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Research review

How parental dietary behavior and food parenting practices affect children's dietary behavior. Interacting sources of influence?

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ABSTRACT

Until now, the literatures on the effects of food parenting practices and parents' own dietary behavior on children's dietary behavior have largely been independent from one another. Integrating findings across these areas could provide insight on simultaneous and interacting influences on children's food intake. In this narrative review, we provide a conceptual model that bridges the gap between both literatures and consists of three main hypotheses. First, parental dietary behavior and food parenting practices are important interactive sources of influence on children's dietary behavior and Body Mass Index (BMI). Second, parental influences are importantly mediated by changes in the child's home food environment. Third, parenting context (i.e., parenting styles and differential parental treatment) moderates effects of food parenting practices, whereas child characteristics (i.e., temperament and appetitive traits) mainly moderate effects of the home food environment. Future studies testing (parts of) this conceptual model are needed to inform effective parent-child overweight preventive interventions.

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Contents

Introduction	2
Our conceptual model	2
Article outline	2
Parental dietary behavior and their food parenting practices: a broad literature review	2
Parents' dietary behavior	3
Food modeling mechanism and effect	3
Food parenting practices	3
Food restriction and pressure	3
Instrumental and emotional feeding	4
Stimulation of healthy and prevention of unhealthy intake	4
Conclusion	5
Parental dietary behavior and food parenting practices: interactive sources of influence?	5
Parenting context	5
Parenting dimensions and styles	5
Differential parental treatment	6
Child's characteristics	6
Temperament	6
Appetitive traits	7
General conclusion	7
References	9

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Introduction

Childhood obesity is a serious public health epidemic in most industrialized countries (Ebbeling, Pawlak, & Ludwig, 2002; Lobstein, Baur, & Uauy, 2004; Wang & Lobstein, 2006). It has generally been acknowledged that facets of the current dietary environment contribute to obesity among children. Numerous obesogenic environmental influences have been distinguished according to the ANGELO (ANalysis Grid for Environments Linked to Obesity) framework, with influences being distinguished on the micro- and macro-environmental levels (Kremers, 2010; Swinburn, Egger, & Raza, 1999). Parents are considered a key influence in children's micro-environments. In this narrative review, we focus on 'diet' and 'diet-related' parenting practices, referred henceforth as 'food parenting practices' (Baranowski et al., 2013; Hughes et al., 2013). This perspective focuses on diet with the acknowledgement that environmental influences naturally include both activity and diet-related processes, and potential clustering of activity and diet (Kremers, 2010). We discuss the micro-environmental home setting parents create for their children by their own intake and the food parenting practices they use to socialize their children. We highlight distinctions and potential areas of overlap in literatures on parent-child dietary behavior and food parenting practices.

To the best of our knowledge, previous studies have not evaluated interactions between parental dietary behavior and food parenting practices, which refer to food-specific discrete, observable acts of parenting (Power, 2013; Power et al., 2013). One previous study reported an interaction between parental dietary behavior (i.e., fruit consumption) and the *general* parenting context in explaining adolescents' fruit consumption (Rodenburg, Oenema, Kremers, & van de Mheen, 2012). We propose that examining interactions between parental dietary behavior and food parenting practices may reveal important insights into how parents influence the home food environment and, subsequently, shape children's dietary behavior. These findings may direct the development of evidence-based child obesity preventive interventions.

Hence, the overarching aim of this review is to present the rationale for a new conceptual model that bridges a gap between the literature that considers how children's dietary intake is influenced by parents' own dietary behavior and the literature that examines the impact of food parenting practices. In our view, this conceptual model indicates the most important pathways for understanding children's dietary behavior related to overweight and obesity. It is important to note that this paper does not provide a systematic review of the literature. Instead, we provide an opinion-based review that addresses the pathways in the proposed conceptual model. Illustrative examples are included in the interest of stimulating research in potentially eminent interactive pathways. Our conceptual model mainly focuses on infants, preschoolers and school-aged children, as the shared environment appears to play a substantial role in determining their dietary behaviors (Hasselbalch, Heitmann, Kyvik, & Sorensen, 2008; Pimpin et al., 2013; Wardle & Cooke, 2008). However, in providing evidence for our model we also use literature among adolescents.

Our conceptual model

Figure 1 summarizes our conceptual model describing parental influences on child's dietary behavior via their own dietary behavior and their food parenting practices. The model consists of three main hypotheses. First, parental dietary behavior and food parenting practices are important interactive sources of influence on children's dietary behavior and Body Mass Index (BMI). Second, parental influences are importantly mediated by changes in the child's home food environment. Third, parenting context (i.e., parenting styles and differential parental treatment) moderates effects of food

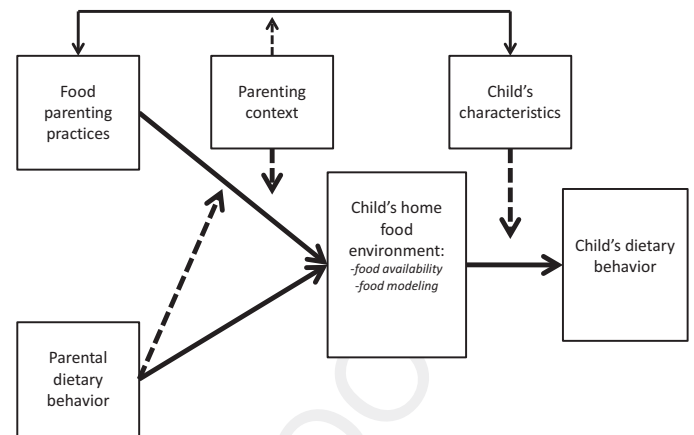


Fig. 1. Conceptual model of how parents influence their child's dietary behavior. Note: Dotted lines are moderating effects; thicker lines indicate most important effects

parenting practices, whereas child characteristics (i.e., temperament and appetitive traits) mainly moderate effects of the home food environment.

Article outline

In the following section we present the rationale for our conceptual model (and first two hypotheses) by providing a broad overview of the literature on parental dietary behavior and food parenting practices. We discuss the mechanisms involved and potential interactive effects between parental dietary behavior and food parenting practices. Then, we discuss our third hypothesis pertaining to moderating influence of the parenting context (i.e., parenting styles and differential parental treatment) and child characteristics (i.e., temperament and appetitive traits). Finally, we end with conclusions and recommendations for future research.

Parental dietary behavior and their food parenting practices: a broad literature review

According to some scholars, parents are responsible for structuring their children's food environment, the 'when', 'what', and 'how much' of food provided, while children should be allowed to determine 'how much' to eat of the food (portions) provided to them (Johnson, 2000; Satter, 1995). That young children are under certain conditions able to determine 'how much' they should eat follows from research demonstrating that infants and young children can modify their food intake in response to the energy content of food (Birch & Deysher, 1985, 1986; Spill, Birch, Roe, & Rolls, 2011), can learn to associate flavor cues with energy in foods (Birch & Deysher, 1985, 1986), and appear to have a relatively stable daily dietary behavior patterns, despite variations from meal to meal (Birch, Johnson, Andresen, Peters, & Schulte, 1991; Stein, Shea, & Basch, 1991). Whereas infants and young children are generally very good at self-regulating their energy intakes, they are thought to become more attuned to external signals as they develop (Mela, 2001), and parents may play an eminent role in this development. The apparent innate sensitivity to the energy content of the food may be disturbed when children are instructed by adults to focus on external instead of internal signals of hunger and satiety (Birch, McPhee, Shoba, Steinberg, & Krehbiel, 1987; Johnson, 2000). We propose that most detrimental parental effects are those that stimulate a high energy-dense food environment. Large portions of energy-dense food may promote excess consumption among children as young as 2 years of age (Fisher & Kral, 2008; Rolls, 2000). Moreover, exposure to a variety

of energy-dense foods might also promote excess consumption and the development of early obesity, although more research is needed to understand the link between variety and obesity (Nicklaus, 2009). Thus, parental influences may importantly influence children's dietary behavior, and these influences may operate through parents' own dietary behavior and food parenting practices.

Parents' dietary behavior

Parental dietary behavior is regarded as a passive process influencing the child's food environment and subsequent dietary behavior. Cross-sectional studies have shown parent-child correspondence in the intakes of healthy and unhealthy foods and drinks, particularly for mothers (Cooke et al., 2004; Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002; Fisk et al., 2011; Grimm, Harnack, & Story, 2004; Hart, Raynor, Jelalian, & Drotar, 2010; McGowan, Croker, Wardle, & Cooke, 2012; Oliveria et al., 1992; Ovaskainen et al., 2009; Sonnevile et al., 2012; Wroten, O'Neil, Stuff, Liu, & Nicklas, 2012; Zuercher, Wagstaff, & Kranz, 2011). However, a meta-analysis revealed that these associations were rather weak though consistent, with associations being slightly stronger for fat intake and for non-USA samples (Wang, Beydoun, Li, Liu, & Moreno, 2011). This might indicate greater similarity in parent-child dietary composition and greater similarity when more meals are eaten together by parents and children (in the USA school meals among school-age children and adolescents are more common compared to most non-USA countries) respectively. Although this correlational work has generated evidence demonstrating that parents' dietary behavior might – at least to some extent – influence children's intake, these studies cannot be used to infer causality. Therefore, the processes by which parents affect their children's food intake by means of their own intake remain largely unclear.

Shared genetics may play a role in parent-child correspondence in intakes: however, home environmental factors, such as food availability and food modeling, may even be more important among younger children. A large population-based twin study has shown that shared environmental influences are the predominant drivers of dietary behavior in young children (Pimpin et al., 2013). Among older children, twin studies provide evidence for both genetic and shared environmental effects on food preferences and dietary behavior (Hasselbalch et al., 2008; Wardle & Cooke, 2008). This may suggest that parental influences on children's dietary behavior decline as children age and genetic effects become more visible. With 'food availability' we refer to energy-density, variety, and portion size, well-known environmental guidelines influencing intake (de Coen et al., 2012; Fisher & Kral, 2008; Herman & Polivy, 2008; Rolls, 2000). With 'food modeling' we refer to social learning that occurs when parental food intake behaviors are observed and eventually modeled by children (Herman & Polivy, 2005). It should be emphasized in this review that 'food availability and modeling' are regarded as overall characteristics of the home food environment, whereas specific availability and modeling practices (i.e., being enthusiastic about eating healthy foods) have also been distinguished as food parenting practices (Gevers, Kremers, de Vries, & van Assema, 2014). Although a detailed review of the environmental 'food availability' mechanism runs beyond the scope of this review, we nevertheless give a brief overview on food modeling in the following section.

Food modeling mechanism and effect

According to Bandura (1977), modeling is a cognitive process whereby individuals form beliefs and attitudes about the behaviors they observe in others, which in turn shapes their own behavior. In other words, children's perceptions of the eating of their parents might influence their own food intake eventually leading children to adopt their parents' eating behaviors, such that parental 'norms'

provide a reference for what is appropriate (Herman & Polivy, 2005). Modeling is therefore likely to affect long-term consumption patterns through established eating norms conveyed through the food choices and amounts consumed by parents. However, it has also been proposed that modeling effects could be explained by direct behavioral mimicry effects (Hermans et al., 2012). Behavioral mimicry refers to a process in which a person unwittingly imitates the behavior (e.g., gestures, postures) of another person, occurring because of the tight neural link between perception and action (Iacoboni et al., 1999). Notably, the normative explanation of modeling considers psychological affiliation (shared group membership) as a requirement for modeling (Cruwys, Bevelander, & Hermans, 2015), whereas the mimicry explanation considers psychological affiliation as an antecedent or consequence of modeling, with reciprocal positive associations found between mimicry and liking (Chartrand & Bargh, 1999; Lakin & Chartrand, 2003). Regardless of the precise mechanisms, however, it is assumed that children model parents' food intake. There are a few lines of evidence that support this idea.

From a review of experimental studies on (healthy) food selection it becomes clear that children are more likely to select and eat an unfamiliar food if they see another person eating the food (Shutts, Kinzler, & DeJesus, 2013). In addition, a recent review on modeling of food intake shows that modeling effects are rather robust; with nearly all studies showing significant food modeling effects, despite substantial variability in methodology, food type, social context and participant demographics (Cruwys et al., 2015). So far, however, far too little attention has been paid to parent-child modeling and experimental research on this topic is lacking.

Food parenting practices

Just like parental dietary behavior, food parenting practices may also influence children's dietary behavior via food availability and modeling. However, food parenting practices are regarded as more active processes, where a parent for instance specifically chooses to buy a specific food product or chooses to model eating behaviors in front of the child as a way of trying to promote the behavior. It should be noted that food parenting practices were originally thought to influence children's appetitive traits, following from an older experimental line of research suggesting that the use of restrictive feeding practices can increase the appeal of restricted foods and lead to increased intake in circumstances where those restrictions are lifted (Birch, Fisher, & Davison, 2003; Fisher & Birch, 1999). However, food parenting practices do not only affect appetite. Subsequent research has revealed a wide range of practices that can influence the child's food environment (Gevers et al., 2014). In general, practices that are highly controlling or use food as a way to change children's behavior or mood appear to be less effective in promoting moderate dietary intake among children, as follows from the following overview on food restriction, food pressure, instrumental feeding and emotional feeding. In contrast to these seemingly less effective practices, also potentially important practices stimulating healthy and preventing unhealthy intake will be discussed.

Food restriction and pressure

The food parenting practices literature has mainly arisen from investigations of two highly controlling strategies – food restriction (focusing on the prevention of unhealthy intake) and pressure to eat (stimulating food intake). When parents use more controlling practices, children may focus more on external rather than internal signals of hunger and satiety, which may impede eating self-regulation (Johnson & Birch, 1994). Moreover, experimental studies demonstrate that children who are pressured to eat certain foods may show decreased preference for those foods later on, while

children who are restricted may develop increased preferences for restricted foods (Ventura & Wroboey, 2013). Thus, pressure and restriction may induce unintended effects on food preferences among children. The timing of effects on intake, however, seems to be important here. That is, it seems that the effects of food restriction on increased consumption are delayed (i.e. when the child is given free access to the food later on), whereas the effects of pressure to eat appear to operate during eating occasions where pressure is used (i.e. decreased intake) (Fisher & Birch, 1999; Galloway, Fiorito, Francis, & Birch, 2006; Jansen, Mulkens, & Jansen, 2007). Among the same line, concurrent correlational research often reports restriction to be positively, and pressure to eat negatively, associated with children's food intake and weight status (Faith, Scanlon, Birch, Francis, & Sherry, 2004; Ventura & Birch, 2008). However, some observational studies among preschoolers have shown that parental pressure or prompting to eat was not (Lewis & Wroboey, 2011; Lumeng & Burke, 2006) or positively (Drucker, Hammer, Agras, & Bryson, 1999; Klesges et al., 1983; Klesges, Malott, Boschee, & Weber, 1986; Lumeng et al., 2012) associated with the child's speed of eating, food intake and BMI. Similar survey findings were reported for restriction among younger children: no association, or a negative association was observed between parental restriction and children's eating and/or weight (Campbell et al., 2010; Carnell & Wardle, 2007; Farrow & Blissett, 2008; Gregory, Paxton, & Brozovic, 2010; Gubbels et al., 2009; Powers, Chamberlin, van Schaick, Sherman, & Whitaker, 2006). These findings suggest that parents of preschoolers have somewhat more control over their children's dietary behavior and, subsequently, BMI development when using controlling food parenting practices.

To date, the longitudinal work on highly controlling feeding practices has mainly focused on older children. These studies appear to support an interpretation of reverse causality involving child effects instead of parental effects. In particular, parental pressure to eat appears to be exerted in response to children with lower intakes and lower weight (Spruijt-Metz, Li, Cohen, Birch, & Goran, 2006; Webber, Cooke, Hill, & Wardle, 2010). More longitudinal studies of food restriction have been performed, providing mixed evidence, with some studies suggesting that food parenting practices are a response to child adiposity (Payne, Galloway, & Webb, 2011; Rhee et al., 2009; Spruijt-Metz et al., 2006) and others finding effects of parental restriction to increase child's intake or BMI (Birch et al., 2003; Faith, Berkowitz et al., 2004; Francis & Birch, 2005). It can, thus, be concluded that highly controlling food parenting practices do not seem to be effective in stimulating healthy intake and may be partly driven by child effects, although the field is in particular need of longitudinal studies among preschoolers.

Instrumental and emotional feeding

Food parenting practices in which food is used as a reward to control children's behaviors (instrumental feeding) or emotions (emotional feeding) also do not seem to be effective in stimulating healthy children's intake. Experimental research suggests that children whose mothers often use food to regulate emotion consume more palatable foods than do children whose mothers use this feeding practice less often where emotional overeating may be elicited in response to negative mood (Blissett, Haycraft, & Farrow, 2010). Among the same line, it has been demonstrated that emotional feeding is associated with increases in child obesogenic eating behaviors (Rodenburg, Kremers, Oenema, & van de Mheen, 2014; Rodgers et al., 2013). In addition, higher levels of emotional feeding have been reported by mothers with lower education (Saxton, Carnell, Van Jaarsveld, & Wardle, 2009), suggesting that emotional feeding may partly explain the well-known association between lower socio-economic status (SES) and obesity (McLaren, 2007). When parents use food as a reward for desired behaviors among their offspring, children show increases in their energy-dense snack

intake and BMI scores over time (Rodenburg et al., 2014; Rodgers et al., 2013). These influences on children's dietary behavior may be due to direct changes in the child's obesogenic home environment (e.g., offering more candies), with instrumental and emotional feeding characterized by the use of unhealthy food products (Raaijmakers, Gevers, Teuscher, Kremers, & van Assema, 2014). It is possible that parents who use these strategies also structure the home environment in a way that is more obesogenic than parents who do not; such practices may cause children to associate negative emotions and eating in a manner that results in unhealthy eating patterns. To date, research on the use of (mostly unhealthy) food rewards and feeding to modulate children's emotions is sparse. Studies of immediate and longer-term mediating mechanisms explaining effects of these practices on child's dietary behavior are needed.

Stimulation of healthy and prevention of unhealthy intake

Some forms of parental food parenting practices appear to influence healthy intake among children. For instance, experimental research has shown that offering children larger portions of vegetables and fruits produces modest increases in intakes among children who like those foods (Mathias et al., 2012; Savage, Fisher, Marini, & Birch, 2012; Savage, Haisfield, Fisher, Marini, & Birch, 2012; Spill, Birch, Roe, & Rolls, 2010). This supports the idea of deliberately using larger portion sizes to stimulate intake of healthy foods. Similarly, parents may also increase the variety of different healthy foods provided, considering that food variety also increases consumption (Nicklaus, 2009). The opposite may also be true where parents may decrease portion sizes and variety of unhealthy food to limit intake. These parental influences on a child's intake mainly reflect changes in the child's food environment. These changes may be due to passive processes arising from (changes in) the shared family food environment, but may also be due to active acts from parents (food parenting practices). When parents actively restrict access by keeping so-called 'junk-food' out of the home, this has often been defined as 'covert control' (Mitchell, Farrow, Haycraft, & Meyer, 2013). Longitudinal survey studies suggest that covert types of restriction that shape the food environment are more beneficial than overt types of food restriction involving interactions between parent and child to reduce the amount and/or types of food children eat (Rodenburg et al., 2014; Rodgers et al., 2013). Future research should examine the mechanisms underlying these seemingly positive and negative aspects of restriction.

Besides these food parenting practices influencing the obesogenic home environment, parents also have a more active role in promoting children's acceptance of and, eventually, preference for novel or disliked foods, such as certain vegetables (Ventura & Wroboey, 2013). For instance, experimental research has shown that the use of rewards for tasting new foods increased preference for and consumption of those foods (Birch, Zimmerman, & Hind, 1980; Wardle, Herrera, Cooke, & Gibson, 2003). Similarly, repeated exposure of food intake has been shown to increase preference for and consumption of healthy foods (Anzman-Frasca, Savage, Marini, Fisher, & Birch, 2012; Hausner, Olsen, & Moller, 2012). Experimental research demonstrates that children were also more likely to eat novel food when adult models were eating the same food (Addessi, Galloway, Visalberghi, & Birch, 2005). In addition, the facial expressions of eating models influence preschool aged children's desire to eat particular foods (Barthomeuf, Droit-Volet, & Rousset, 2012; Frazier, Gelman, Kaciroti, Russell, & Lumeng, 2012). Although these food modeling studies have been mainly performed among teachers, observational findings suggest that food modeling practices whereby parents actively eat (novel) healthy foods and show positive facial reactions to these foods in the presence of their children could help in stimulating children to smell and try these foods (Blissett, Bennett,

Donohoe, Rogers, & Higgs, 2012). In sum, rewarding children for trying new foods, repeated exposure and food modeling are examples of food parenting practices that parents can use to stimulate healthy intake among their offspring. Additionally, experts suggest that food parenting practices that provide reasoning and education may be beneficial, although such food parenting practices have hardly been studied (Gevers et al., 2014). Research on the development of emotion regulation demonstrates may benefit from practices that help children understand emotional regulation and its control (Morris, Silk, Steinberg, Myers, & Robinson, 2007). Along the same line, we expect that educating children about and discussing food preferences may be important food parenting practices to be considered. These practices might for instance directly impact the child's food environment by increasing the probability of parent-child food modeling. Future research should examine whether and why reasoning and education are beneficial practices.

Finally, as consumption of sugar-sweetened beverages (SSBs) and diets higher in energy density may promote increases in BMI in adults and in children (Mesas, Munoz-Pareja, Lopez-Garcia, & Rodriguez-Artalejo, 2012; Perez-Escamilla et al., 2012; Valdes, Rodriguez-Artalejo, Aguilar, Jaen-Casquero, & Royo-Bordonada, 2013), active monitoring and setting clear limits or rules about eating are proposed to be important food parenting practices determining the child's obesogenic home environment (Gevers et al., 2014). Parents should have clear expectations or rules about when and what can be eaten and drunk during the day (with some restriction or limited access to certain products being seemingly necessary), and should stimulate regular family meals eaten together at the dinner table.

Conclusion

In sum, parents may function as gatekeepers in this obesogenic world and support children's attendance to internal signals of satiety while simultaneously controlling healthy dietary behavior. They may do so by covertly avoiding (consumption of) 'junk-food', avoiding food for reward or emotional regulation, providing clear and healthy rules about when and what can be eaten, providing larger portions with a variety of healthy foods (and vice versa lower portions with less variety of unhealthy foods), and stimulating healthy intake by repeated exposure, rewarding the child for trying new and healthy foods, and active healthy food modeling (e.g., smiling when eating healthy food themselves). Nevertheless, as child's appetitive traits have high genetic origin (Carnell, Haworth, Plomin, & Wardle, 2008), and it is the environment that drives up obesity rates (Hill, Wyatt, Reed, & Peters, 2003; Swinburn et al., 2011), we suggest that the most important food parenting practices underlying the obesity epidemic are those (e.g., rules, monitoring, structure, modeling practices) that directly influence the home food environment (i.e., food availability and modeling) compared to those food parenting practices (e.g., restriction, pressure, rewarding, encouragement) that act more directly on child appetitive traits. Because of the limitations of current evidence (i.e., mostly cross-sectional or short-term experimental studies focusing on a few food parenting practices) more research is necessary to support this suggestion.

Parental dietary behavior and food parenting practices: interactive sources of influence?

We propose that the use of food parenting practices that stimulate children's intake of healthy foods and prevent intake of unhealthy foods are particularly important for parents having unhealthy dietary behavior themselves. Support for this idea can be found in the alcohol literature (Kuendig & Kuntsche, 2006; van den Eijnden, van de Mheen, Vet, & Vermulst, 2011). Beneficial parenting characteristics (i.e., better parental bonding, stricter alcohol rules) have been associated with lower alcohol use among adolescents

whose parents drink excessively. Those observations suggest that more effective parenting is necessary to prevent alcohol use among those adolescents whose parents drink excessively. In the same line, we hypothesize that parents with more unhealthy dietary behavior need more healthy food parenting practices and rule setting to prevent unhealthy dietary behavior among their children, whereas parents with more healthy dietary behavior are in less need of healthy food parenting practices. With regard to childhood obesity prevention, we speculate that it is easier to change food parenting practices than parents' own dietary behavior, considering that weight control research has been less successful in improving long-term success among adults (Jeffery et al., 2000). A first step for research is to examine whether beneficial food parenting practices may influence children's dietary behavior and BMI for families in which parents have unhealthy dietary behavior themselves. To the best of our knowledge, there have not been studies on this topic. Hopefully, this review will stimulate research on interactive effects between parents' own dietary behavior and their food parenting practices, in line with the first hypothesis of our conceptual model.

Parenting context

In our conceptual model, and that of others (Sleddens, Gerards, Thijs, de Vries, & Kremers, 2011), the parenting context is thought to influence effects of food parenting practices on child dietary outcomes. With parenting context we refer to the general cross-situational variation in general parenting approach, often evaluated in terms of parenting styles or dimensions (Power, 2013).

Parenting dimensions and styles

Two parenting dimensions that have often been used are the dimensions of 'responsiveness to the child' and 'control or demands on the child' (Power, 2013). A third general parenting dimension that has been relatively often used is parental consistency, the degree to which parents provide their child with a predictable, organized, and consistent environment (Sleddens, O'Connor et al., 2014). Some researchers evaluate general parenting dimensions in isolation and consider potential interactions between single dimensions (variable-centered approach), whereas others use a person-centered perspective in which scores on multiple dimensions are used to classify parents into various parenting styles. Parenting styles are usually classified into typologies varying according to the dimensions of 'responsiveness to the child' and 'demands on the child': authoritative (high demands, high responsiveness); authoritarian (high demands, low responsiveness); indulgent/permissive (low demands, high responsiveness); and uninvolved (low demands, low responsiveness) (Power, 2013).

Parenting styles may also vary across different domains. Hughes and colleagues developed the Caregiver's Feeding Styles Questionnaire (CFSQ) to examine dimensions of demandingness and responsiveness in the eating context (Hughes, Power, Fisher, Mueller, & Nicklas, 2005). Indulgent feeding styles were associated with the greatest risk at childhood obesity (Hughes et al., 2005, 2007, 2011; Hughes, Shewchuk, Baskin, Nicklas, & Qu, 2008). Items of the CFSQ refer to behaviors at the dinner table (e.g., tells child to eat a small amount of food, tells child to eat something on the plate, arranges food to make it more interesting). Rather than focusing on control and responsiveness solely at the dinner table, Gevers and colleagues suggest the need to distinguish higher order-dimensions (i.e., control, responsiveness and structure) from a variety of food parenting practices (Gevers et al., 2014). These higher order-dimensions are distinct from general parenting dimensions in that they are food (domain) specific. The higher order feeding dimensions may predict children's dietary behavior in the context of general parenting styles.

So far, most studies have examined the relationship between general parenting styles and children's weight status. Reviews of intervention studies (Gerards, Sleddens, Dagnelie, de Vries, & Kremers, 2011) and survey studies (Sleddens et al., 2011) support the idea that authoritative parenting is associated with better weight(-related) outcomes compared to other parenting styles. However, these direct effects are rather small and tend to be more indirect (Cislak, Safron, Pratt, & Gaspar, 2012). Hence, they do not support making general parenting styles a main target of preventing and treating obesity (Pinquart, 2014). Increasing parental consistency might be a better target, as some promising prospective research suggests that parental inconsistency preceded increases in offspring BMI (Jansen, Giallo, Westrupp, Wake, & Nicholson, 2013; Pinquart, 2014). However, effects were small. Therefore, we propose that the general parenting context, particularly the consistency with which practices are being performed, may moderate the effects of food parenting practices on child outcomes, as results from one recent study suggest (Gevers, van Assema, Sleddens, de Vries, & Kremers, 2015).

This idea of the moderating influence of the parenting context is in line with the contextual model of parenting style recommended by Darling and Steinberg (1993). In this case, parenting style is regarded as a contextual 'emotional climate' variable that moderates the relationships between specific parenting behaviors (in this case food parenting practices) and child outcomes, with authoritative parenting often being regarded as the most beneficial parenting context to influence specific parenting practices. In line with the contextual model of parenting style, most studies have supported the idea that controlling food parenting practices are related to healthier eating when exercised in an authoritative parenting context (Joyce & Zimmer-Gembeck, 2009; Lessard, Greenberger, & Chen, 2010; Tung & Yeh, 2014; van der Horst et al., 2007). To date, van der Horst and colleagues found that the positive association of restrictive food parenting practices with adolescents' lower sugar-sweetened beverage consumption was stronger when parents were moderately controlling or highly involved (van der Horst et al., 2007). A somewhat similar finding was observed in older adolescents among whom higher levels of parental eating persuasion were associated with more healthy eating habits for adolescents experiencing more parental warmth, but with less healthy eating habits for adolescents experiencing less parental warmth (Lessard et al., 2010). These findings were extended by a more recent longitudinal study in which increased maternal monitoring (keeping track of the sweets, snacks and high-fat foods that children eat) was associated with a decreased chance of having an overweight child among mothers with a more authoritative parenting style, but with an increased chance of having an overweight child one year later for mothers with a more authoritarian parenting style (Tung & Yeh, 2014). In the same line, encouragement and covert control were prospectively associated with desirable child dietary behaviors, particularly for children reared in a positive parenting context (Sleddens, Kremers et al., 2014). Null results, however, have also been reported (Taylor, Wilson, Slater, & Mohr, 2011).

In sum, most survey studies suggest that food parenting practices work better and induce more healthy dietary behavior among offspring of parents with general authoritative styles. The underlying reasons for this observation are unclear. Is it because rather similar practices work better for authoritative parents, for instance, because those parents may provide a warmer emotional climate in which children are more likely to comply with parental requests? Or do authoritative parents use (other) more effective practices than other parents, for instance by using other forms of control or providing a more consistent parenting context in which food parenting practices have greater impact on the home food environment? One study suggests that authoritative parenting is associated with a less obesogenic home environment (Johnson, Welk, Saint-Maurice, &

Hmels, 2012). Another study found that more strict rules in the family with regard to health behaviors, including rules for mealtime, bedtime, and screen time, combined with low parental responsiveness was associated with lower intakes of energy-rich foods among children (Ray, Kalland, Lehto, & Roos, 2013). These findings suggest that a warm emotional climate is not the sole moderating mechanism to explain effects on children's dietary intake. It has previously been proposed that authoritative mothers might control intake by not buying certain foods (covert control), whereas authoritarian mothers might control food intake by saying 'no' (Wardle & Carnell, 2007). As such, differences in the specific use of food parenting practices may underlie differences in parenting styles. Future research should further examine these mechanisms that may explain authoritative parents' often reported greater success in their food parenting practices. Overall, the consistency and control way (overt versus covert) with which food parenting practices have been employed appear to be potentially promising mechanisms to explain the apparent effectiveness of food parenting practices among authoritative parents. These practices might be more often exerted by mothers with higher education (Saxton et al., 2009).

Differential parental treatment

Sibling studies have shown that parents treat their children differently. To some extent, this may reflect adaptive and flexible reactions to child differences in temperament or appetitive traits. Large differences in parental treatment between siblings, however, appear to have clear negative effects on internalizing and externalizing problems among children (Buist, Dekovic, & Prinzie, 2013). There are only a few studies examining effects of differential food parenting practices between siblings on eating behavior and dietary intake. Most studies have focused on extremely controlling food parenting practices, including pressure and restriction (Farrow, Galloway, & Fraser, 2009; Horn, Galloway, Webb, & Gagnon, 2011; Payne et al., 2011). Differences were found between siblings for pressure and restriction, with these differences being mainly associated with child temperament, appetitive traits, and concerns parents have for their individual child weight, rather than with actual child weight status. Thus, restriction and pressure partly appear to be non-shared environmental factors led by individual child effects and weight concerns parents have for that specific child, rather than being potential factors influencing children's BMI, although more research is necessary.

Instead of focusing on Differential Parental Treatment (DPT) with regard to extremely controlling food parenting practices, it may be useful to expand the research area to investigate whether DPT might influence effects of other, seemingly more effective, food parenting practices. Children might be less likely to follow certain practices and rules when they notice that particular rules and other food parenting practices are specific to them (i.e., that they are treated differently compared to their brother or sister). Future studies should examine potential effects of DPT with regard to other food parenting practices and may also include DPT effects of parenting styles.

Child's characteristics

The third hypothesis of our conceptual model also included interactions between child's characteristics and the home food environment. This 'interactionist' approach takes into account that some children are more vulnerable to obesogenic environmental influences than others (Kremers et al., 2013).

Temperament

Temperament refers to differences in innate behavioral style, including emotional reactions and patterns of self-regulation (Sansón,

Hemphill, & Smart, 2004). Bergmeier and colleagues reviewed broad temperament traits in preschoolers, including poor self-regulation or impulsivity, high emotionality, low negative affectivity and high and low soothability, that are potentially implicated in the development of child overweight and obesity (Bergmeier, Skouteris, Horwood, Hooley, & Richardson, 2014). Most studies support a link between child temperament and child BMI in preschoolers, and longitudinal studies support a link between difficult child temperament and more rapid weight growth (Bergmeier et al., 2014). A meta-analytic review on the particular role of impulsivity in pediatric obesity reported that impulsivity was greater among overweight/obese children compared to healthy weight children (Thamotharan, Lange, Zale, Huffhines, & Fields, 2013). In addition, early child difficult temperament has shown associations with obesogenic diets in later childhood (Vollrath, Stene-Larsen, Tonstad, Rothbart, & Hampson, 2012). This supports the idea that early child temperament plays a role in the development of children's diets and weight gain. Parents may play an obvious eminent role herein. Bergmeier and colleagues also reported on a few studies showing an association between child temperament and maternal feeding practices involved in obesogenic risk factors for young children. In this context, the work of Blissett and colleagues is worth noting. These scholars have reported consistent associations between difficult infant temperament and food parenting practices (Blissett & Farrow, 2007; Haycraft & Blissett, 2012). The association between difficult child temperament and food parenting practices has also been found among school-aged children (Horn et al., 2011). Food parenting practices may thus explain why children with more difficult temperaments display a more unhealthy diet and are more often obese than other children. Future prospective studies should examine whether food parenting practices may mediate the link between children's temperament and weight gain.

In addition to an indirect effect of child's temperament on child's dietary behavior and BMI via food parenting practices, some studies suggest that particular temperament traits interact with food parenting practices. For instance, Gubbels and colleagues found that food parenting practices showed a stronger association with dietary intake in 2-year olds with a more easy temperament (Gubbels et al., 2009). In addition, the inverse relation between inhibitory control and children's weight status was strongest among children who had parents employing restrictive food parenting practices (Anzman & Birch, 2009). In the same line, Rollins and colleagues recently observed greater increases in intake in response to restriction, particularly among children with lower regulatory of higher appetitive tendencies (Rollins, Loken, Savage, & Birch, 2014). However, in line with our conceptual model and 'interactionist' models (Kremers et al., 2013), most research has focused on whether temperament, and particularly poor self-regulation, interacts with the food environment. More impulsive and reward-sensitive children and adults appear to be more adversely affected by unhealthy food environments including sensory food cues and food-conditioned environments (Appelhans et al., 2012; Guerrieri, Nederkoorn, & Jansen, 2008; Nederkoorn, Guerrieri, Havermans, Roefs, & Jansen, 2009; Paquet et al., 2010; Scholten, Schrijvers, Nederkoorn, Kremers, & Rodenburg, 2014; van den Akker, Jansen, Frentz, & Havermans, 2013). However, it may be that less impulsive people are more strongly affected by subtle or normative environmental food cues. We have observed that young adult females who reported less impulsive behaviors modeled the food intake of another female more strongly and reacted more strongly to a subtle olfactory food cue in addition to food being present (Hermans, Larsen, Herman, & Engels, 2012; Larsen, Hermans, & Engels, 2012). This might illustrate the ability of less impulsive individuals to have greater control over eating and activity behaviors according to subtle cues and parental guidelines or norms (i.e., normative environments). Alternatively, more impulsive children may be more strongly influenced by sensory food

environments. However, research is necessary to further investigate this assumption.

Appetitive traits

Research suggests that child appetitive characteristics (similar to temperament) are rather stable and predominantly determined by genes (Carnell et al., 2008). According to dual process frameworks, the child's impulsivity (i.e., lack of inhibitory control) should be considered in interaction with the child's appetitive traits (automatic traits). In support of these frameworks, adult research has shown that inhibitory control moderated the influence of automatic snack food preference on the amount of food eaten and weight gain (Hofmann, Friese, & Roefs, 2009; Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010). In addition, research has shown that children who found food highly reinforcing and showed that food-related impulsivity had a blunted response to environmental enrichment treatment, that is, the presence of alternatives to unhealthy foods in the home and neighborhood environments (Best et al., 2012). This suggests that heightened appetitive traits, in combination with impulsivity, makes achieving healthy child dietary behavior through changes in the home food environment difficult for parents. However, more research is necessary. Parenting styles may also moderate the associations between appetitive traits and child's intake and weight status, thus, parenting context should also be taken into account (Rodenburg, Kremers et al., 2012).

General conclusion

Although previous research has identified moderators (i.e., child temperament and parenting styles) of food parenting practices, these studies have mainly been limited by cross-sectional designs. In addition, previous research has mostly focused on extremely controlling food parenting practices. Considering that children's appetitive traits have high genetic origin (Carnell et al., 2008), and it is the environment that drives up obesity rates (Hill et al., 2003; Swinburn et al., 2011), we suggest the need for research that seeks to (1) explain how parents influence the child's home food environment by combination of their own dietary behavior and their food parenting practices (and higher order feeding dimensions) under the umbrella of the general parenting context and (2) understand whether and how children's characteristics interact with home food environment.

Based on previous research on parenting characteristics and adolescents' alcohol use (Kuendig & Kuntsche, 2006; van den Eijnden et al., 2011), we propose that parents who display healthy dietary behavior themselves are less in need of healthy food parenting practices. However, when parents regularly display unhealthy dietary behavior, their food parenting practices are of greater importance in determining the child's dietary behavior. Future research should examine this. Parental food diaries and validated food frequency questionnaires may be used to measure the potential influence of actual parental own dietary behavior in interaction with their food parenting practices on children's dietary behavior and BMI. Understanding for whom food parenting practices exert most prominent effects is important, as it also gives further insight into the mechanisms involved.

Fundamental issues for research include the conditions under which and the mechanisms by which particular food parenting practices influence the home food environment, and the exact characterization of 'home food environment'. The further development of higher-order dimensions of food parenting practices (i.e., Gevers et al., 2014) may result in more consistent findings and better insight into which combinations of practices yield most promising findings. Yet, the measurement of the 'home food environment'

is difficult. There are a number of validated survey measures assessing the home obesogenic environment (Bryant et al., 2008; Campbell, Crawford, & Ball, 2006; Pinard et al., 2012), but these measures often reflect the overall obesogenic family environment. In other words, there is no room for unique variance explained by individual family members. Moreover, these instruments focus on the general quality of the food available in the household and cannot adequately assess quantity. Observational instruments have been developed to assess food and activity availability at day-care centers and schools (Gubbels et al., 2010, 2011; van der Horst, Oenema, van de Looij-Jansen, & Brug, 2008; van der Horst, Timperio et al., 2008). Some of those observational measures also take quantity into account, but still, the child-unique food environment has not been adequately addressed. Future research should develop an observational instrument, combined with parental interviews, to quantify the food available at home to individual children within the family (food availability) as well as the food eaten together by family members (food modeling). We suggest that observing the home environment is important in order to gain a better understanding of environmental factors influencing obesity.

The food environment has a social component that includes social norms for eating that seemingly determine our food intake. Studies which have manipulated social norms around eating have demonstrated that people eat more when others eat more, and less when others eat less. However, this research field has mainly been focused on the snack intake of young adult females in laboratory settings (cf. Cruwys et al., 2015). We suggest that research on the effects of food parenting on children's dietary behavior might profit by the use of experimental research designs. Similar experimental studies on food restriction and pressure by Birch and colleagues (Birch et al., 2003; Fisher & Birch, 1999) and experiments on the effects of social influences on the acceptance of novel food in children (Addressi et al., 2005; Blissett et al., 2012) have moved the research field forward. Future experimental work could investigate parental modeling effects on children's healthy and unhealthy food intake, under what conditions children are likely to obey to food-specific parenting rules, and whether and how the food environment (i.e., food variety, portion sizes) interacts with children's characteristics, including (genetic) appetitive traits and impulsivity. Next, observational research on parent-child interactions in the eating context is also warranted because parents may inaccurately portray their use of particular parenting styles and food parenting practices (Frankel et al., 2012; Moens, Braet, & Soetens, 2007; Sacco, Bentley, Carby-Shields, Borja, & Goldman, 2007; Taylor et al., 2011). Finally, prospective designs are important to yield insight into the causal order of the associations between food parenting practices, the child's home food environment, and child's dietary behavior (and BMI). Future prospective research can profit by using Ecological Momentary Assessments (EMA), involving the repeated sampling of parents' and children's current behaviors in real-time.

Although previous research described in this opinion review has been particularly focused on mothers, it should be noted that our conceptual model focuses on both parents. Maternal and paternal influences have potential combined effects. For instance, children are particularly sensitive to disfavoring mothers' differential negativity when they are also disfavored by their fathers (Meunier et al., 2012; Meunier, Wade, & Jenkins, 2012). In addition, high levels of parental incongruence with regard to general parenting dimensions have been shown to attenuate the favorable impact of fathers' rules and nurturance on their children's snacking (Gevers et al., submitted for publication). It has been suggested that fathers may use different food parenting practices than mothers, but the literature on food parenting by fathers is scant (Khandpur, Blaine, Fisher, & Davison, 2014). Future research should examine the additive and combined effects of both maternal and paternal parenting on child's dietary behavior.

In addition to its scientific value, understanding how parents influence children's dietary behavior is also beneficial to the prevention of obesity. Unfortunately, food parenting practices often reflect the inconsistent and unhealthy intake patterns of parents themselves. We suggest this should and can be changed, with selective prevention programs for obese parents. During pregnancy, obese parents may learn how they can prevent their child (with probable high genetic susceptibility for obesity) from becoming obese by creating a healthy child's home food environment. To date, there are few randomized controlled trials that have commenced in infancy or prenatally. Short-term effects of an early food parenting practices intervention showed promising results with regard to food parenting practices changes; however, the intervention effects on maternal food parenting practices did not translate into statistically significant differences in anthropometric child outcomes at 2 years of age, but may manifest when the child is older (Daniels, Mallan, Nicholson, Battistutta, & Magarey, 2013). Another line of intervention research that may follow our propositions is to include elements of general parenting styles into obesity prevention programs, in addition to the more traditional focus on parenting practices. There is some evidence to suggest that mothers with lower education display lower levels of authoritative control over feeding (Saxton et al., 2009), suggesting that future selective prevention programs might be aimed at lower educated mothers (and probably also at fathers).

To date, interventions aimed at stimulating healthy food intake among children are increasingly popular. These interventions appear to be more successful when a social component is included. The child's home food environment, thus, also can be considered as a social environment, with within-group differences, as previously been discussed. Likewise, there may be notable cultural differences in the home food environment, and food can be regarded as a medium for cultural exchange and cultural affiliation (Shutts et al., 2013). Intervention programs should take these group differences into account. It could be the case that children actually model the amount of unhealthy food intake of their parents. It has even been suggested that children from families with middle and least educated mothers have a higher risk to directly model eating behavior at the dinner table, as more evening meals are eaten together by these families compared to families with more educated mothers (Campbell et al., 2002). However, so far, no study has examined whether children actually model their parents' food consumption patterns. Considering that individuals have limited insight into the external factors that could influence their food intake (Vartanian, Herman, & Wansink, 2008), parents are probably not aware of the effects of their own intake on their children's intake. Overall, parents should be more aware of their own role in children's dietary behavior and therefore should limit the availability of unhealthy products in sight of their children and increase the availability of healthy foods instead.

The interaction between a child's (genetic) characteristics and the home food environment can be regarded as a dual process framework, with parents being the 'frontal lobes' of their children, suppressing unhealthy dietary behavior. However, as children grow older, they are exposed to more diverse food environments, without their parents being present to guide them. Previous research has shown that individual's inhibitory control moderated the influence of automatic snack food preference on the amount of food eaten and weight gain among young adults (Hofmann et al., 2009; Nederkoorn et al., 2010). Thus, children should, over time, also develop own self-regulatory inhibitory control capacity. Parents may play an important role herein, with adequate parenting being associated with better effortful control (EC) and executive functioning (EF) in early childhood (Bernier, Carlson, Deschenes, & Matte-Gagne, 2012; Bernier, Carlson, & Whipple, 2010; Kochanska, Aksan, Prisco, & Adams, 2008; Kochanska, Murray, & Harlan, 2000; Moilanen, Shaw, Dishion, Gardner, & Wilson, 2010; Piotrowski, Lapierre, & Linebarger,

2013). We encourage researchers to consider using a developmental focus, examining the potentially increasing importance of children's self-control, in interaction with appetitive traits and the food environment, for the prevention of obesity when they grow older.

To conclude, results from studies testing (part of) the conceptual model are of societal relevance as a basis for a theory-based intervention program aimed at improving eating and BMI outcomes in young children. The societal costs of overweight and obesity are tremendous (Withrow & Alter, 2011). Early childhood overweight is an eminent risk factor for later overweight and obesity (Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008). To date, parents are often not actively involved in current interventions stimulating healthy food intake, while it is known that more positive results have been achieved when interventions included greater parental participation or adherence (Hingle, O'Connor, Dave, & Baranowski, 2010; Niemeier, Hektner, & Enger, 2012; Stice, Shaw, & Marti, 2006). Understanding why and under what conditions parents influence child dietary behavior will help guide interventions to early prevent unhealthy dietary behavior and the development of overweight.

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