Activity Child cohorT (INPACT), for which approval was obtained from the Ethical Committee of the Erasmus MC (University Medical Center Rotterdam). INPACT is an observational study (initiated in 2008) focusing on modifiable determinants of overweight in the home environment of primary school children in the Netherlands. INPACT was conducted among primary school children in southern Netherlands (Eindhoven area). In recruiting the schools, we collaborated with the Municipal Health Authority for Eindhoven and surrounding area (GGD Brabant-Zuidoost). The Municipal Health Authority invited all general primary schools in their service area to participate in the INPACT study. Of the 265 schools invited, 91 took part. The response rate from rural and urban schools was equal. The primary caregivers of third-grade students (aged ± 8 years) were invited to participate in the cohort study, together with their child. Of the 2948 parent-child dyads invited, 1839 (62.4%) gave written informed consent to participate in the INPACT study for four years. The study included four assessments, each separated by a one-year time interval, and started in the autumn of 2008 (baseline). In the assessments, qualified research assistants measured the children's height and weight at school, children completed a questionnaire at school, and primary caregivers completed a questionnaire at home.
The present study was based on data from 2008 (baseline) and 2009 (second assessment). Child and parental background characteristics, and policy-related parenting practices were measured in 2008, while role modelling-related parenting practices and child preferences were measured in 2009 when the children were generally 9 years old (Box 7.1). Parent-child dyads with complete data from baseline to 2009 were included in the present study, resulting in 1480 parent-child dyads (80% of the original cohort). Logistic regression analyses on selective dropout from baseline to 2009 showed that parent-child dyads who were not native Dutch dropped out more often. There was no selective dropout regarding child age/gender and parental education level.

Measures

Child food and activity preferences

Child food and activity preferences were assessed with our newly-developed, self-reporting, visual instrument for primary school children in which food and activity preferences are rank-ordered by means of pair comparison. We distinguished three preference domains: foods, drinks and leisure-time activities. Food preferences included four 'snack' items, namely fruit, crudités (uncooked vegetables), sweet snacks and savoury snacks. In a questionnaire, these items were visualized in images of children who had these products in their hands, accompanied by the name of the food item. By comparing the four food items in pairs, six food pair-comparisons were created. In the questionnaire, the children were asked to indicate which food item of the pair they preferred. In the same way, four drink items (sugar-sweetened beverages (SSBs), light drinks, tea without sugar and fruit juice) were compared in six drink pairs, and eight leisure-time activity items (cycling, using the computer, watching television, playing sport at a club, reading, playing outside, dancing and tinkering (e.g. painting, colouring and pasting)) in 28 activity pairs. Selection of leisure-time activities was based on interviews with Dutch children participating in JUMP-in[51] about the leisure-time activities they perform most often.
Based on the children's answers, we rank-ordered the food, drink and activity preferences by counting the number of times a certain food, drink or activity was preferred. For example, three out of six food pair-comparisons included fruit. If fruit was never preferred, the child scored a 0 (= least preferred) on the fruit preference variable, if fruit was preferred one time, the child scored a 1, if fruit was preferred two times, the child scored a 2 and if fruit was preferred all three times, the child scored a 3 (= most preferred) on the fruit preference variable. In this way, we constructed four food preference variables, ranging from 0 (least preferred) to 3 (most preferred), four drink preference variables, also ranging from 0 (least preferred) to 3 (most preferred), and eight activity preference variables, ranging from 0 (least preferred) to 7 (most preferred). Food and drink preference variables were rescaled from 0, 1, 2 and 3 to 0, 2.33, 4.67 and 7 to simplify mean comparison with activity preference variables.
Our direct way of comparison simplified the two-step rank-ordering approach of Birch and colleagues[11], in which children allocate foods or food photographs to one of the three categories representing liking, disliking or indifference (step 1), and subsequently select the food (photograph) they like best within each category, repeating this after each favourite food (photograph) is removed, until all foods in all three categories have been ranked (step 2). Such an approach is not applicable in questionnaires, but is reported to be reliable[11,46]. Our instrument also proved to be reliable, as in the pair comparisons children were highly consistent in their answering of food, drink and activity preferences, i.e. if a child indicated to prefer fruit to vegetables, and sweet snacks to fruit, the child indicated to prefer sweet snacks to vegetables as well. Tested with Wilcoxon signed-rank tests, the highest percentages of non-consistent answering was 13.1% for food preferences (between sweet and savoury snacks), 7% for drink preferences (between SSBs and light drinks), and 12% for activities (between watching television and using the computer).
Although visual instruments measuring preferences have used photographs[41,46,48,49], it is difficult to find photographs of foods and activities that are comparable with regard to attractiveness[30]. Therefore, to develop a coherent instrument, we used images instead of photographs. The images used in the pair-comparisons were specially designed for our instrument for primary school children aged 8-11 years. After questionnaire completion, research assistants evaluated the instrument with children who

completed the questionnaire individually (not in a classroom setting) by asking them informally how they had experienced filling out the questionnaire, and what their opinion was about the images used in the questionnaire. In this way, research assistants learned that the images were attractive and appealing, and that filling out the questionnaire was an engaging process for the children, although some children had difficulty in making a choice. Research assistants indicated that the instrument had a short administration time (about 6 min on average) and that the instrument was suitable in individual and classroom settings. Classroom use has the advantage of simultaneous administration with multiple children, which decreases the research burden for schools. In addition, a higher response rate is expected when the information is collected in a classroom setting at school compared to individual administration at home[49].

Box 7.1 Study variables by measurement year

Child background characteristics
(parent-reported, 2008, except for child weight status, which was based on measured height and weight):
- age
- gender
- ethnicity
- weight status

Parental background characteristics
(parent-reported, 2008):
- parental BMI
- parental education level

Parenting practices
(parent-reported):
- healthy eating policies (2008)
- physical activity policies (2008)
- healthy eating role modelling (2009)
- physical activity role modelling (2009
- sedentary behaviour role modelling (2009)

Child food and activity preferences
(child-reported, 2009):
- food preferences
- drink preferences
- activity preferences (i.e. for physical activity and sedentary behaviour)

Child characteristics

The following child characteristics were collected: age, gender, ethnicity and weight status (see Box 7.1 for measurement year and in which way it was reported). Child age was calculated in years by subtracting the child's date of birth from the date of completion of the questionnaire. To assess the child's ethnic background, the country of origin of both parents was reported. According to standard procedures of Statistics Netherlands, a child was classified as native Dutch if both parents were born in the Netherlands, as a western immigrant if at least one parent was born outside the Netherlands but inside Europe (including former Yugoslavia and the Soviet Union), North America, Oceania, Indonesia or Japan, and as a non-western immigrant if at least one parent was born in Turkey, Africa, Latin America or Asia[52]. Child weight status was derived from child BMI, which was based on the child's height and weight: i.e. weight (kg)/height $(m)^2$, as measured by qualified research assistants. Children were measured at school according to standard procedures in light clothing without shoes, to the nearest 0.1 kg and 0.1 cm[53]. International cut-off scores were used to determine a child's weight status: non-overweight (i.e., normal or underweight) or overweight (i.e., overweight or obese)[54].

Parental background characteristics

Parental characteristics were reported by the primary caregiver in a questionnaire (see Box 7.1 for measurement year). Parental education level was measured by the highest education level of the primary caregiver. According to international classification systems, it was defined as low (primary school and lower vocational/lower general secondary education), medium (intermediate vocational education, higher general secondary education and pre-university education), high (higher vocational education and university), or non-defined[55]. To assess parental BMI, the primary caregiver reported his/her own height and weight, and reported whether he/she was the child's biological parent. Parental BMI (for biological primary caregivers only) was calculated on the basis of these answers ($n_{\text{primary caregiver BMI}}$ = 1412, 4.6% missing).

Parenting practices

Parenting practices scales were also reported by the primary caregiver (see Box 7.1 for measurement year), based on the validated Home Environment Survey[56]. They included healthy eating policies (7 items, e.g. 'In the past 30 days, how often did you eat breakfast with your child?'), physical activity policies (5 items, e.g. 'In the past 30 days, how often did you send your child outside to play when the weather was nice?'), healthy eating role modelling (12 items, e.g. 'In the past 30 days, how often did you eat healthy meals or snacks while your child was around? ("healthy" defined as fruits, vegetables, low-fat foods, lean meats, whole grains, etc.)'), physical activity role modelling (6 items, e.g. 'In the past 30 days, how often did your child see you doing something that was physically active (e.g., walking, biking, playing sports)?') and sedentary behaviour role modelling (2 items, e.g. 'In the past 30 days, how often did your child see you watching television?'). Answering scales ranged from never (1) to always (5). A higher score on a scale implies more policies/role modelling.

Strategy for analyses

All analyses were performed using IBM SPSS Statistics version 19.0. Cases with missing values were excluded per analysis. To describe the study population, we computed means, standard deviations (SDs) and percentages for socio-demographic variables. Means, SDs and percentages highest quartile ranking were computed for the preference variables, and independent T-tests and ANOVAs were performed to test gender, age, weight status and ethnicity differences in mean preference scores.

Principal component analysis (PCA) with oblique rotation was performed to examine clustering of preferences. A scree plot was used to determine the number of components. Items with absolute component loadings ≥ 0.3 were considered part of the component, in line with previous research[57]. Cluster scores were computed for each child as each preference score multiplied by their corresponding component loadings[35].

Given the explorative nature of the analyses[57], backward linear regression analyses were conducted to examine the relationship of the cluster scores (dependent variables) with child characteristics, parental background characteristics and parenting practices.

7.4 Results

At baseline (n=1839), according to IOTF cut-off points[54], 7% of the children were underweight, 79% had a normal weight and 14% were overweight, of which 3% were obese. The prevalences of overweight and obesity were similar to Dutch prevalence rates among primary school children[58]. The mean age of the children was 8.2 years (SD=0.5, range 7-10 years). Boys (50.5%) and girls (49.5%) were represented in almost equal numbers. Of all children, 17% were from a non-Dutch ethnic background with one or both parents born abroad, of which 9% from non-western countries and 8% from western countries. Primary caregivers were predominantly female (92%). Of all primary caregivers, 21% had finished education at a low level, 45% at a medium level, 32% at a high level, and 2% at a non-specified level. Of the primary caregivers, 1% was underweight, 66% had a normal weight and 33% were overweight, of which 9% were obese, which is in line with Dutch prevalence rates among women[59].

Percentages highest quartile ranking, mean preference scores and significant differences by gender, weight status, age and ethnicity are presented in Table 7.1. The highest quartile rankings were for fruit, fruit juice and playing sport at a club, and the lowest for vegetables, tea without sugar and cycling. Independent T-tests revealed that all preference variables differed significantly by gender. Girls had a significantly higher preference for fruit, vegetables, fruit juice, tea, dancing, tinkering and reading than boys, and a significantly lower preference for sweet snacks, savoury snacks, SSBs, light drinks, cycling, using the computer, watching television, playing sport at a club and playing outside. Compared to normal-weight children, overweight children had a higher preference for healthy food and drinks (fruit and tea), for dancing and tinkering, and a lower preference for unhealthy food and drinks (sweet snacks and SSB's), using the computer, playing sport at a club and playing outside. Compared with non-western immigrant children, native Dutch children had a higher preference for sweet snacks, SSBs and playing sport at a club, and a lower preference for vegetables, cycling and reading. Older children (aged 10-11 years) had a higher preference for playing on the computer and a lower preference for reading than younger children (aged 8-9 years).

Table 7.1 Mean preference scores and percentage highest quartile ranking by gender, weight status, age and ethnicity

Preference for:	n	mean	SD	p-value	% highest quartile ranking (preference score ≥ 6)
1. Fruit	1456	4.71	1.98		33.7
boys	734	4.51	2.03	0.000	30.5
girls	719	4.91	1.92		37.0
non-overweight	1232	4.65	2.01	0.001	33.0
overweight	178	5.19	1.73		41.0
2. Vegetables	1449	2.02	2.20		5.2
boys	731	1.73	2.12	0.000	4.1
girls	715	2.31	2.25		6.3
native Dutch	1265	1.95	2.18	0.001[62]	4.9
non-western immigrant	116	2.76	2.40		9.5
western immigrant	65	1.97	2.11		3.1
3. Sweet snacks	1447	3.70	2.38		22.7
boys	726	3.84	2.34	0.024	23.1
girls	718	3.56	2.41		22.0
non-overweight	1224	3.76	2.37	0.004	23.0
overweight	177	3.20	2.39		18.6
native Dutch	1263	3.80	2.38	0.000[63]	23.9
non-western immigrant	116	2.70	2.19		9.5
western immigrant	65	3.55	2.37		20.0
4. Savoury snacks	1444	3.56	2.31		18.8
boys	725	3.90	2.31	0.000	23.7
girls	716	3.23	2.26		13.8
5. SSBs	1438	3.10	2.22		12.6
boys	729	3.58	2.16	0.000	17.0
girls	706	2.61	2.17		8.1
non-overweight	1215	3.22	2.20	0.000	13.3
overweight	178	2.25	2.06		5.1
native Dutch	1254	3.17	2.21	0.002[62]	12.8
non-western immigrant	116	2.43	2.12		7.8
western immigrant	65	2.87	2.40		16.9
6. Light drinks	1441	3.95	2.19		22.0
boys	728	4.29	2.13	0.000	26.4
girls	710	3.59	2.21		17.6
7. Fruit juice	1459	4.97	2.29		48.0
boys	734	4.70	2.33	0.000	42.4
girls	722	5.24	2.23		53.5
8. Tea (without sugar)	1457	2.02	2.36		9.1
boys	732	1.42	2.06	0.000	5.3
girls	722	2.63	2.49		13.0
non-overweight	1234	1.96	2.32	0.014	8.6
overweight	177	2.47	2.58		12.4

9. Cycling	1417	3.35	1.57		7.2
boys	708	3.71	1.42	0.000	8.4
girls	706	2.98	1.63		5.9
native Dutch	1237	3.31	1.57	0.040[62]	7.0
non-western immigrant	112	3.68	1.65		10.8
western immigrant	65	3.51	1.45		6.1
10. Using the computer	1429	2.63	1.74		6.9
boys	714	3.43	1.61	0.000	11.8
girls	712	1.83	1.48		2.1
8-9 years old	1114	2.57	1.72	0.011	6.3
10-11 years old	305	2.86	1.77		9.2
non-overweight	1209	2.67	1.75	0.007	7.2
overweight	178	2.29	1.62		4.5
11. Watching television	1414	2.83	1.71		6.9
boys	707	3.43	1.54	0.000	10.2
girls	704	2.23	1.67		3.5
12. Playing sport at a club	1419	5.49	1.80		62.3
boys	707	5.87	1.59	0.000	71.2
girls	709	5.12	1.92		53.2
non-overweight	1197	5.56	1.75	0.004	63.8
overweight	176	5.07	2.13		52.3
native Dutch	1236	5.55	1.75	0.010[63]	63.1
non-western immigrant	114	5.10	2.05		55.3
western immigrant	66	5.14	2.22		56.1
13. Dancing	1409	1.99	2.50		15.1
boys	702	0.46	1.19	0.000	1.3
girls	704	3.51	2.52		28.7
non-overweight	1194	1.92	2.46	0.006	14.6
overweight	172	2.51	2.63		18.6
14. Tinkering	1407	3.21	1.84		11.8
boys	697	2.57	1.69	0.000	6.3
girls	707	3.85	1.75		17.1
non-overweight	1190	3.16	1.85	0.000	10.9
overweight	173	3.69	1.74		19.1
15. Reading	1408	3.15	2.03		15.8
boys	703	2.94	1.92	0.000	11.9
girls	702	3.37	2.12		19.7
8-9 years old	1095	3.22	2.07	0.014	16.9
10-11 years old	303	2.91	1.87		11.5
native Dutch	1229	3.10	2.02	0.011[62]	14.8
non-western immigrant	113	3.66	2.08		25.6
western immigrant	63	3.40	2.03		17.5
16. Playing outside	1406	5.32	1.53		58.0
boys	697	5.54	1.33	0.000	65.1
girls	706	5.10	1.68		51.0
non-overweight	1189	5.36	1.51	0.035	59.2
overweight	175	5.10	1.60		51.4

Note: only significant differences are displayed.
SD=standard deviation; all preference variables range from 0 (least preferred) to 7 (most preferred);
SSBs=sugar-sweetened beverages

PCA revealed 3 preference clusters (Table 7.2). The first cluster included a high preference for sweet snacks, savoury snacks and SSBs, and a low preference for fruit, fruit juice, vegetables and reading ('unhealthy-food-and-drink-preference cluster'). The second cluster comprised a high preference for playing sport at a club, cycling and playing outside, and a low preference for reading and tinkering ('active-leisure-time-preference cluster'). The third cluster included a high preference for computer use, watching television, and sugar- and artificially-sweetened drinks, and a low preference for tea, dancing and tinkering ('sedentary-sweetened-drinks cluster'). The three preference clusters explained 43.7% of the variance in the original items. Preference cluster 1 and 3 were positively correlated (r=0.30), while preference cluster 1 and 2 (r=-0.09) and preference cluster 2 and 3 (r=0.05) were scarcely related.

[62] non-western immigrant > native Dutch
[63] non-western immigrant < native Dutch

Table 7.2 Component loadings of principal component analysis on preferences for food, drinks and activities

Preferences	Cluster 1	Cluster 2	Cluster 3
Fruit juice	**-0.683**	-0.146	0.073
Fruit	**-0.676**	0.051	0.025
Vegetables	**-0.557**	0.144	-0.167
Sweet snacks	**0.556**	-0.127	0.089
Reading	**-0.537**	**-0.527**	0.147
Savoury snacks	**0.536**	-0.051	0.047
SSBs	**0.502**	-0.006	**0.348**
Sporting at a club	0.021	**0.620**	0.109
Playing outside	-0.008	**0.618**	-0.018
Cycling	-0.177	**0.617**	0.113
Dancing	0.093	-0.265	**-0.695**
Tea	0.019	0.094	**-0.681**
Using the computer	0.251	-0.151	**0.654**
Watching television	0.295	-0.276	**0.560**
Tinkering	0.091	**-0.302**	**-0.554**
Light drinks	0.187	0.059	**0.302**

Note: SSBs =sugar-sweetened beverages

Results of the regression analyses with preference cluster scores as dependent variables (Table 7.3) showed that non-western immigrant children, girls, younger children, overweight children and children of more active parents scored significantly lower on the unhealthy-food-and-drink preference cluster (cluster 1). Girls, children of parents with a higher BMI and children of more sedentary parents scored significantly lower on the active-leisure-time preference cluster (cluster 2), while children of parents who used PA policies scored significantly higher on preference cluster 2. Girls and overweight children scored significantly lower on the sedentary-sweetened-drinks preference cluster (cluster 3). In addition, children of more active parents scored significantly lower on the sedentary-sweetened-drinks cluster, while children of parents who watched television and played on the computer more often scored significantly higher on this cluster.

Table 7.3 Child and parental characteristics related to cluster scores (standardized regression coefficients backward regression), n=1170[64]

	Cluster 1: unhealthy-food-and-drink-preferences[65]	Cluster 2: active-leisure-time-preferences[66]	Cluster 3: sedentary-sweetened-drinks- preferences[67]
Child characteristics:			
Ethnicity: non-western (1) vs native Dutch (0)	-0.11***		
Gender: girl (1) vs boy (0)	-0.14***	-0.29***	-0.59***
Age: 10/11 (1) vs 8/9 (0)	0.06*		
Body mass index (BMI) child: overweight (1) vs non-overweight (0)	-0.06*		-0.06*
Parental background characteristics:			
Parental BMI		-0.06*	
Parenting practices:			
PA role modelling	-0.06*		-0.06*
PA policies		0.06*	
Sedentary behaviour role modelling		-0.07*	0.06*

7.5 Discussion

This study examined clustering of food and activity preferences in a community-based sample of children aged 8-11 years. It also explored whether child characteristics, parental background characteristics and parenting practices are related to these clusters. To our knowledge, this is the first study to examine preference clustering in children. In line with our hypotheses, the results demonstrate healthy and unhealthy preference clusters, namely a clustering of preferences for unhealthy foods and unhealthy drinks (cluster 1), a clustering of preferences for various types of PA (cluster 2), and a clustering of preferences for unhealthy drinks and sedentary behaviours (cluster 3). These preference clusters largely correspond with common healthy and unhealthy behavioural clusters[32–39], suggesting that behavioural clustering may result from clustering of preferences for such behaviours. The next step is to relate our preference clusters to child dietary and activity behaviours to test the magnitude of their relevance. This could help to ascertain which preference clusters should be addressed in future interventions aimed at improving children's food and activity preferences.

[64] child characteristics: gender, age, ethnicity, weight status; parental characteristics: parental education level, parental BMI; parenting practices: healthy eating policies, PA policies, healthy eating role modelling, PA role modelling, sedentary behaviour role modelling

[65] R^2=0.05

[66] R^2=0.10

[67] R^2=0.36

The present study indicates how parents may influence their child's food and activity preferences. Healthy parenting practices appear to be supportive for healthy preferences in children, as PA role modelling was negatively associated with the unhealthy-food-and-drink and with the sedentary-sweetened-drinks preference cluster, while PA policies were positively related to the active-leisure-time-preference cluster. These findings contribute to previous research, indicating that modelling and restricting/controlling are associated with child food preferences[23,24]; however, more interesting, our results also suggest that such parenting practices could be important for the development of activity preferences, especially because little is known about the development of activity preferences in children[26–28].

Our findings revealed gender differences in all three clusters: compared to girls, boys scored higher on the unhealthy food cluster (cluster 1), on the sedentary cluster (cluster 3) as well as on the physical activity cluster (cluster 2). The finding that boys have a significantly higher preference for various types of PA is in accordance with others[42]. Although Nemet and colleagues[42] found no gender differences in nutrition preferences, our findings of healthier food preferences in girls contribute to previous research[12,20], which also indicates that differences in intake between boys and girls are strongly mediated by their gender-specific preferences[12]. Indeed, our gender-specific findings are in line with behavioural clustering studies showing that boys are more likely than girls to have an unhealthy intake pattern[60,61] and a high active/high sedentary behavioural pattern[36]. Therefore it is essential that future studies, including intervention studies, acknowledge gender differences in preferences and behaviour.

Although the higher preferences of boys for active leisure-time activities and sedentary activities (using the computer and watching television) may reflect an innate preference[62,63], children also develop their preferences through personal experience and social interaction[23,64]. Particularly in girls, the innate preferences for sweet, salty and high-fat foods[17,65] might be (partly) replaced by learned preferences for healthier food choices. It is suggested that sociocultural pressure on girls and mothers to conform to gender stereotypes may play a role in this process[22,66], even among primary school children[67–69]. Learned preferences could also explain weight status differences. In our study, overweight children scored lower on the unhealthy-food-and-drink and on the sedentary-sweetened-drinks-preference cluster. Although the regression coefficients were very low, associations were not in line with previous preference research. Earlier studies found a higher preference for sedentary behaviour and a higher preference for unhealthy food in overweight children[26,40,42] or found no association between food and activity preferences with weight[30]. Our findings could reflect parental influences on preferences of overweight children through behaviour. Parents of children who were overweight at baseline might react to their child's weight status (e.g.[70–72]) and try to influence the child's behaviour in a positive way. For instance, parents might increase availability to healthy food products, behave as a positive role model for healthy eating[12,17,25], increase availability to PA equipment and become more active themselves. These parenting practices could improve the child's opportunities for a healthy lifestyle, which might also result in healthier food and activity preferences[12].

The current study has some limitations, some of which are related to our newly developed instrument to measure food and activity preferences. Firstly, although the instrument is based on the strengths of existing measures, showed high consistency in answering, and was positively evaluated by the participating children, it has not yet been validated. Secondly, the images used were ethnically diverse and not unisex, which could influence child preferences. However, participating children were instructed to choose the food/drink/activity they preferred, independent of the gender and ethnicity of the images. We have clear indications that children were not influenced by the gender and ethnicity of the images, e.g. girls scored significantly higher on fruit preference while the fruit image was masculine, and boys scored significantly higher on computer preference while the computer image was feminine. Finally, child food preferences were measured in global concepts (fruit, vegetables, sweet snacks and savoury snacks), while activity preferences were slightly more specific (e.g. reading, tinkering, using the computer, playing outside, etc.). Instruments measuring, for example, children's fruit/vegetable preferences, often make use of various types of fruits/vegetables and ask participants to indicate how much they like a certain fruit/vegetable (e.g.[48,49]). This could lead to relatively long instruments and to missing values due to unfamiliarity with certain foods. The use of global concepts prevents these problems, and produces a concise instrument (i.e. only six questions to rank-order food preferences). In our current instrument, activity preferences were measured in 28 pair-comparisons. It is useful to explore whether the number of activities can be reduced, while maintaining the distinction between PA and sedentary behaviour[73], and incorporating various types of PA[33]. The inclusion of television viewing, computer gaming, outdoor playing and sporting seems sufficient to measure activity preferences, although the impact of new technologies on sedentary behaviour (e.g. smartphones and tablet-pcs) should not be overlooked. Another limitation lies in the choice of analytical methods. To evaluate preference clustering we used PCA, which relies on various subjective choices that may influence the outcomes. Finally, dropout analyses showed selective dropout on ethnicity in the parent questionnaires. Most likely, immigrants who were not fluent in Dutch dropped out more often. However, because of the low number of immigrants in our sample, this probably had no effect on our results.

Conclusion

The current study found evidence for the clustering of children's food and activity preferences in an unhealthy-food-and-drink-preference cluster, an active-leisure-time-preference cluster and a sedentary-sweetened-drinks-preference cluster. Boys scored higher on all three clusters, demonstrating that gender differences should be acknowledged in future studies. Parental role modelling of PA and parental policies of PA were related to child preference clusters in a positive way, indicating that parents are able to influence their child's preferences. Because our preference clusters largely matched with common healthy and unhealthy behavioural clusters, this indicates that behavioural clustering may result from clustering of preferences for such behaviours. A subsequent phase is to relate our preference clusters to children's dietary and activity behaviours, which may help in the development of interventions aimed at improving children's food and activity preferences.

7.6 References

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chapter 8

discussion

General discussion

General discussion

8.1 Introduction

The aim of this thesis was to elucidate parental influences on primary school children's energy balance-related behaviours (EBRBs) and their weight, by studying the interplay between parental and child-related correlates.

The following research questions were addressed:

1. What are important parental and child-related correlates of children's EBRBs and weight?
2. To what extent and by which mechanisms do these parental and child-related correlates interact in explaining children's EBRBs and weight?

To answer the research questions, six studies were performed. In this chapter I first describe the main findings of these studies (§8.2). Second, some methodological issues are discussed that should be taken into consideration when interpreting the findings (§8.3). Third, the study findings are then integrated and considered in relation to answering the research questions (§8.4). Finally, implications of the findings for research and practice are discussed (§8.5), followed by a general conclusion (§8.6).

8.2 Main findings

Chapter 2 reports on the association between parenting style and child weight, including the potential moderating influence of child age, ethnicity and parental education level. Parenting style was assessed three-dimensionally by adding *psychological control* to the generally accepted parenting style dimensions of *behavioural control* and *support*. The study shows that rejecting parenting – the only parenting style that is characterized by high psychological control – was associated with a higher child BMI z-score. In addition, it shows that the association between rejecting parenting and child BMI z-score was independent of child age, ethnic background and parental education level.

Chapter 3 reports on associations of parental feeding styles with child dietary behaviours and weight, and with changes in child dietary behaviours and weight over a one-year period. In addition, the chapter reports on the potential contextual role (moderating influence) of parenting style dimensions. Five parental feeding styles were distinguished: instrumental feeding, emotional feeding, encouragement, overt control and covert control. Children's dietary behaviours included fruit intake, snack intake and sugar-sweetened beverage (SSB) intake. Instrumental and emotional feeding were associated with child fruit intake and child snack intake in an unfavourable way (less fruit, more snacking), whereas encouragement, overt control and covert control had favourable (negative) associations with child snacking and SSB intake. Associations of parental feeding styles with changes in child dietary behaviours over one year were generally similar, although the effect sizes were somewhat lower. Except for covert control, which was unfavourably related to child BMI z-score, parental feeding styles were only related to child dietary behaviours and not to weight. Although psychological control and behavioural control moderated some associations between parental feeding styles and child dietary behaviours, not all were in the hypothesized direction.

In **Chapter 4** the interplay between specific parenting and more distal parental factors in explaining child behaviour was studied in more detail. Parenting style, parental education level and ethnicity were studied as higher-order moderators and as underlying determinants of the association between parental fruit intake and child fruit intake. Parental education level, ethnicity (western immigrant vs. native Dutch) and parental fruit intake were positively related to child fruit intake, whereas rejecting parenting, characterized by high levels of psychological control and low levels of support and behavioural control, was negatively related to child fruit intake. Parental education level was an underlying determinant of the association between parental and child fruit consumption. General parenting interacted with parental fruit intake in explaining child fruit consumption: the association between parental and child fruit intake was more pronounced with higher levels of psychological control and higher levels of behavioural control. In addition, a non-Dutch ethnic background strengthened the association between parental and child fruit intake.

Chapter 5 reports on the interplay between various diet- and activity-related parenting practices by applying a clustering approach. In addition, the study describes associations of the potential clusters with child and parental background characteristics, including parenting style dimensions, and with child EBRBs. Five clusters of parenting practices were identified: 1) high visibility and accessibility of screens and unhealthy food, 2) diet- and activity-related rules, 3) low availability of unhealthy food, 4) diet- and activity-related positive modelling, and 5) positive modelling on sports and fruit. The study showed that parenting practices cluster on the type of home environment, i.e. physical (clusters 1 and 3), political (cluster 2) and socio-cultural (clusters 4 and 5), while cutting across the dietary and activity domain.
A low parental education level was positively associated with cluster 1 (the only unhealthy cluster), while a high(er) education level was positively associated with three healthy clusters. Child body mass index (BMI), parental BMI, ethnicity and the parenting style dimensions of psychological control and behavioural control were also related to one or more clusters, in general in the hypothesized directions.
For example, a higher parental BMI and more psychological control in cluster 1, and more behavioural control and less psychological control in cluster 4. Separate clusters were related to both child dietary and activity behaviours in the hypothesized directions: healthy clusters were related to obesity-reducing

behaviours such as child fruit intake and outdoor playing, whereas the unhealthy cluster was associated with obesity-inducing behaviours such as child snacking and screen time.

Chapter 6 reports on child appetitive traits in relation to children's dietary behaviours and weight, and changes in dietary behaviours and weight over a one-year period. In addition, the study examines whether child appetitive traits interact with general parenting in determining children's dietary behaviours and weight. Children's dietary behaviours included fruit intake, snack intake and SSB intake. Food-approaching appetitive traits were positively related, and food-avoidant appetitive traits were negatively related to child BMI z-score and to child fruit intake. There were no, or less consistent, associations for snack and SSB intake. Child appetitive traits were more strongly related to child weight than to child dietary behaviours. There were almost no associations of child appetitive traits with changes in child dietary behaviours and weight over a one-year period. Concerning the moderating effect of general parenting, authoritative parenting eliminated the negative association between food fussiness and fruit intake, while neglecting parenting strengthened the positive association between food-approaching appetitive traits and weight.

Chapter 7 reports on the interplay between children's food and activity preferences by applying a clustering approach. The study also describes associations of the potential clusters with child and parental background characteristics, as well as parenting practices. Three clusters of child preferences were identified: 1) a clustering of preferences for unhealthy foods and unhealthy drinks, 2) a clustering of preferences for various physical activity behaviours, and 3) a clustering of preferences for unhealthy drinks and sedentary behaviour. The study showed that child preferences cluster within the dietary domain (cluster 1), within the activity domain (cluster 2) as well as across domains (cluster 3). In addition, clusters were related to child gender and physical activity-related parenting practices. Boys had a higher cluster score than girls on all three preference clusters, whereas physical activity-related parenting practices were negatively related to unhealthy preference clusters and positively related to the physical-activity preference cluster.

Table 8.1 summarizes the main findings, divided into primary and interactive associations of parental and child-related correlates of children's EBRBs and weight. Primary associations provide context-free generalisations about correlates of children's EBRBs and weight; potential determinants are studied as isolated factors. Interactive associations, on the other hand, elucidate under which circumstances a relationship occurs.

Table 8.1 Summary of the main findings: primary and interactive associations

PRIMARY ASSOCIATIONS	Chapter
Parenting style is a multidimensional construct of which the dimension of psychological control is associated with a higher child BMI z-score.	2
Instrumental feeding and emotional feeding are associated with child fruit intake and child snack intake in an unfavourable way (less fruit, more snacking).	3
Encouragement, overt control and covert control have favourable (negative) associations with child snacking and SSB intake.	3
Covert control is positively associated with child BMI z-score.	3
Parental education level, ethnicity (western immigrant vs. native Dutch) and parental fruit intake are positively related to child fruit intake; rejecting parenting is negatively related to child fruit intake.	4
Clusters of healthy parenting practices are positively related to obesity-reducing child behaviours, whereas a cluster of unhealthy parenting practices is positively related to obesity-inducing behaviours.	5
Food-approaching appetitive traits are positively, and food-avoidant appetitive traits are negatively related to child BMI z-score and to child fruit intake.	6
INTERACTIVE ASSOCIATIONS	
a. Parental and child-related correlates	
High parental education level increases parental fruit consumption, which increases child fruit consumption.	4
Parental education level is positively related to clusters of healthy parenting practices and negatively to a cluster of unhealthy parenting practices.	5
Behavioural control is positively related to clusters of healthy parenting practices, whereas psychological control is positively related to a cluster of unhealthy parenting practices.	5
Boys score higher than girls on healthy as well as unhealthy preference clusters, whereas physical activity-related parenting practices are negatively related to unhealthy child preference clusters and positively to a healthy child preference cluster.	7
b. Moderating influences	
Child gender, age and ethnicity do not moderate the association between psychological control and child BMI z-score.	2
Psychological control and behavioural control moderate associations between parental feeding styles and child dietary intake.	3
Psychological control, behavioural control and ethnicity moderate the association between parental and child fruit intake.	4
Authoritative parenting and neglecting parenting moderate associations between child appetitive traits and child dietary intake/weight.	6
c. Clustering	
Parenting practices cluster across the dietary and activity domain in healthy and unhealthy clusters.	5
Child preferences cluster within and across the dietary and activity domain in healthy and unhealthy clusters.	7

8.3 Methodological considerations

The INPACT study was initiated in 2008 to collect data for the individual studies that are presented in this thesis (see §1.6 for a detailed description of the INPACT study). This section discusses some methodological issues that need to be kept in mind when interpreting the findings of the individual studies.

8.3.1 Study design

Cross-sectional and longitudinal approach

The INPACT study is a longitudinal, observational study. A limitation of observational studies is that it is not possible to draw firm causal inferences from them. In general, this limitation is stronger for cross-sectional studies than for longitudinal studies, because cross-sectional studies are carried out at one time point and thus give no indication of the sequence of events[1]. However, some variables are regarded as more stable than others, presuming that they are a predictor or cause. For example, parental education level and ethnicity, are (relatively) stable[2]. Similarly, although intervention studies provide evidence for the modifiability of parenting styles[3], in observational studies parenting styles can be considered as relatively stable[2,4]. The trait-like character of these distal parental factors, but also of child characteristics such as gender and appetitive traits, makes a reverse influence of child intake/weight on these factors less plausible, and longitudinal analyses superfluous in this regard. On the other hand, proximal parental factors such as parental feeding styles are less stable and more responsive to contexts[2,5-9], which makes longitudinal analyses essential to elucidate cause and effect. Therefore, in addition to cross-sectional analyses which were performed to answer the research questions on the association between home-environmental factors and child dietary intake/weight, the association between parental feeding styles and child dietary intake/weight was also analysed in a prospective way (Chapter 3). However, because this study did not measure parental feeding styles at both time points and had a short follow-up period of one year, the benefits of a longitudinal approach could not be fully exploited.

Apart from elucidating cause and effect, longitudinal analyses have the potential to test changes in outcome variables over time, exploring a potential cumulative effect of a relatively stable predictor on an outcome variable. In Chapter 6, the cumulative effect of children's appetitive traits on dietary intake and weight was tested. Again, a follow-up period of one year hampered the benefits of a longitudinal approach, indicating that studies with a longer follow-up period are required.

Study population

Recruitment of participants through schools

At baseline, 1839 parent-child dyads were included in the INPACT study. They were recruited through schools, which gave the data a nested structure (participants within schools). This could lead to nesting of associations, which requires multilevel analyses. The potential nested effect of parent-child dyads within schools was explored in one study (Chapter 4). No indication for nesting of effects was found, which eliminates the need to perform multilevel analyses.

One-parent approach

In the INPACT study, parental influences were assessed in one parent only (i.e. the primary caregiver), which is a limitation. The one-parent approach was based on practical considerations. In a large-scale cohort study, following both parents over several years is difficult to accomplish, especially when parents divorce. Because of the expected high non-response among partners over the years, a one-parent approach was chosen. Although primary caregivers reported on their partner's education level, country of birth, height and weight, and relationship to the child (biological parent, adoptive parent, step parent, etc.), to better understand the impact of parental influences on children's EBRBs and weight it is recommended to include both parents in future studies.

External validity

As no random sample of Dutch parent-child dyads was taken, the results of the studies presented in this thesis cannot be simply generalized to the remainder of the Netherlands. However, the aim of the studies presented in this thesis was not to make valid statements about Dutch parents and their primary school children (e.g. prevalence rates of childhood obesity, prevalence rates of authoritative parenting or prevalence rates of food-approaching children in the Netherlands). The aim was to explore associations between parental factors and child behaviour/weight and their underlying mechanisms. This requires variance in the concepts measured, which makes external validity (i.e. generalizability) of the results to people that were not included in the study population less relevant. Nevertheless, at baseline, 7% of the children participating in the INPACT study were underweight, 79% had a normal weight, 11% were overweight and 3% were obese; these rates are similar to national Dutch prevalence rates of overweight and obesity among primary school children[10]. Of the parents, who were predominantly female (92%), 1% was underweight, 66% had a normal weight and 33% were overweight, of which 9% were obese; these data are also in line with national Dutch prevalence rates among women[11]. Therefore, it is assumed that our results are representative with respect to weight status. The percentage of high-educated parents in the INPACT sample (32%) was similar to Dutch figures of highest educational attainment among the labour force[12], and the percentage of non-native Dutch children (17%) was slightly lower than the percentage of non-native Dutch in the general population (21%)[13].

Dropout

The studies presented in this thesis used questionnaire data from baseline (2008) to the third assessment (2010) of the INPACT study. In 2010, 1497 of the 1839 parents were still participating in the INPACT study, implying an attrition rate of 18.6%, which is relatively low compared to similar cohort studies (e.g. [14,15]). The high number of participants in 2010 ensured sufficient statistical power to examine the complex sets of associations studied in this thesis. However, selective dropout is an issue for consideration in cohort studies. Logistic regression analyses on selective dropout in the parent questionnaire from baseline to 2010 showed that parents of non-western and western immigrant children dropped out more often. There was no selective dropout on child age/gender and parental education level. Most likely, immigrant parents who were not fluent in Dutch dropped out more often. Because of the low number of immigrants in the INPACT study, this probably had no effect on the results; moreover, ethnicity was controlled for in all the analyses.

8.3.2 Assessment issues

All studies described in this thesis were based on questionnaire data, mostly parent reports. Child weight (status) was based on anthropometric measures. Some of the consequences of using questionnaires and anthropometric data are addressed below.

Questionnaires

Large-scale observational studies on EBRBs generally use self-reports, because it is virtually impossible to obtain objective measures of health-related behaviours[16], and self-reports are practical and relatively inexpensive[17,18]. However, self-reports may be biased in several ways. In parents, self-reported data relating to their own parenting behaviours may be prone to social desirability bias. Social desirability refers to a tendency by respondents to portray an overly positive image of their true selves[19]. Reporting on their own EBRBs may (additionally) be hampered by a recall bias, which may lead to an overestimation or underestimation of actual behaviour[20]. In addition, in the studies presented in this thesis, children's EBRBs were proxy reports, i.e. parents reported on their children's EBRBs. Apart from recall bias and social desirability bias, this may also cause a bias because parents may not be fully aware of their child's dietary and activity behaviour in other environments that they are exposed to, such as the school environment and the home environment of friends. These potential biases could pose a threat to construct validity. Therefore, the quality of the measurement instruments should be taken into account when interpreting the results of the studies presented in this thesis. In the INPACT study, validated questionnaires were used where available. For example, child fruit, snack and SSB intake were assessed using several items from a validated food frequency questionnaire designed for parents to accurately assess energy intake of children in the Netherlands aged 2-12 years[21,22]. The instrument was validated using doubly-labelled water, and was concluded to be a valid and useful instrument in Dutch surveys assessing energy intake in children. Children's appetitive traits were assessed using a validated Dutch translation[23] of the Children's Eating Behaviour Questionnaire[24], which proved to possess adequate to good internal consistency in the Dutch situation. In the same way, the validated Dutch translation[25] of the Parental Feeding Style Questionnaire[26] possessed adequate to good internal consistency in the Dutch situation.

As no validated parenting style questionnaire was available, parenting style was assessed using the Dutch translation[27] of an instrument based on earlier work by Steinberg et al.[28,29]. Although this questionnaire is used in many studies worldwide[27,30-32], it needs to be validated, or a valid and reliable new questionnaire to assess parents' parenting style needs to be developed (see e.g. [33]).

The questions used to assess physical activity and sedentary screen-time behaviour in children were based on a standard questionnaire for assessing children's activity behaviour which is used in Dutch Youth Health Care[34]. The parent reports of the daily amounts of time their children were engaged in certain activities were poorly reported (e.g. for some parents it was obvious that they reported weekly amounts of time instead of daily amounts of time). Therefore, in the analyses the parent reports on physical activity and sedentary screen-time behaviour were limited to the number of days their children were engaged in certain activities (frequency). This may not accurately reflect behaviour duration or energy expenditure, especially for outdoor playing and screen time. The development of valid and reliable questionnaires to examine children's activity and sedentary behaviours needs attention in future research.

Apart from existing questionnaires, child food and activity preferences were assessed with a newly-developed, visual self-reporting instrument for primary school children in which food and activity preferences were rank ordered by means of pair comparisons. Although it was based on the strengths of existing measures, showed high consistency in answering and was positively evaluated by the participating children, it has not been validated. For further use, the instrument needs to be validated, for example against laboratory tasks in which children are asked to taste and rank real foods.

In validation studies, special attention should be given to *selective* misreporting, for example in overweight subjects, because it is known that they tend to underreport their food intake more than normal weight subjects (e.g. [35-37]). Special attention to selective misreporting in predictor and/or outcome variables is important, because selective misreporting biases the effect sizes of associations. Non-selective misreporting only affects descriptive information, such as mean dietary intake and activity behaviour, which may be over- or underreported, while selective misreporting under- or overestimates effect sizes of associations.

Anthropometrics

Children's height and weight, which were objectively assessed, were used to calculate children's BMI. Although objectively assessed child BMI has the strength of being unbiased, and although in clinical and non-clinical health care BMI has become a standard indicator of overweight and obesity[38], it is questioned whether it is a reliable measure for assessing child overweight. BMI does not discriminate between lean mass and fat mass. In addition, it does not discriminate between abdominal fatness and hip fatness, while excess abdominal fatness is a better measure of cardiovascular disease risk factors in children than general fatness, assessed by BMI[39,40]. Therefore, the use of additional measures, such as waist circumference for assessing abdominal fatness and skin folds to discriminate between lean mass and fat mass, is recommended to assess body fat in children as a predictor for child health (e.g., [36]).

In the INPACT study, children's anthropometric measures included waist circumference. Apart from examining the association between child BMI z-score and child waist circumference for the total sample at baseline (Pearson's $r=0.83$, $p<0.001$), these data have not yet been analysed. It is interesting to use INPACT data to examine associations of parental factors with child BMI z-score and with child waist circumference to establish whether it is relevant to use such an additional measure in studies on parental factors on children's weight/fatness.

8.3.3 Magnitude of the effect sizes

In this thesis, although many correlates reached statistical significance, the effect sizes were mostly small (0.1 to 0.3) and a few were moderate (0.3 to 0.5)[41]. Thus, although the associations found were not based on chance (expressed in statistical significance), their practical relevance, expressed in the magnitude of the effect sizes and explained variances, may be limited. Small to moderate effect sizes are not uncommon in research examining environmental influences on EBRBs[42-44], and there are several factors that may explain the effect sizes found in this thesis. First of all, the correlates studied in the separate studies focus on a small part of the complex totality of environmental and personal factors that influence a child's EBRBs and weight. In addition, environmental factors are more distal to child behaviour and weight than person-related factors (e.g., attitude, self-efficacy, intention and knowledge), expressing itself in small

effect sizes and low variances explained when related to a single behaviour. Nevertheless, distal factors are likely to have an influence on more than one behaviour[2]. For example, in this thesis a higher parental education level was related to a higher child fruit intake (Chapter 4), but there is evidence that it is also related to a higher vegetable intake[42]. Thus, although the effect size of the individual association between parental education level and child fruit intake may show limited relevance, the combined or synergistic effect of parental education level on a range of EBRBs is supposed to be much larger. New methods and new analytic approaches to grasp the complex interplay between environment and child are needed, which may increase effect sizes and explained variances.

Apart from the complexity of the correlates of various levels and the interplay between these factors, which may underestimate their relevance when analysed in relatively isolated ways, selective misreporting in predictors and outcome variables may also play a role (see §8.2.2). It is difficult to determine whether in general this will lead to underestimation or overestimation of effect sizes.

Although several factors may explain the small effect sizes found in this thesis, it should be kept in mind that (especially for child weight) the explained variance will in any case be limited, as genetic studies show a substantial heritability for child BMI. For example, a twin study aimed to quantify genetic and environmental influences on BMI in children aged 8-11 years showed a genetic influence of 60%[45]. Regardless of that, environmental influences have the potential to (be) change(d), whereas genes are stable, which makes the study of environmental influences on child behaviour and weight relevant for future studies.

8.3.4 Analytical approach

Multiple linear regression analyses

The research models tested in the studies presented in this thesis were based on the ecological systems theory. They were mainly tested using multiple regression analyses, completed with moderation and (in one study) mediation analyses. Although the ecological systems theory assumes reciprocal relationships, in linear regression analyses parental and child-related factors were treated as independent variables and child behaviour/weight as dependent variables. As discussed before, this is plausible for (relatively) stable factors such as parental education level and child appetitive traits, but not necessarily for proximal parental factors such as parental feeding styles and parenting practices, which are less stable and more responsive to contexts[2,5–9,46]. For example, a parental rule regarding SSB consumption could determine, but could also be a result of a child's SSB intake (e.g. a rule is set because of abundant SSB intake resulting in child weight gain). If the parental rule is a reaction to child behaviour and/or weight, it is expected that, in turn, this will influence child SSB intake and, potentially, child weight. This so-called reciprocal determinism, where the causal relationships are bi-directional, makes the discussion of traditional 'causal' pathways more complex[47], and suggests the need for new analytic choices. In contrast to multiple regression analyses, Structural Equation Modelling (SEM) is an appropriate statistical technique to test for bi-directionality. In addition, SEM has the ability to model mediating and moderating variables at the same time. Other advantages of SEM compared with multiple regression analyses include testing models with multiple dependent variables, using Confirmatory Factor Analysis to reduce measurement error, testing the overall models, and the ability to model error terms[48-50]. Testing complex models such as the ones in this thesis, integrating moderating and mediating variables at the same time, or using multiple dependent variables, is relatively new in this field of research and is therefore explorative in nature. A multiple regression approach is appropriate to explore and generate hypotheses for further research, which will likely benefit from deductive tests that apply a SEM approach.

Parenting style versus parenting style dimensions

General parenting is the main parental influence studied in this thesis. In some studies it was operationalized in separate parenting style dimensions (e.g., Chapters 3 and 5), whereas in others it was operationalized in parenting styles (e.g., Chapters 2 and 6). Parenting styles were constructed by dichotomising the sample on each parenting style dimension (median split) and examining the dichotomous variables simultaneously. Both approaches have pros and cons. In the absence of normative data, the parenting styles constructed by using a median split are relative. This implies that authoritative parents in the INPACT study are authoritative compared to other parents in the INPACT study, but could be non-authoritative in another sample. Thus, since scores on various parenting style dimensions may differ across samples, comparing study results on parenting styles across samples is impossible.

Using separate dimensions instead of parenting styles increases statistical power. However, it neglects the interaction between parenting style dimensions, which distinguishes, for example, an authoritative parent from an authoritarian parent. Although both parents score high on behavioural control, an authoritative parent is also highly supportive, whereas an authoritarian parent is not. In parenting research that assesses parenting styles by combining the dimensions of support and behavioural control, authoritative parenting shows favourable associations with all kinds of outcome measures, including school achievement, child EBRBs and child weight[51,52], whereas authoritarian parenting does not. This implies that, for example, the level of parental support determines whether high behavioural control should be seen as a contributory or risk factor for child behaviour. On the other hand, the parenting style dimension of psychological control is seen as a risk factor in itself[53,54].

Sleddens et al.[33] recently developed the Comprehensive General Parenting Questionnaire (CGPQ), consisting of five parenting constructs: i.e., nurturance (including parental support), overprotection, coercive control (including psychological control), behavioural control and structure. They suggest using clustering techniques for future studies using the CGPQ, to be able to assess the contribution and interaction of all five parenting constructs, which may allow for better differentiation among parenting styles. A similar approach could be applied to the three parenting style dimensions distinguished in this thesis.

8.4 Elaborating on the main findings

The studies presented in this thesis focus on primary and interactive associations of parental and child-related correlates with children's EBRBs and weight. As stated in the introduction, in this work four levels of parental influence have been distinguished: socio-demographic factors (i.e. parental education level and ethnicity), parenting style, parental feeding styles, and diet- and activity-related parenting practices. In addition, child-related correlates of children's EBRBs and weight were studied, namely child appetitive traits and child diet- and activity-related preferences.

Following the research questions and Table 8.1, §8.4.1 elaborates on the main findings related to primary associations and §8.4.2 focuses on the main findings in which the interplay between parental and child-related correlates of children's EBRBs and weight is taken into account (interactive associations). Finally, in this section the research questions are discussed in an integrated way (§8.4.3).

8.4.1 Parental and child-related correlates of children's EBRBs and weight: primary associations

One study in this thesis (Chapter 4) examined primary associations of parental education level and ethnicity with child fruit intake. In that study, a positive association was found between parental education level and child fruit intake, which is in line with previous research[42,55,56], and with the well-established association between socioeconomic position and health, stating that the socioeconomically better-off do better on most health measures[57].
Although there is an established association between ethnic culture and child weight (i.e., immigrant children are at higher risk for overweight and obesity than their native counterparts)[58], the association between ethnic culture and children's fruit intake has been less extensively studied, and the results of the few available studies are inconsistent (e.g. [59,60]). In Chapter 4 it was found that western immigrant children ate more fruit than native Dutch children, which is in line with a recent Dutch study that, in addition, found a higher fruit intake among children from Turkish and Moroccan origin[60]. Because in both studies the associations were adjusted for parental education level, differences in fruit intake between native Dutch and immigrant children cannot be explained by underlying differences in parental educational attainment. This indicates that other factors (e.g., cultural factors and eating patterns) may also be important in explaining children's EBRBs. It also underlines the importance of examining immigrant children and their parents, who are overrepresented among the lower-educated[61], as a target group separate from children of low-educated native Dutch parents in intervention studies on parental influences on children's EBRBs.

Two studies examined primary associations of *parenting style*, one with child weight and one with child fruit intake (Chapters 2 and 4, respectively). In these studies, parenting style was assessed three-dimensionally by adding the dimension of psychological control to the generally accepted parenting style dimensions of behavioural control and support. The overall conclusion in the literature is that authoritative parenting shows favourable associations with child weight and EBRBs, although an absence of associations has also been reported[52]. The favourable influence of authoritative parenting was not confirmed in this thesis, but Chapters 2 and 4 found an unfavourable association of rejecting parenting, characterized by high levels of psychological control, and low levels of behavioural control and support, on children's weight and fruit intake. As rejecting parenting is the only parenting style that is characterized by high levels of psychological control, the study findings indicate that psychological control explains a part of the association between parenting style and child weight and fruit intake. This underlines the importance of including psychological control in parenting measures when studying childhood overweight and child behaviour.
In addition, the findings indicate that psychological control has a detrimental impact on child weight and fruit intake, which is in line with the few studies that examined psychological control in relation to child BMI z-scores and child dietary intake[62-64]. Although regarded as relatively stable in observational studies[2,4], intervention studies provide evidence that it is possible for parents to change their parenting style[3]. Thus, parents using psychological control in their parenting should be discouraged to do this, and encouraged to become skilled in other types of parenting.

Of the *parental feeding styles* studied (Chapter 3), instrumental and emotional feeding were unfavourably related to child fruit and snack intake, whereas encouragement, overt control and covert control showed favourable associations with child snacking and SSB intake. In research, parental feeding styles are measured in various ways (e.g. [26,65-67]) making cross-comparisons of study findings difficult. Nevertheless, a Dutch study using the same questionnaire as the one used in this thesis also indicated a detrimental impact of instrumental and emotional feeding on children's snack intake[23]. Instrumental feeding and emotional feeding differ from encouragement, overt control and covert control because they do not aim to influence child dietary behaviour; instead they use food to regulate non-nutritive child behaviour. Therefore, conceptually they can be seen as general parenting strategies. The findings suggest that, similar to psychological control (which applies emotional strategies to regulate non-nutritive child behaviour), using food as a form of reward (instrumental feeding) or offering food to deal with emotional distress (emotional feeding) should be discouraged because of its detrimental effect on child dietary behaviour.

Two studies examined primary associations of *parenting practices* with children's EBRBs (Chapters 4 and 5). One study (Chapter 4) found a positive association between parental and child fruit intake, which is in line with previous findings of (fruit) modelling studies (e.g. [42,55,68-70]). In Chapter 5, clusters of diet- and activity-related parenting practices were related to various EBRBs, which broadened scientific knowledge on parenting practices, as parenting practices are mainly related to specific behaviours (e.g. fruit modelling is related to fruit intake and not to snack intake)[42]. Again, a positive association was found between parental modelling and children's EBRBs. In addition, and consistent with previous findings, home availability and accessibility, as well as a parental rule-setting, were found to be positively related correlates of children's EBRBs[42,43,46,55,71,72]. The findings indicate that parenting practices may be a good starting point for interventions aimed at improving child dietary and/or activity behaviour.

Child appetitive traits as *child-related correlates* of children's EBRBs were examined in relation to both dietary behaviours (fruit, snack and SSB intake) and weight (Chapter 6). These traits were related to child fruit intake and weight, with strongest associations for weight. Food-approaching children had a higher BMI z-score than food-avoidant children. This is in line with previous findings (e.g.[73-76]) and supports the idea that the genetic influence of child BMI is mainly explained by a lack of appetite control[77,78], which is shown in food-approaching children. Child appetitive traits have a strong genetic component and are thus not easily modifiable[79,80]. However, assessing appetite traits in childhood might help to identify children at higher risk while they are still at a healthy weight, enabling targeted interventions to prevent obesity[81].
Apart from child appetitive traits, parental feeding styles were examined in relation to both dietary behaviours and weight (Chapter 3). Although all child appetitive traits were significantly related to child weight, most parental feeding styles were not. Child weight is largely determined by genetics, including the genetic component of appetitive traits, and is thus less susceptible to change than dietary behaviours[45,77,81].
This suggests that the main aim of parents of overweight children should be to improve their child's dietary behaviour, while taking into account their child's appetitive traits. Healthier eating habits have

a positive influence on child health in general (e.g., reducing cardiovascular disease risk factors and a reduced risk on some sorts of cancer[82–84]) and may eventually influence child weight (secondary aim). Restricting food intake and a covert way of control may be effective parental strategies for children with stronger food-approaching tendencies[7,85,86].

8.4.2 Parental and child-related correlates of children's EBRBs and weight: interactive associations

The research framework for the studies presented in this thesis was based on the ecological systems theory (Figure 1.1). This framework assumed an interplay between different types/levels of parental factors with factors at the individual level in explaining children's EBRBs and weight, which was confirmed in this thesis. The interplay was demonstrated in various ways.

Higher-order moderation

The potential moderating influence of parenting style was studied most extensively (Chapters 3, 4 and 6). The two studies that examined the potential higher-order influence of separate parenting style dimensions found evidence for a contextual role of behavioural control and psychological control. In one study, high behavioural control strengthened the positive association between parental and child fruit intake in parents who consumed relatively high levels of fruit (Chapter 4). In the other study, however, high behavioural control was found to strengthen the unfavourable, negative association between instrumental feeding and child fruit intake and eliminate the favourable, negative association between overt control and child SSB intake (Chapter 3). Thus, in line with previous research, these findings indicate that behavioural control moderates associations between parental factors and child dietary behaviours. However, the optimal level of behavioural control remains unclear[52]. As suggested before (§8.2.4), this may be explained by neglecting the interaction between behavioural control and parental support. This explanation was supported in Chapter 6, i.e. the study that examined parenting styles instead of separate parenting style dimensions as potential moderating influence. The study found a favourable influence of authoritative parenting on the association between food fussiness and child fruit intake, by eliminating the negative association between them (Chapter 6).

Studies including the moderating influence of psychological control are new in this field. In the studies presented in this thesis, psychological control was consistently found to be an unhealthy parenting context for child dietary behaviours; this is in line with findings that indicate that psychological control is a risk factor in itself[53,54,87].

Associations between various levels of parental influence

Two studies related parental education level and parenting style to parenting practices (Chapters 4 and 5). A higher parental education level was associated with a higher parental fruit intake and with clusters of healthy parenting practice, which is in line with the established positive association between socioeconomic position and health[57]. The parenting style dimensions of behavioural control and psychological control were related to clustered parenting practices: high parental behavioural control was associated with clusters of healthy parenting practices whereas high psychological control was associated with an unhealthy parenting practices cluster. In addition, psychological control was more prevalent among lower-educated parents and among parents of non-native Dutch children, especially parents of non-western immigrant children (Table 2.1).

The findings support an interplay between a range of parental influences. Chapter 4 indicates a causal chain in which a higher parental education level causes a higher parental fruit intake, which (partly) causes a higher child fruit intake. The study also shows a favourable moderating influence of a non-native Dutch ethnic background on the association between parental and child fruit intake. Such findings underline the importance of further unravelling the exact mechanisms of a broad spectrum of parental influences in explaining children's EBRBs and weight, preferably based on an ecological systems theory approach, including mediation and moderation analyses[88].

Clustering

Two studies in this thesis used a clustering approach to study the interplay between a) diet- and activity-related parenting practices (Chapter 5), and b) diet- and activity-related child preferences (Chapter 7). Although there is considerable evidence for clustering of children's EBRBs in healthy and unhealthy patterns (see §1.2), examining clustering of *determinants* of children's EBRBs is relatively new. Both studies found evidence for clustering across the dietary and activity domain, in healthy and unhealthy clusters. The finding that healthy clusters of parenting practices were related to various obesity-reducing child behaviours indicates that clusters of parenting practices may be related to clusters of children's EBRBs. The co-occurrence of healthy parenting practices and healthy child behaviour was recently supported in a study that examined clustering of eating routines and various activity-related behaviours in children aged 5 years. The study found (a.o.) a 'Traditional Family' pattern, in which eating together as a family and the number of meals per day clustered with children's active means of transport[89].

Because parental education level positively relates to clusters of children's EBRBs (i.e. a higher education level is associated with healthy behavioural clustering)[89–91], and to clusters of parenting practices (this thesis), a subsequent step is to also incorporate higher-order parental influences (e.g., parental education level and general parenting) in clustering studies on parenting practices and child behaviour. Thus, apart from mediation and moderation analyses, future studies may benefit from using a clustering approach as a new way to study the interplay between the various levels of parental influences in explaining children's EBRBs and weight.

8.4.3 To conclude: answering the research questions in an integrated way

The research questions that were addressed are:

1. What are important parental and child-related correlates of children's EBRBs and weight?
2. To what extent and by which mechanisms do these parental and child-related correlates interact in explaining children's EBRBs and weight?

The results of the studies presented in this thesis show that various levels of parental factors (from distal to proximal) as well as child-related factors are associated with child EBRBs and weight, in both primary and in interactive associations. As the findings on primary associations of parental education level, ethnic background, psychological control, instrumental and emotional feeding, parental modelling, parental rule-setting, home availability and accessibility, and child appetitive traits with child EBRBs and weight are

consistent with previous research, these factors can be seen as important correlates of children's EBRBs and weight. Their importance is reflected in different ways. For example, ethnic background, parental education level and child appetitive traits are not (easily) modifiable, but can be important to identify specific target groups for obesity prevention interventions, i.e., children of low-educated parents, immigrant children and children with food-approaching appetitive traits.

Relatively stable, but modifiable general parenting influences, such as psychological control, instrumental feeding and emotional feeding, can be an important focus in interventions targeted at parents to improve their children's dietary behaviours and weight, by improving their general parenting skills which, additionally, may favourably influence other than weight-related child behaviours[2,3].

Diet- and activity-related parenting practices are also interesting starting points for interventions aimed at improving child dietary and/or activity behaviour. However, they are assumed to be less trait-like and more responsive to contexts than general parenting style and socio-demographic factors [5]; this assumption was supported in this thesis. Distal or higher-order parental factors interacted with proximal parental factors and child appetitive traits in explaining children's EBRBs and weight. For example, the strength of the association between parental fruit modelling and child fruit intake was determined by the parent's education level. In addition, moderating influences of parenting style on parental feeding styles and child appetitive traits were found, indicating that authoritative parenting is a favourable context, whereas a parenting context in which high levels of psychological control are used is an unfavourable context for child EBRBs and weight. However, not all parental feeding styles and child appetitive traits interacted with higher-order parental factors in explaining child behaviour and weight. These correlates might be robust for contextual factors[92]. Because of its complexity, it is important to further elucidate the interplay between parenting practices, higher-order parental factors and child characteristics (e.g. child temperament or eating style) [93,94] before tailored interventions can be developed and introduced on a large scale.

Examining clustering in determinants of children's EBRBs is relatively new. As both child preferences and parenting practices clustered in healthy and unhealthy patterns, this topic needs further investigation. The potential synergy between determinants that occur in clusters could result in more efficient interventions aimed at improving children's EBRBs, by applying an integrated approach that addresses multiple determinants simultaneously[95]. However, more insight is needed in the stability of clustering, as only stable clusters may be suitable for intervention purposes.

8.5 Implications of the study findings

This section presents some overall implications for research (§8.5.1) and practice (§8.5.2).

8.5.1 Implications for research

Bi-directional associations

Parenting does not occur in isolation. According to the ecological systems theory, it is the result of bi-directional relations between parent and child, influenced by interactions with the broader environment[96-98]. Although the studies in this thesis acknowledged an interplay of proximal parental factors, such as parental feeding styles and parenting practices, with more distal parental factors, bi-directionality between parent and child was not taken into account in the research framework (Figure 1.1). Child EBRBs and weight were not presented as nested structures, but modelled (and studied) as dependent variables, whereas there is evidence for bi-directional associations between parent and child (e.g. [76,99]). A qualitative study of Carnell et al. (2011) showed that parents especially react to child dietary behaviours and less to weight[99]. Such insights show the complexity of the impact of parenting, and are essential to guide future studies that further elucidate bi-directional associations between parental factors and children's EBRBs and weight, in longitudinal observational studies or experimental manipulations.

Parenting practices: how do they develop?

The evidence that parents react to children's dietary behaviours by using specific parenting practices[7,9,99] assumes that parents use parenting practices as conscious strategies to influence 'problematic' child behaviour. Whether or not parents perceive a certain behaviour as problematic (e.g., not eating fruits or constantly using the computer) will depend on the parents' norms, values, (health) beliefs, knowledge, etc. However, the knowledge on how parenting practices emerge or develop is still very limited and reactions to 'problematic' child behaviour is only one explanation. Most likely they are also the result of the way in which parents are themselves socialized, e.g. what they learned from their parents. In this thesis, evidence was found for the influence of parental education level on parenting practices, but it remains unclear why higher-educated parents use healthier parenting practices than do lower-educated parents. This raises the question whether parenting practices are habits or deliberate strategies, reactive or not, and on which beliefs they are based. Future studies need to further examine the determinants of distinct parenting practices, distinguishing between lower- and higher-educated parents. Such explorative studies require qualitative research and can benefit from a longitudinal design (see [100]).

From a parent approach to a family approach

In the INPACT study, parental influences were assessed in one parent only (the primary caregiver), who was predominantly female (92%). Most parenting studies focus on assessing the parenting of only the mothers[52]. However, to better understand the impact of parenting on children's behaviours, future studies need to include other influential family members, starting with fathers. There is evidence that fathers and mothers have a differential influence on child behaviours. For example, paternal role modelling on physical activity is a main determinant for child physical activity, whereas maternal role modelling is not[43].
In addition, children's EBRBs are likely to be influenced by the combined parenting practices of mothers

and fathers[94]. Parenting practices of mothers and fathers can be highly incongruent[101], which may be more prevalent among children of divorced parents.
Siblings also need to be included in future studies because, within one parent, parenting practices may differ across children within the same family depending on the child's age, gender, eating behaviour, temperament and weight status[5,102]. Thus, studying the influence of consistent and incongruent parenting practices in parents and across parents is a relevant topic to be further explored. This may involve research methods other than large-scale surveys, such as observing a family in its daily home environment.

From the home environment to a broader perspective

This thesis focused on the home environment in explaining children's EBRBs and weight, because in primary school children the home environment is still a critical context for their development[46,103-107]. Nevertheless, other environmental influences outside the home environment may also be important, such as the neighbourhood (e.g., recreation facilities, neighbourhood safety), school, interpersonal (e.g., peer influence , social norms), and societal/macro environment (e.g., culture, climate, location)[70,108-110]. After investigating the independent contribution of the home and neighbourhood environment, a study of Crawford et al.[111] indicated that the home environment is more important than the neighbourhood environment in explaining children's physical activity and BMI z-score. However, that study ignored the interplay between the home and neighbourhood environment. In future studies, it is more important to acknowledge the interplay between the home environment and the broader context than to examine the relative importance of various environments because, according to the ecological systems theory, a change at one level can affect all other levels[112].

Theory-driven research: from an isolated approach to an interactionist, dynamic ecological approach

This thesis confirms the added value of using the ecological systems theory in explaining children's EBRBs and weight. As stated before, in the research framework guiding the studies presented in this thesis, children's EBRBs and weight were not presented as the inner circle, as nested structures, but were modelled as dependent variables. Including the interplay between parenting and children's EBRBs will improve research models of studies that elucidate children's EBRBs and weight[113].
The recommendations for future research mentioned in this section indicate that the impact of parenting is complex. Future research may benefit by also adopting principles from the dynamic systems theory[114]. The concept of systems refers to a "complex of interacting elements"[115] or a "group of parts that are interacting according to some kind of process"[116]. This emphasises that not the characteristics of the individual units or parts, but the extent and nature of linkages among the various units are important[117]. The operation of an element in a system depends on the existence and operation of other elements in the system. This implies that, for example, the impact of a restrictive parental rule towards child snacking cannot be understood by mechanistically modelling it by correcting for all other potential determinants in the causal chain (e.g., vending machines at school, a parent's parenting style, availability of snacks in the home, child characteristics), but by examining the system conditions under which the restrictive rule has an impact[114]. This view requires new conceptual research models and appropriate strategies for analysis in observational studies, as well as new ways of data collection, such as qualitative longitudinal studies and observing people in their natural setting[100,118].

8.5.2 Implications for practice

Practical implications will relate to a parental approach primarily aimed at improving children's EBRBs. Promoting a healthy lifestyle is important for (almost) all children, not only for overweight children, as the majority of children nowadays do not meet fruit, vegetable and physical activity recommendations[119-122].

Interventions combining parenting style with (clustered) parenting practices

This thesis indicates that both parenting styles and (clusters of) parenting practices are important home-environmental factors that need attention in interventions targeted at parents to improve their children's EBRBs. Improving their general parenting skills (e.g. discouraging psychological control, instrumental feeding and emotional feeding, and encouraging authoritative parenting) may also influence child behaviours (other than weight-related ones) in a favourable way[2,3], which may increase parents' confidence in parenting. The potential synergy between clusters of parenting practices could be used by applying an integrated approach, e.g. by addressing strictness (rules) on various EBRBs simultaneously (e.g., encouraging parents to set fruit and vegetable rules as well as active commuting rules). It has been shown that interventions combining general parenting with lifestyle components lead to better results than interventions focusing exclusively on general parenting[3]. Thus, it is recommended to develop family interventions focussing on improving both general parenting and diet- and activity-related parenting practices, i.e., positive parental role-modelling, setting clear diet- and activity-related rules and making healthy food and physical activity equipment available and accessible.

Message

There is evidence that an intervention message that targets increasing healthy behaviour (i.e. fruit and vegetable intake) shows better results than an intervention message that focuses on reducing unhealthy behaviour (i.e. high-fat and high-sugar food intake)[38]. Thus, as a way of positive parenting, parents should bring a positive message by telling their children what they are allowed to do (e.g. eat fruits and vegetables, drink water, commute in an active way to school, play outside) instead of telling them what they are not allowed to do. In the same way, the intervention message to parents should be positive (e.g., as a good parent, you are allowed to set rules), which is in line with the existing Lifestyle Triple P intervention, a parent-focused group programme that addresses the topics of nutrition, physical activity and positive parenting[123,124].
In addition, as role modelling is an important correlate of children's EBRBs, parents should be made aware of the responsibility of being a role model. Parents may not always be aware of their own behaviours or realise the extent to which their behaviours influence the behaviour of their children[125].

Target groups

Although it should be acknowledged that family interventions aimed at improving children's EBRBs are important for the majority of parents, this thesis indicates that low-educated parents require special attention. As stated before, more insight is needed in the way in which determinants of parenting practices differ between low-educated parents and high-educated parents. In any case, involving low-educated parents in the development and implementation of an intervention seems to be an effective strategy to reach and engage them[126].

A parental approach embedded in a societal approach

Family interventions may be most effective when they are embedded in a societal approach, which may strengthen the social norm for a healthy lifestyle. JOGG (Youth on a Healthy Weight) of the Convenant Healthy Weight, a Dutch initiative to combat overweight on a societal level, is such an approach. It acknowledges that society-wide efforts are needed to modify the obesogenic environment, involving public and private stakeholders at all levels (e.g. national policy makers, local policymakers, commercial food suppliers, local food stores, schools, parents, etc.) to foster healthier lifestyles in a sustainable way[45,113,127,128].

8.6 Family matters?

The aim of the work in this thesis was to elucidate parental influences on primary school children's EBRBs and weight, by studying the interplay between parental and child-related correlates. The results of the studies show that various levels of parental influences (from distal to proximal) as well as child-related factors are associated with children's EBRBs and weight. The findings indicate that parents are able to influence their child's EBRBs (and weight), and can contribute to providing a supportive home environment. Thus, family really does matter.

8.7 References

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summary

Samenvatting

Summary

In the Netherlands, as in many other countries, the prevalence of overweight and obesity among children has increased rapidly over the past decades. Overweight and obesity are associated with numerous negative physical health consequences. In addition, they are associated with psychosocial problems such as a low self-esteem, depression and eating disorders. In view of these consequences, and given the tracking of overweight from childhood into adulthood, preventing overweight and obesity during childhood is an important public health target.

Overweight is the result of a long-term positive energy balance, in which energy intake through foods and drinks exceeds energy expenditure, mainly through physical activity. As dietary and activity behaviours are associated with the energy balance, they are referred to as energy balance-related behaviours (EBRBs). EBRBs are viewed as important behavioural determinants that can induce (e.g., unhealthy snacking and watching television) or reduce (e.g., eating fruit and playing outside) childhood overweight. Therefore, they are seen as important starting points for interventions to prevent overweight in children. To promote obesity-reducing EBRBs and discourage obesity-inducing EBRBs in childhood requires a detailed understanding of the modifiable factors that influence children's EBRBs. As the home environment is a critical context for the development of children's dietary and activity behaviours, and parents are primarily responsible for shaping the home environment, this thesis focuses on elucidating parental influences on EBRBs and weight of primary school children, aged 8-12 years.

Parental influences can be classified into various levels, which are defined by their proximity to child behaviour: distal or higher-order variables are further removed from child behaviour than proximal or lower-order variables. In this thesis, four levels of parental influence on children's EBRBs and weight are distinguished, arranged from distal to proximal parental influences:

1. socio-demographic influences;
2. parenting styles (or general parenting);
3. parental feeding styles;
4. diet-related and activity-related parenting practices.

Research shows that children's EBRBs and weight are influenced by multiple levels of parental factors. For years these potential determinants have mainly been studied as isolated factors, providing context-free generalizations about determinants of children's EBRBs. However, there is theoretical and empirical evidence that parenting does not occur in isolation. According to the ecological systems theory, it is the result of bi-directional relationships between parent and child, influenced by interactions with the broader environment.
Acknowledging that various levels and types of parental influences and child-related factors interact in explaining and predicting children's EBRBs, provides more information than merely studying potential determinants of EBRB as isolated factors. Elucidating under which circumstances a relationship occurs is assumed to be helpful for intervention development aimed at improving children's EBRBs and weight.

The ecological systems theory has been applied as theoretical framework that guided the studies presented in this thesis.

This thesis aimed to elucidate parental influences on primary school children's energy balance-related behaviours (EBRBs) and weight by studying the interplay between parental and child-related correlates. The following research questions were derived from the research aim:

1. What are important parental and child-related correlates of children's EBRBs and weight?
2. To what extent and by which mechanisms do these parental and child-related correlates interact in explaining children's EBRBs and weight?

In 2008, the IVO Nutrition and Physical Activity Child cohorT (INPACT) was initiated to answer the research questions. This prospective, observational study was conducted among primary school children and their primary caregivers in southern Netherlands (Eindhoven area). The study included four assessments with a one-year time interval. Assessments included parent questionnaires, child questionnaires and child anthropometrical measurements (height, weight and waist circumference). Children's height and weight were measured to calculate their body mass index (BMI). Baseline data collection took place in the autumn of 2008, when participating children were on average 8 years old. The final data collection period was in the autumn of 2011, when the children were on average 11 years old. The studies presented in this thesis are based on parent- and child-reported data and measured height and weight from baseline to the third wave of data collection in 2010.

Chapters 2 to 5 focus on primary and interactive associations of parental correlates of children's EBRBs and weight, whereas chapters 6 and 7 focus on primary and interactive associations of child-related correlates of children's EBRBs and weight.

Chapter 2 reports on the association between parenting style and child weight, including the potential moderating influence of parental education level, ethnicity and child age in a cross-sectional way. Parenting style was assessed three-dimensionally by adding psychological control to the generally accepted parenting style dimensions of behavioural control and support. The study shows that rejecting parenting – the only parenting style that is characterized by high psychological control – was associated with a higher child BMI z-score. In addition, it shows that the association between rejecting parenting and child BMI z-score was independent of child age, ethnic background and parental education level.

General parenting can be modelled as a distal factor for child weight. To open the black box between general parenting and child weight, chapter 3 reports on associations of parental feeding styles with child dietary behaviours and weight, and with changes in child dietary behaviours and weight over a one-year period. In addition, the chapter reports on the potential contextual role (moderating influence) of parenting style dimensions. Five parental feeding styles were distinguished: instrumental feeding (e.g., rewarding a child with sweets), emotional feeding (e.g., comforting a child with sweets), encouragement (e.g., encouraging a child to try foods that he/she has not tasted before), overt control (e.g., being firm about when and how much a child is allowed to snack) and covert control (e.g., avoiding having sweets in

the home). Children's dietary behaviours included fruit intake, snack intake and sugar-sweetened beverage (SSB) intake. Instrumental and emotional feeding were associated with child fruit intake and child snack intake in an unfavourable way (less fruit, more snacking), whereas encouragement, overt control and covert control had favourable (negative) associations with child snacking and SSB intake. Associations of parental feeding styles with changes in child dietary behaviours over one year were generally similar, although the effect sizes were somewhat lower. Except for covert control, which was unfavourably related to child BMI z-score, parental feeding styles were only related to child dietary behaviours and not to weight. Although psychological control and behavioural control moderated some associations between parental feeding styles and child dietary behaviours, not all were in the hypothesized direction.

In **Chapter 4** the interplay between specific parenting and more distal parental factors in explaining child behaviour was studied in more detail. Parenting style, parental education level and ethnicity were studied as higher-order moderators and as underlying determinants of the association between parental fruit intake and child fruit intake. Parental fruit intake and child fruit intake were positively related.
In addition, parental education level and ethnicity (western immigrant vs. native Dutch) were positively related to child fruit intake, whereas rejecting parenting, characterized by high levels of psychological control and low levels of support and behavioural control, was negatively related to child fruit intake. Parental education level was an underlying determinant of the association between parental and child fruit consumption. General parenting interacted with parental fruit intake in explaining child fruit consumption: the association between parental and child fruit intake was more pronounced with higher levels of psychological control and higher levels of behavioural control. In addition, a non-Dutch ethnic background strengthened the association between parental and child fruit intake.

Chapter 5 reports on the interplay between various diet- and activity-related parenting practices by applying a clustering approach. In addition, the study describes associations of the potential clusters with child and parental background characteristics, including parenting style dimensions, and with child EBRBs. Five clusters of parenting practices were identified:
1) a cluster characterized by high visibility and accessibility of screens and unhealthy food;
2) a cluster characterized by diet- and activity-related rules;
3) a cluster characterized by low availability of unhealthy food;
4) a cluster characterized by diet- and activity-related positive modelling;
5) a cluster characterized by positive modelling on sports and fruit.
The study showed that parenting practices cluster on the type of home environment, i.e. physical (clusters 1 and 3), political (cluster 2) and socio-cultural (clusters 4 and 5), while cutting across the dietary and activity domain. A low parental education level was positively associated with cluster 1 (the only unhealthy cluster), while a high(er) education level was positively associated with three healthy clusters. Child body mass index (BMI), parental BMI, ethnicity and the parenting style dimensions of psychological control and behavioural control were also related to one or more clusters, in general in the hypothesized directions. For example, a higher parental BMI and more psychological control in cluster 1, and more behavioural control and less psychological control in cluster 4. Separate clusters were related to both child dietary and activity behaviours in the hypothesized directions: healthy clusters were related to obesity-reducing behaviours such as child fruit intake and outdoor playing, whereas the unhealthy cluster was associated with obesity-inducing behaviours such as child snacking and screen time.

Chapter 6 reports on child appetitive traits in relation to children's dietary behaviours and weight, and changes in dietary behaviours and weight over a one-year period. In addition, the study examines whether child appetitive traits interact with general parenting in determining children's dietary behaviours and weight. Children's dietary behaviours included fruit intake, snack intake and SSB intake. Food-approaching appetitive traits were positively related, and food-avoidant appetitive traits were negatively related to child BMI z-score and to child fruit intake. There were no, or less consistent, associations for snack and SSB intake. Child appetitive traits were more strongly related to child weight than to child dietary behaviours. There were almost no associations of child appetitive traits with changes in child dietary behaviours and weight over a one-year period. Concerning the moderating effect of general parenting, authoritative parenting eliminated the negative association between food fussiness and fruit intake, while neglecting parenting strengthened the positive association between food-approaching appetitive traits and weight.

Chapter 7 reports on the interplay between children's food and activity preferences by applying a clustering approach. The study also describes associations of the potential clusters with child and parental background characteristics, as well as parenting practices. Three clusters of child preferences were identified:
1) a clustering of preferences for unhealthy foods and unhealthy drinks, 2) a clustering of preferences for various physical activity behaviours, and 3) a clustering of preferences for unhealthy drinks and sedentary behaviour. The study showed that child preferences cluster within the dietary domain (cluster 1), within the activity domain (cluster 2) as well as across domains (cluster 3). In addition, clusters were related to child gender and physical activity-related parenting practices. Boys had a higher cluster score than girls on all three preference clusters, whereas physical activity-related parenting practices were negatively related to unhealthy preference clusters and positively related to the physical-activity preference cluster.

General discussion

The final chapter (**chapter 8**) discusses methodological issues, elaborates on the main study findings and discusses scientific and practical implications of the studies described in this thesis. It was concluded that various levels of parental factors (from distal to proximal) as well as child-related factors are associated with child EBRBs and weight, in both primary and interactive associations. Findings on primary associations were consistent with previous research. Therefore, parental education level, ethnic background, psychological control, instrumental and emotional feeding, parental modelling, parental rule-setting, home availability and accessibility, and child appetitive traits can be seen as important correlates of children's EBRBs and weight. Correlates which are not (easily) modifiable, such as parental education level, ethnic background and child appetitive traits, can be important to identify specific target groups for obesity prevention interventions, whereas parenting styles and parenting practices can be important focuses in general interventions targeted at parents to improve their children's dietary and activity behaviours. Because of its complexity, it is important to further elucidate the interplay between parenting practices, higher-order parental factors and child characteristics before tailored interventions can be developed and introduced on a large scale. Examining clustering in determinants of children's EBRBs is

a relatively new way to examine interactive mechanisms, but as both child preferences and parenting practices clustered in healthy and unhealthy patterns, this topic needs further investigation.
The findings of this thesis indicate that parents are able to influence their child's EBRBs (and weight), and can contribute to providing a supportive home environment. Thus, family really does matter!

Samenvatting

Net als in veel andere landen is in Nederland de afgelopen decennia de prevalentie van overgewicht en obesitas bij kinderen sterk toegenomen. Overgewicht en obesitas zijn geassocieerd met tal van negatieve gevolgen voor de lichamelijke gezondheid. Daarnaast worden ze geassocieerd met psychosociale problemen, zoals een laag zelfbeeld, depressie en eetstoornissen. Bovendien is bekend dat kinderen met overgewicht een grotere kans hebben om ook als volwassene overgewicht te hebben. Vanuit volksgezondheidsperspectief is het dan ook van belang al tijdens de kindertijd overgewicht en obesitas tegen te gaan.

Overgewicht is het resultaat van een langdurige positieve energiebalans, waarbij de energie-inname uit voedsel en drank het energieverbruik, voornamelijk door lichamelijke activiteit, overschrijdt. Eet- en beweeggedrag worden dan ook als belangrijke gedragsdeterminanten van overgewicht bij kinderen gezien. Voor een succesvolle preventie van overgewicht bij kinderen moet gezond eet- en beweeggedrag, zoals het eten van fruit en buitenspelen, gestimuleerd worden en ongezond eet- en beweeggedrag, zoals het eten van ongezonde tussendoortjes en tv-kijken, ontmoedigd. Om dit te bereiken is een gedetailleerd inzicht nodig in invloeden op eet- en beweeggedrag van kinderen die te veranderen zijn. De thuisomgeving kan wat dat betreft als een belangrijke context worden gezien. Ouders zijn primair verantwoordelijk voor het vormgeven van de thuisomgeving. Om die reden richt dit proefschrift zich op het vergroten van het inzicht in ouderlijke invloeden op eetgedrag, beweeggedrag en het gewicht van basisschoolleerlingen in de leeftijd van 8 tot 12 jaar.

Ouderlijke invloeden kunnen worden ingedeeld in verschillende niveaus: distale ouderlijke factoren liggen verder verwijderd van het gedrag van het kind dan proximale factoren. Van distaal naar proximaal worden in dit proefschrift de volgende vier niveaus van ouderlijke invloed op eetgedrag, beweeggedrag en gewicht van het kind onderscheiden:

1. socio-demografische factoren;
2. opvoedstijlen (of algemene manier van opvoeden);
3. voedingsspecifieke opvoedstijlen (gericht op eetgedrag in het algemeen);
4. voedings- en beweeggerelateerde opvoedpraktijken (gericht op specifiek eet- en beweeggedrag, zoals snacken of sporten).

Uit onderzoek blijkt dat eetgedrag, beweeggedrag en het gewicht van kinderen door meerdere niveaus van ouderlijke factoren worden beïnvloed. Jarenlang zijn deze mogelijke determinanten als geïsoleerde factoren bestudeerd. Opvoeden gebeurt echter niet geïsoleerd. Volgens de ecologische systeemtheorie is opvoeden het resultaat van bi-directionele relaties tussen ouder en kind, die weer beïnvloed worden door de bredere omgeving waarin die relaties zich afspelen. Door dit samenspel (of interactie) tussen verschillende niveaus en vormen van ouderlijke invloeden en kindkenmerken te erkennen, kan eet- en beweeggedrag van kinderen mogelijk beter verklaard en voorspeld worden dan wanneer een geïsoleerde benadering wordt gehanteerd. Het vergroten van inzicht onder welke omstandigheden een relatie tot stand komt, kan nuttig zijn voor het ontwikkelen van interventies die gericht zijn op het verbeteren van het eet- en beweeggedrag (en daarmee het gewicht) van kinderen. In dit proefschrift is de ecologische systeemtheorie toegepast als theoretisch kader.

Dit proefschrift heeft tot doel meer inzicht te krijgen in de invloed van ouders op eetgedrag, beweeggedrag en gewicht van kinderen in de basisschoolleeftijd, door de interactie tussen verschillende niveaus van ouderlijke invloeden en kindkenmerken te bestuderen. De volgende onderzoeksvragen zijn geformuleerd:

1. Wat zijn belangrijke ouderlijke en kindgerelateerde determinanten van eetgedrag, beweeggedrag en gewicht van kinderen?
2. In welke mate en met welke mechanismen interacteren deze determinanten in het verklaren van eetgedrag, beweeggedrag en gewicht van kinderen?

Om de onderzoeksvragen te beantwoorden heeft het IVO in 2008 het 'IVO Nutrition and Physical Activity Child Cohort' (INPACT) opgezet. Deze prospectieve, observationele studie is uitgevoerd in Eindhoven en omliggende gemeenten onder basisschoolleerlingen en één van hun ouders. De studie omvatte vier metingen met een tijdsinterval van een jaar. De jaarlijkse metingen bestonden uit een vragenlijst voor één van de ouders, een vragenlijst voor het kind en het meten van lengte, gewicht en buikomtrek van het kind. Lengte en gewicht van het kind zijn gebruikt om de BMI (body mass index) van het kind te berekenen. De eerste meting vond plaats in het najaar van 2008, toen de deelnemende kinderen in groep 5 zaten (gemiddelde leeftijd: 8 jaar). De laatste meting was in het najaar van 2011, toen de kinderen gemiddeld 11 jaar oud waren. Voor de studies in dit proefschrift is gebruik gemaakt van de meet- en weeggegevens, en de gegevens uit de ouder- en kindvragenlijsten van de eerste drie metingen.

De hoofdstukken 2 tot en met 5 van dit proefschrift richten zich op ouderlijke factoren die samen kunnen hangen met eetgedrag, beweeggedrag en gewicht van het kind, terwijl de hoofdstukken 6 en 7 zich richten op kindgerelateerde factoren in relatie tot eetgedrag, beweeggedrag en gewicht van het kind.

In **hoofdstuk 2** worden de resultaten gerapporteerd van een cross-sectionele studie naar de relatie tussen opvoedstijl van de ouder en gewicht van het kind, inclusief de mogelijk modererende invloed van opleidingsniveau van de ouder, etniciteit en leeftijd van het kind op deze relatie. De opvoedstijl van de ouder werd driedimensionaal gemeten door de dimensie 'psychologische controle' toe te voegen aan de algemeen geaccepteerde opvoedstijldimensies 'gedragscontrole' en 'betrokkenheid'. De studie laat zien dat een afwijzende opvoedstijl – de enige opvoedstijl die gekenmerkt wordt door een hoge mate aan psychologische controle – samenhing met een hogere gestandaardiseerde BMI-score van het kind. Daarnaast bleek de positieve relatie tussen een afwijzende opvoedstijl en gestandaardiseerde BMI onafhankelijk te zijn van de leeftijd van het kind, etnische achtergrond en ouderlijk opleidingsniveau.

Ouderlijke opvoedstijl kan gemodelleerd worden als een distale factor ten opzichte van het gewicht van een kind. Om inzicht te krijgen in tussenliggende factoren, beschrijft hoofdstuk 3 resultaten van een studie naar de relatie tussen voedingsspecifieke opvoedstijlen en a) eetgedrag en gewicht van het kind en b) veranderingen in eetgedrag en gewicht van het kind over een periode van een jaar. Daarnaast is in deze studie de mogelijke modererende invloed van opvoedstijlen meegenomen. Vijf voedingsspecifieke opvoedstijlen werden onderscheiden: instrumenteel voeden (bijv. het kind belonen met een snoepje), emotioneel voeden (bijv. het kind troosten met een snoepje), aanmoedigen (bijv. het kind stimuleren een grote variëteit aan voedingsproducten te consumeren), openlijk controle uitoefenen (bijv. regels stellen over wanneer wel en wanneer niet gesnoept mag worden) en heimelijk controle uitoefenen (bijv. ongezonde voedingsproducten niet in huis halen). Als eetgedragingen werden fruitconsumptie, snackconsumptie en frisdrankconsumptie meegenomen. Instrumenteel en emotioneel voeden hingen op een ongunstige manier samen met fruit- en snackconsumptie van het kind (minder fruit, meer tussendoortjes), terwijl ouderlijke aanmoedigingen, en openlijke en heimelijke ouderlijke controle op een gunstige manier samenhingen met snack- en frisdrankconsumptie van het kind (minder tussendoortjes en frisdrank). Relaties tussen voedingsspecifieke opvoedstijlen en veranderingen in eetgedrag en gewicht van het kind over een periode van een jaar waren over het algemeen vergelijkbaar, hoewel de effectgroottes iets kleiner waren. Met heimelijke controle als uitzondering (heimelijke controle hing ongunstig samen met de gestandaardiseerde BMI score van het kind), hingen voedingsspecifieke opvoedstijlen alleen samen met eetgedrag; niet met gewicht. Hoewel psychologische controle en gedragscontrole sommige relaties tussen voedingsspecifieke opvoedstijlen en eetgedrag van het kind modereerden, was dat niet altijd in de veronderstelde richting.

In **hoofdstuk 4** worden resultaten beschreven van een studie die gedetailleerder kijkt naar de interactie tussen voedingsspecifiek opvoeden en distalere ouderlijke factoren in het verklaren van eetgedrag van een kind. Opvoedstijl, opleidingsniveau van de ouder en etniciteit werden zowel als modererende factor als als achterliggende factor bestudeerd van de relatie tussen fruitconsumptie van de ouder en fruitconsumptie van het kind. Ouderlijke fruitconsumptie en fruitconsumptie van het kind hingen positief met elkaar samen. Ook opleidingsniveau en etniciteit (westerse allochtoon versus autochtoon) hingen positief samen met fruitconsumptie van het kind, terwijl een afwijzende opvoedstijl – gekenmerkt door een hoge mate van psychologische controle en relatief weinig ouderlijke betrokkenheid en gedragscontrole – hier negatief mee samenhing. Opleidingsniveau was een achterliggende factor van de samenhang tussen ouderlijke fruitconsumptie en fruitconsumptie van het kind. Opvoedstijl interacteerde met ouderlijke fruitconsumptie in het verklaren van fruitconsumptie van het kind: het verband tussen ouderlijke fruitconsumptie en fruitconsumptie van het kind was sterker bij relatief veel psychologische controle en relatief veel gedragscontrole. Daarnaast was de relatie onder allochtonen sterker.

In **hoofdstuk 5** staat de interactie tussen voedings- en beweeggerelateerde opvoedpraktijken centraal. Onderzocht is of deze opvoedpraktijken clusteren. Daarnaast is gekeken of de mogelijke clusters samenhangen met kindkenmerken en ouderlijke factoren (inclusief opvoedstijldimensies), en met eet- en beweeggedrag van het kind. Vijf clusters werden gevonden:

1) een cluster gekenmerkt door zichtbaarheid en toegankelijkheid van beeldschermen en ongezond voedsel;
2) een cluster gekenmerkt door voedings- en beweeggerelateerde regels;
3) een cluster gekenmerkt door afwezigheid van ongezond voedsel;
4) een cluster gekenmerkt door positief voorbeeldgedrag wat betreft eten en bewegen;
5) een cluster gekenmerkt door positief voorbeeldgedrag wat betreft sporten en fruit eten.

De studie liet zien dat opvoedpraktijken niet alleen binnen het eet- en beweegdomein clusteren, maar ook daartussen. Daarnaast clusteren opvoedpraktijken naar type thuisomgeving, namelijk naar de fysieke thuisomgeving (cluster 1 en 3), de politieke thuisomgeving (cluster 2) en de socio-culturele thuisomgeving (cluster 4 en 5). Een laag opleidingsniveau van de ouder hing positief samen met cluster 1 (het enige ongezonde cluster), terwijl een hoog opleidingsniveau positief samenhing met drie gezonde clusters.

Daarnaast hingen BMI van het kind, BMI van de ouder, etniciteit en de opvoedstijldimensies psychologische controle en gedragscontrole met één of meerdere clusters samen, over het algemeen in de veronderstelde richting. Zo hingen een hogere ouderlijke BMI en meer psychologische controle samen met cluster 1, terwijl meer gedragscontrole en minder psychologische controle samenhingen met cluster 4. Afzonderlijke clusters hingen zowel met eet- als met beweeggedrag van het kind samen, en in de veronderstelde richting: gezonde clusters hingen samen met gezond gedrag, zoals fruitconsumptie en buitenspelen, terwijl het ongezonde cluster samenhing met ongezond gedrag, zoals snacken en beeldschermtijd (tv-kijken en computeren).

Hoofdstuk 6 beschrijft resultaten van een studie naar eetstijlen van kinderen in relatie tot a) hun eetgedrag en gewicht en b) veranderingen in hun eetgedrag en gewicht over een periode van een jaar. Daarnaast is in deze studie onderzocht of eetstijlen interacteren met ouderlijke opvoedstijl in het verklaren van eetgedrag en gewicht van kinderen. Als eetgedragingen werden fruitconsumptie, snackconsumptie en frisdrankconsumptie meegenomen. Eetstijlen die de voedselinname bevorderen, zoals reageren op het zien van eten, genieten van eten, en emotioneel overeten, hingen positief samen met de gestandaardiseerde BMI-score van het kind en met fruitconsumptie van het kind. 'Eetvermijdende' stijlen, zoals reageren op het gevoel van verzadiging, kieskeurig zijn wat betreft eten en emotioneel ondereten, hingen negatief samen met de gestandaardiseerde BMI-score en fruitconsumptie van het kind. Er werden geen of minder consistente relaties gevonden tussen eetstijlen en snack- en frisdrankconsumptie van het kind. Eetstijlen hingen sterker samen met het gewicht dan met het eetgedrag van het kind. Er waren nauwelijks relaties tussen eetstijlen en veranderingen in eetgedrag en gewicht van het kind over een periode van een jaar. Wat de modererende invloed van ouderlijke opvoedstijl betreft, autoritatief opvoeden elimineerde de negatieve relaties tussen 'kieskeurigheid' en fruitconsumptie van het kind, terwijl een verwaarlozende opvoedstijl de positieve relatie tussen eetstijlen die de voedselinname bevorderen en gewicht van het kind versterkte.

Hoofdstuk 7 beschrijft een studie naar de interactie tussen eet- en beweegvoorkeuren van kinderen. Onderzocht is of deze voorkeuren clusteren. Daarnaast is onderzocht of de mogelijke clusters samenhangen met kindkenmerken, ouderlijke achtergrondfactoren en met ouderlijke opvoedpraktijken. Drie voorkeursclusters werden geïdentificeerd:

1) een cluster van voorkeuren voor ongezond voedsel en ongezond drinken;
2) een cluster van voorkeuren voor beweeggedrag (sporten, buitenspelen en fietsen);
3) een cluster van voorkeuren voor ongezonde drankjes en sedentair gedrag, zoals computeren en tv-kijken.

De studie liet zien dat eet- en beweegvoorkeuren van kinderen clusteren binnen het eetdomein (cluster 1), binnen het beweegdomein (cluster 2), en tussen het eet- en beweegdomein (cluster 3). Verder hingen de clusters samen met het geslacht van het kind en met beweeggerelateerde opvoedpraktijken. Jongens scoorden op alle drie de clusters hoger dan meisjes, terwijl beweeggerelateerde opvoedpraktijken negatief samenhingen met ongezonde voorkeursclusters en positief met het gezonde beweegvoorkeuren-cluster.

Discussie

Het laatste hoofdstuk, **hoofdstuk 8**, gaat in op methodologische kwesties, integreert de belangrijkste resultaten uit de verschillende studies en bespreekt de wetenschappelijke en praktische implicaties van de bevindingen uit dit proefschrift.

Geconcludeerd kan worden dat verschillende niveaus van ouderlijke invloeden (van distaal tot proximaal) en kindkenmerken samenhangen met eetgedrag, beweeggedrag en gewicht van het kind, zowel in directe als in indirecte associaties. De bevindingen uit studies waarin directe relaties werden onderzocht, komen overeen met eerder onderzoek. Opleidingsniveau van de ouder, etnische achtergrond, psychologische controle, instrumenteel voeden, emotioneel voeden, ouderlijk voorbeeldgedrag, het stellen van regels, de beschikbaarheid en toegankelijkheid van voeding en beweegmogelijkheden, en eetstijlen van het kind kunnen dan ook als belangrijke invloeden op eetgedrag, beweeggedrag en/of gewicht van het kind worden gezien. Invloeden die niet (gemakkelijk) te veranderen zijn, zoals opleidingsniveau van de ouder, etnische achtergrond en eetstijlen van het kind, zijn belangrijk om specifieke doelgroepen te identificeren waarop interventies ter voorkoming van overgewicht zich kunnen richten. Generieke interventies voor ouders om eet- en beweeggedrag van hun kinderen te verbeteren, kunnen zich richten op het verbeteren van de algemene opvoedstijl en de opvoedpraktijken van de ouders. Voor het ontwikkelen en op grote schaal implementeren van toegepaste interventies ('advies-op-maat') is het van belang meer inzicht te krijgen in het complexe samenspel tussen opvoedpraktijken, meer distale ouderlijke factoren en kindkenmerken. Het onderzoeken van clustering van determinanten van eet- en beweeggedrag van kinderen is een relatief nieuwe manier om dit samenspel te onderzoeken. Aangezien zowel voorkeuren van kinderen als ouderlijke opvoedpraktijken clusteren in gezonde en ongezonde patronen, is dit een onderzoeksonderwerp dat nadere aandacht verdient.

De bevindingen in dit proefschrift laten zien dat ouders in staat zijn om eet- en beweeggedrag (en daarmee het gewicht) van hun kind te beïnvloeden, en dat zij wat dit betreft kunnen bijdragen aan een ondersteunende thuisomgeving. Kortom, eet- en beweeggedrag zijn zeker familiezaken!

Dankwoord

Een proefschrift is niet af voordat het dankwoord geschreven is. Jaren heb ik ernaar uitgekeken en nu mag het dan eindelijk: alle mensen bedanken die me op de één of andere manier hebben geholpen deze klus te klaren.

Allereerst mijn (co)promotoren. Brigitte, jij verdient de eerste plek. Als jij geen onderzoeksvoorstel had geschreven, was het INPACT-onderzoek nooit van de grond gekomen. Onze samenwerking was kort, maar bedankt voor je enthousiasme, goede zorgen en je creatieve geest! Stef, wat fijn dat jij het gat dat Brigitte achterliet op wilde vullen. Het was prettig hoe je me opnam in de Maastrichtse wereld van (op)voedings- en beweegonderzoek. Ik waardeer je manier van begeleiden: je positieve instelling, je kunst de grote lijn te zien, maar toch ook de punten en komma's eruit te weten halen, je kunst om altijd op tijd te reageren, en je kunst om mensen zichzelf te laten zijn en blijven. Het is altijd leuk om onderzoeksbevindingen met je in een breder perspectief te plaatsen, wat ik als socioloog zo graag doe. Ik vind het zo leuk (en terecht) dat je straks in toga bij mijn verdediging bent! Anke, ik ken weinig mensen die zo grondig te werk gaan als jij. Jouw aanpak heeft mijn proefschrift zeker verbeterd. Dank daarvoor! Dike, mijn promotor, maar daarvoor ook al vele jaren een fijne collega. Dank voor je vertrouwen in mij en de vrijheid die ik daardoor heb gekregen. Ook al heb je het ontzettend druk, het is fijn te weten dat je er altijd voor me bent op momenten dat ik het écht even nodig heb!

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Als een kwalitatief onderzoeker de wondere wereld van het kwantitatieve instapt, is statistische hulp af en toe gewenst. Caspar, dank dat je me wilde helpen! Je hebt me het inzicht gegeven dat kwantitatief onderzoek minder hard is dan vaak wordt voorgewend, en dat er ook in de statistiek meerdere wegen zijn die naar Rome leiden. Laraine, ik heb veel geleerd van je correcties op mijn Engels. Dank daarvoor, en ook altijd zo snel! Monique, opmaken en ontwerpen is jou wel toevertrouwd. En als er iemand is die aan een half woord genoeg heeft, ben jij het wel. Dank voor al je mooie ontwerpen, van nieuwsbrieven tot de vrolijke 'poppetjes'-vragenlijst. Maar zeker ook dank voor het ontwerp van de omslag van mijn proefschrift. Ik ben er erg blij mee!

Eén stabiele factor als paranimf is niet genoeg. Marieke, ik ben erg blij dat jij mijn tweede paranimf wilt zijn. Net als bij een huis moet bij vriendschap het fundament goed zijn; dan kan het een leven lang mee. Wat hebben wij dat fundament op de middelbare school goed gelegd; daar plukken we nu nog steeds de vruchten van. Het is zo fijn met je te kunnen lachen en lief en leed te kunnen delen! Renate, ook jij bent een ware vriendin. Wat ben je toch slim en wat doe je alles toch snel. Je proefschrift is al lang af, en met squash sla je me van de baan, maar wat is het toch fijn dat we elkaar regelmatig zien! Binnenkort weer eens een toontje hoger zingen? Juud en Wil, doen jullie dan gezellig mee ;-). Astrid, wij hebben elkaar al veel te lang niet gezien. Maar áls we elkaar zien of spreken is het goed, en dat is voor mij vriendschap! Sam, ook jij bedankt! Ik had nooit gedacht op het schoolplein een vriendin te vinden, laat staan eentje met wie je ook je werk- en promotiesores kunt delen ;-).

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Lieve Beso, bedankt dat je bent wie je bent. Ik ben zo blij dat je me de tijd en ruimte hebt gegeven mijn proefschrifttaak te voltooien! Het is klaar. Tijd voor nieuwe kansen en uitdagingen. Ik heb er zin in!

Curriculum vitae

Gerda Rodenburg was born on 17 February 1974 in Ouderkerk a/d IJssel, the Netherlands. In 1992 she completed secondary education at the CSG Comenius, Capelle a/d IJssel. Before starting a Bachelor's degree course in Commercial Economics at the Ichthus Hogeschool Rotterdam in 1993, she obtained some working experience in several companies. As part of her Bachelor's education, she studied for 6 months at the Höhere Wirtschafts- und Verwaltungsschule in Lucerne, Switzerland. In 1997 she obtained her Bachelor's degree and began working on a temporary basis. From 1998 onwards, she combined working life with the study of Sociology. In 2002 she obtained her Master's degree, specialisation 'Urban Issues and Policy' and 'Labour and Organisation'. In the final year of her Master's study, she started working as a researcher at the IVO Addiction Research Institute in Rotterdam. She specialised in qualitative research among vulnerable people, including drug addicts, illegal migrants and the long-term unemployed. From the IVO, she worked on secondment at the Risbo research institute (affiliated with the Faculty of Social Sciences of the Erasmus University Rotterdam), and at Tranzo which is Tilburg University's scientific centre for care and welfare. In 2007, she started a PhD project at IVO on parental influences on children's dietary and activity behaviours; this project involved close cooperation with Maastricht University, department of Health Promotion. As part of her PhD project, she obtained her Master's degree in Public Health, specialisation 'Epidemiology' at the Netherlands Institute of Health Sciences (NIHES). From September 2012 she has been working as a researcher at IVO, primarily involved in projects related to alcohol and drug prevention among adolescents. From June 2013 onwards, she holds the position of senior researcher at IVO.

Gerda Rodenburg werd op 17 februari 1974 geboren te Ouderkerk a/d IJssel. In 1992 behaalde zij haar VWO-diploma aan de CSG Comenius te Capelle a/d IJssel. Voordat zij in 1993 aan de opleiding HEAO-Economisch Linguïstisch aan de Ichthus Hogeschool Rotterdam begon, deed zij een jaar werkervaring op bij diverse bedrijven. Als onderdeel van haar HEAO-opleiding studeerde zij een half jaar aan de Höhere Wirtschafts- und Verwaltungsschule in Luzern, Zwitserland. In 1997 rondde zij haar HEAO-opleiding succesvol af en ging aansluitend via uitzendbureaus werken. Vanaf 1998 combineerde zij haar werk met een deeltijdstudie Sociologie aan de Erasmus Universiteit Rotterdam. In 2002 studeerde zij af in de richtingen 'Grootstedelijke Vraagstukken en Beleid' en 'Arbeid en Organisatie'. In het laatste jaar van haar studie startte zij haar onderzoekswerkzaamheden bij het IVO, Instituut voor Onderzoek naar Leefwijzen en Verslaving, te Rotterdam. Zij specialiseerde zich in kwalitatief onderzoek onder kwetsbare groepen, zoals harddrugverslaafden, illegale vreemdelingen en langdurig werklozen. Vanuit het IVO werkte zij op detacheringsbasis bij onderzoeksinstituut Risbo, verbonden aan de Faculteit der Sociale Wetenschappen van de Erasmus Universiteit Rotterdam, en bij Tranzo, wetenschappelijk centrum voor zorg en welzijn van de Universiteit Tilburg. In 2007 startte zij bij het IVO met haar promotieonderzoek naar de invloed van ouders op eet- en beweeggedrag van kinderen. Zij werkte hierin nauw samen met de Universiteit Maastricht, afdeling Gezondheidsbevordering. Als onderdeel van haar promotietraject behaalde zij in 2011 een Master's degree in Gezondheidswetenschappen, specialisatie Epidemiologie, bij het Netherlands Institute for Health Sciences (NIHES). Sinds september 2012 hield zij zich als onderzoeker bij het IVO vooral bezig met projecten gericht op alcohol- en drugspreventie bij jongeren. Vanaf juni 2013 vervult zij binnen het IVO de functie van senior-onderzoeker.

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