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Citation for published version (APA):

Gubbels, J. S., Kremers, S. P., Stafleu, A., Dagnelie, P. C., Goldbohm, R. A., de Vries, N. K., & Thijs, C. (2009). Diet-related restrictive parenting practices. Impact on dietary intake of 2-year-old children and interactions with child characteristics. *Appetite*, 52(2), 423-429.
<https://doi.org/10.1016/j.appet.2008.12.002>

Document status and date:

Published: 01/01/2009

DOI:

[10.1016/j.appet.2008.12.002](https://doi.org/10.1016/j.appet.2008.12.002)

Document Version:

Publisher's PDF, also known as Version of record

Document license:

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Research report

Diet-related restrictive parenting practices. Impact on dietary intake of 2-year-old children and interactions with child characteristics

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ARTICLE INFO

Article history:

Received 10 September 2008

Received in revised form 4 November 2008

Accepted 3 December 2008

Keywords:

Children
Clustering
Diet
Food intake
Food rules
Obesity
Overweight
Parenting practice
Restriction
Snacking

ABSTRACT

This study examined the relationship between diet-related parenting practices, parental characteristics, child characteristics, and 2-year-old child's dietary intake. Cross-sectional data ($N = 2578$) originated from the KOALA Birth Cohort Study. Principal component analyses revealed two restrictive parenting practice clusters: a cluster characterized by prohibition of the intake of various snacks and soft drinks, and a separate cluster characterized by prohibition of cookies and cake. Regression analyses showed that these clusters were related to the children's behavioural style (i.e. oppositional, depressive and/or aggressive behaviour) and to educational level, age and alternative lifestyle of the mother. The clusters also had a favourable influence on dietary intake (i.e. restrictive parenting practices were related to less consumption of the restricted (unhealthy) items and higher consumption of items considered to be healthy), which was moderated by child characteristics. The parenting practices showed a stronger association with dietary intake in children with a favourable behavioural style (i.e. non-depressed, low anxious, low overactive), a favourable eating style or a lower BMI. The findings suggest opportunities for preventive interventions focussing on parents of young children, and indicate that different approaches to parenting practice interventions are needed for different types of children.

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Introduction

Childhood overweight and obesity are a growing problem worldwide. In 2005, at least 20 million of the world's children under the age of five were overweight, and it is expected that these numbers will continue to rise (World Health Organization, 2006). Moreover, overweight and obese children often develop into overweight and obese adults (Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008).

One of the main risk factors for overweight in childhood is an unhealthy diet (Rennie, Johnson, & Jebb, 2005). Parents can have a strong influence on their child's health behaviour, including their dietary intake. For instance, parents control the availability of and exposure to food, act as role models, can provide their child with support and structure, and use specific parenting practices (Golan

& Crow, 2004). These parenting practices appear to have a long-lasting impact on dietary habits and food intake, not only during childhood, but also throughout life (Puhl & Schwartz, 2003).

The term parenting practices refers to content-specific acts of parenting, for example food rules (Darling & Steinberg, 1993). Although several studies have examined the immediate influence of parenting practices on dietary intake and weight in children and adolescents, their results were not consistent. Some studies found favourable associations between diet-related parenting practices and children's dietary intake. Restriction of unhealthy food items was associated with lower consumption of those items (e.g., lower soft drink consumption, De Bruijn, Kremers, de Vries, van Mechelen, & Brug, 2007), and higher consumption of healthy items (more fruit and vegetable consumption, Zabinski et al., 2006). Such a favourable association was also seen for promotion or imposition of healthy foods, which was associated with lower consumption of unhealthy food items (e.g., lower soft drink consumption, De Bourdeaudhuij & Van Oost, 2000; less dietary fat intake, Zabinski et al., 2006) and higher consumption of healthy

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items (more fruit and vegetable consumption, Zabinski et al., 2006). Furthermore, high parental control was associated with higher intake of healthy snacks (Brown & Ogden, 2004). Other studies, however, found restriction to be paradoxically associated with increased intake and preference for the restricted foods, and with overeating and weight gain (e.g., Fisher & Birch, 1999; Liem, Mars, & De Graaf, 2004; Montgomery, Jackson, Kelly, & Reilly, 2006). Promotion of healthy foods or pressure to eat such foods (e.g., vegetables) was associated with lower preference for and intake of these foods (Matheson, Robinson, Varady, & Killen, 2006). Moreover, higher control over food intake in general was associated with higher unhealthy snack intake (Brown & Ogden, 2004). This paradoxical effect is assumed to arise because parental control impedes the development of self-control over food intake (Tiggemann & Lowes, 2002), a mechanism which was confirmed by the findings of Johnson and Birch (1994), who reported reduced ability to compensate food intake in children of parents who exerted high levels of control.

Several other findings complicate matters even more, but could also provide the key to explaining these conflicting findings. Van der Horst et al. (2007) reported that the influence of parenting practices depended on the parents' more general parenting style, with practices having the desired influence on child behaviour only when parents were moderately strict and highly involved. This is in line with the theoretical model proposed by Darling and Steinberg (1993), who argue that general parenting styles provide the context in which specific parenting practices operate. In line with this model, the influence of parenting practices has also been found to be moderated by the child's personality traits (De Bruijn et al., 2007) and gender (e.g., Fisher & Birch, 1999; Montgomery et al., 2006; Zabinski et al., 2006).

The influence of parental and child characteristics on parenting practices has been examined in several studies. While efforts to identify which parents use what practices can help to identify target groups for interventions, an examination of the interactions of parent and child characteristics with parenting practices may also help explain the above moderation effects. With regard to parental factors, stricter parenting practices have been found to be associated with higher parental level of education (e.g., Brown, Ogden, Vogele, & Gibson, 2008) and socio-economic status (Hupkens, Knibbe, Van Otterloo, & Drop, 1998), as well as with both lower (e.g., Brown et al., 2008; Liem et al., 2004; Montgomery et al., 2006) and higher (Keller, Pietrobelli, Johnson, & Faith, 2006) parental BMI, with dietary restraint by the parents (Birch & Fisher, 2000; Fisher & Birch, 1999; Tiggemann & Lowes, 2002), with parents who are older (Brown et al., 2008; Keller et al., 2006; Liem et al., 2004) and with parents who stay at home to take care of the children (Brown et al., 2008). Furthermore, the children's age (e.g., De Bruijn et al., 2007), gender (Stang, Rehorst, & Golicic, 2004) and weight (both measured and perceived; e.g., Birch & Fisher, 2000; Tiggemann & Lowes, 2002) were associated with parenting practices.

It is often not clear whether a child's dietary intake and weight are causes or consequences of certain parenting practices. In practice, however, both are probably true (Faith & Kerns, 2005). Birch and Fisher (2000) have therefore proposed and validated a cyclical model, in which the relative weight of the child is a predictor of restrictive parenting practices, as it influences the parents' perceptions of their child's overweight risk, but in which the child's weight is also a consequence of restrictive parenting practices, through the influence of these practices on energy intake regulation. Overweight children and their parents therefore find themselves in a vicious circle, in which child overweight leads to stricter practices, which in turn may lead to even more weight gain (Birch & Fisher, 2000).

A specific dietary behaviour that puts a child at risk for becoming overweight is a high consumption of energy-dense foods such as snacks and sugar-sweetened beverages (Rennie et al., 2005). It is worrying that such eating habits find their origin in early childhood (Savage, Fisher, & Birch, 2007), and track into later life (Kelder, Perry, Klepp, & Lytle, 1994). It is therefore crucial to study parental influences even in very young children. Note that it is not single behavioural acts, but combinations of multiple risk behaviours and the complex interplay between them that are expected to lead to excess weight gain (Rennie et al., 2005). 'Obesogenic' behaviours have repeatedly been shown to cluster (i.e. co-occur) at various ages (e.g., Kremers, van der Horst, & Brug, 2007; Lioret, Touvier, Lafay, Volatier, & Maire, 2008; Utter, Neumark-Sztainer, Jeffery, & Story, 2003). Nevertheless, previous studies have not used a clustering approach to examine diet-related parenting practices. Clusters of parenting practices could be indicators of a wider obesogenic parental context, and insights into the clustering of parenting practices could help inform the development of interventions aimed at improving diet-related parenting.

The present study examined whether diet-related parenting practices cluster in parents of 2-year-old children, and how these clusters are related to the child's dietary intake. We also examined associations of parental and child characteristics with the practice clusters, and whether these child characteristics influenced the impact of the parenting practices on the child's dietary intake. We hypothesized that restrictive parenting practices would indeed cluster, and that these restrictive clusters would be associated with less unhealthy dietary behaviour on the part of the children. We further hypothesized that the practices would be related to distinct parent and child characteristics, and that the impact of the practices was moderated by child characteristics (see Fig. 1).

Methods

Respondents and procedure

The KOALA Birth Cohort Study (The Netherlands) is a prospective cohort study which started in the year 2000. KOALA is the Dutch acronym for Child, Parent and health: Lifestyle and Genetic constitution. Pregnant women were recruited from an existing cohort for a study of pregnancy-related pelvic girdle pain, as well as through recruitment channels among 'alternative lifestyle' circles (e.g., anthroposophist midwives and general practitioners, Steiner schools and organic food shops; Kummeling et al., 2005). The latter group of women (17.9%) could have an alternative lifestyle in terms of dietary habits (e.g., preferring organic foods), child rearing, vaccination schemes or antibiotics use. All participants signed informed consent, and approval was obtained from the Maastricht University/University Hospital Maastricht medical ethics committee. In total, 2834 women participated and completed questionnaires during pregnancy, and when their child was 3, 7, 12 and 24 months old. At the time

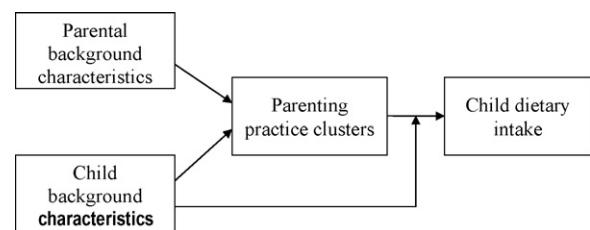


Fig. 1. Hypothesized model of the interaction between parent and child with respect to dietary intake, restrictive practice clusters and background characteristics.

the children were 2 years old, 2578 questionnaires had been returned (91.0%). In all, 51.2% of these children were male. The mean age of the mothers during pregnancy was 32, ranging from 17 to 45 years. The country of birth of the mother was the Netherlands in 96.5% of the cases. A total of 48.7% of the mothers were highly educated, while 37.6% had a medium educational level and 13.7% had a low educational level.

Questionnaire

When the children were 2 years old, parents completed a questionnaire regarding their diet-related restrictive parenting practices (i.e. restrictive rules on food intake) and their child's dietary intake during the month preceding the questionnaire. Several other child and parent characteristics were also assessed.

Diet-related restrictive parenting practice clusters

Parenting practices were assessed by asking parents: 'Are there specific foods that you do not allow your child to eat or drink?' (no/yes). Parents who answered 'yes' were then asked to indicate which of the following foods the child was not allowed to eat: 'Sweets', 'Cookies', 'Cake', 'Soft drinks', 'Crisps' and 'Sugar'. Principal component analysis with oblique rotation was used to form clusters of practices. Both a scree plot and the eigen-values were used to determine the number of components (Field, 2005). For interpretation purposes, an absolute cut-off of .5 was used with regard to component loadings. Cluster scores were computed for each parent-child combination as the sum of the component loadings corresponding to the practices that were applied by the parent.

Dietary intake

Dietary intake was measured by asking parents how often their child consumed 65 food items. Six items corresponding with the restrictive parenting practices were selected for analyses: 'Sweets', 'Chocolate', 'Cookies and Cake', 'Soft drinks with little or no sugar (light)', 'Other soft drinks' and 'Crisps and other savoury snacks'. These six items were complemented with three items on vegetable and fruit intake: 'Raw vegetables', 'Cooked vegetables' and 'Fresh fruit'. Response options were 'Never', 'Less than once a week', '1–3 times a week', '4–6 times a week', 'Once a day', 'Twice a day', 'Three times a day' and 'More than three times a day'. Cooked and raw vegetables were combined into one variable measuring total vegetable intake frequency. The food items were recoded into weekly intake frequency.

Child characteristics

Several child background characteristics were assessed. The children's behavioural style was identified using a selection of questions from a translated version of the Child Behaviour Checklist (Koot, Van Den Oord, Verhulst, & Boomsma, 1997). A total of 51 items were used to assess whether various behavioural characteristics applied to the child. Response options were 'Not applicable at all' (0), 'A little/sometimes' (1), and 'Clearly/often' (2). The items were divided into five subscales measuring oppositional, depressed, aggressive, anxious and overactive behaviour. These scales were derived from factor analyses, and validated in a Dutch sample (Koot et al., 1997). An example of an item measuring oppositional behaviour is 'The child's demands must be met immediately'. An example of an item measuring depressed behaviour is 'The child looks unhappy without good reason'. An example of an aggressive behaviour item is 'The child physically attacks people'. An example of anxious behaviour is 'The child is

afraid to try new things'. An example of an item measuring overactive behaviour is 'The child cannot sit still, is restless or hyperactive'.

Eating style at the age of 1 year was assessed by means of the question: 'Can you describe the eating behaviour of your child'. Response options were 'Eager', 'With reluctance', 'With pleasure', 'Fast', 'Slow', 'Doesn't like many things', 'Likes many things'. Parents could indicate for each response option whether or not it applied to their child (yes/no).

Parents were asked to report the height and weight of their child as periodically assessed at infant welfare centres at age 1 and 2, under the Dutch preventive health system. Weight and height were used to calculate Body Mass Index (BMI, i.e. weight/(height)²; kg/m²). In accordance with international standards for 2 year olds, boys with a BMI above 18.41 and girls with a BMI above 18.02 were considered to be overweight. The cut-offs for obesity are 20.09 for boys and 19.81 for girls (Cole, Bellizzi, Flegal, & Dietz, 2000). Because these cut-offs were not defined for 1 year olds, BMI at age one was categorized into high and low, with a cut-off at the median (17.01 kg/m²). We also recorded the child's gender, as well as the number of hours the child spent at day care.

Parental characteristics

Parents were asked to indicate their own weight status, i.e. whether one or both parents were obese (yes/no). The number of hours a week that both parents were at work was also assessed. Additionally, country of birth, age and highest completed education of the mother were assessed. Education of the mother was categorized into three levels (low, medium and high), in line with international classification systems (Eurostat, 2007; United Nations Educational Scientific & Cultural Organization, 1997). Finally, we recorded whether the parents had been recruited through conventional or 'alternative' channels.

Data analyses

The parenting practice cluster scores were used as dependent variables in backward linear regression analyses, to examine the relation with parental and child characteristics. Linear regression was used to assess the association between cluster scores and the reported consumption frequency of sweets, chocolate, cookies and cake, sugar-sweetened and light soft drinks, crisps, vegetables and fruit. These analyses were corrected for the child and parent background characteristics mentioned above. Finally, interactions between child characteristics and the impact of the practice clusters on the child's dietary intake were explored by examining the explanatory value of adding interaction terms to the regression as described above. In all analyses, *p*-values <0.05 were considered statistically significant.

Results

Mean BMI of the children at age 2 was 16.4 kg/m². No valid BMI score could be computed for 7.2% of the children because of missing data on weight and height. A total of 207 (8.7%) of the remaining children were overweight, and 36 (1.5%) were obese. Further, 5.2% of the mothers and 2.8% of the fathers reported to be obese. Mean number of hours at work per week was 19 h (S.D. = 12) for the mothers and 40 h (S.D. = 10) for the fathers. Children spent an average of 11 h per week (S.D. = 11) at day care.

Table 1 shows the percentage of parents who applied the various food restrictions. In total, almost half of the parents had certain restrictive parenting practices with regard to one or more of these food items (*N* = 1149, 44.6%). Frequencies for most restrictions were, however, rather low. The most common restriction concerned soft

Table 1

Frequencies of diet-related restrictive parenting practices in 2-year-old children of the KOALA Birth Cohort Study ($N = 2578$).

Child is not allowed to consume	<i>N</i> (%)
Sweets	255 (9.9)
Cookies	37 (1.4)
Cake	106 (4.1)
Crisps	153 (5.9)
Sugar	223 (8.7)
Soft drinks	1089 (42.2)

Notes: Parenting practices were assessed by asking parents to indicate which of the six items their child was not allowed to eat.

Table 2

Component loadings of principal component analysis on diet-related restrictive parenting practices ($N = 2578$).

	Cluster	
	1	2
No sweets	0.67	-0.24
No cookies	-0.03	-0.88
No cake	0.06	-0.81
No crisps	0.67	-0.03
No sugar	0.53	-0.31
No soft drinks	0.81	0.22

drink consumption (applied by 42.2% of the parents), while least common was restriction of cookies (1.4% of the parents).

Two clusters of diet-related restrictive parenting practices were found (Table 2). Cluster 1 included rules regarding the intake of sweets, crisps, sugar and soft drinks. Cluster 2 included the absence of rules on the consumption of cookies and cake. The component loadings all had absolute loadings >0.5 . The two clusters were inversely correlated ($r = -0.33$), and the total variance explained by the clusters was 59.6%. For interpretation purposes, scores on the second cluster were multiplied by -1 (so that a higher score means more restriction), which is statistically justified, since the scale for measuring the parenting practices is dichotomous. This means that clustering of the absence of rules, also indicates clustering of the presence of rules.

Table 3 shows the associations of child and parent background characteristics with the parenting practices cluster scores. Higher scores on the first cluster were associated with oppositional behaviour of the child and high educational level and alternative lifestyle of the parents. Lower scores were related to depressed and aggressive behaviour of the child. High scores on the second cluster, i.e. more restriction regarding cookie and cake intake, were also inversely related to aggressive behaviour. Higher scores on cluster 2 (more restriction regarding cookies and cake) were also

Table 3

Associations of background characteristics with diet-related parenting practice cluster scores and total number of diet-related restrictive parenting practices (Standardized regression coefficients backward regression, $N = 1958^a$).

	Cluster 1: restrictive practices regarding snacking	Cluster 2: restrictive practices regarding cookies and cake	Total number of rules
Oppositional behaviour of child	0.08**	0.07*	0.08**
Depressive behaviour of child	-0.05*	-	-
Aggressive behaviour of child	-0.05*	-0.08**	-0.07*
Education level of mother (high vs. low/medium)	0.06**	-	0.06*
Alternative lifestyle (yes vs. no)	0.23**	0.14**	0.23**
Age of the mother	-	0.07**	-
Total variance explained by the model (R^2)	0.07	0.03	0.07

Notes: Scores on the second cluster were multiplied by -1 so that a higher score means more restriction. Excluded (non-significant) variables for all three scores: Gender, BMI at 1 and 2 years, anxious or overactive behaviour, eating style, obesity of mother and obesity of father, hours at work a week for father and mother, hours a week at day care, and country of birth of the mother.

^a N deviates from total sample due to missing values.

* $p \leq 0.05$.

** $p \leq 0.01$.

positively related to oppositional behaviour of the child, alternative lifestyle and older age of the mother. The total number of rules was higher for oppositional children and lower for aggressive children. Parents with an alternative lifestyle and/or a high educational level also reported more rules.

The association between the cluster scores and the intake of specific foods was examined using linear regression (see Table 4). Both clusters were significantly inversely related to unhealthy intake behaviours (i.e. consumption of sweets, chocolate and cookies and cake), and positively associated with fruit and vegetable intake. Higher scores on cluster 1 were further associated with lower intake of both sugar-sweetened and light soft drinks, and with lower crisps intake. Cluster 2 was positively related to soft drink consumption.

We found several significant interactions between child characteristics and the impact of parenting practice clusters on dietary intake. All results indicate that the parenting practices had a stronger favourable impact (i.e. led to less consumption of unhealthy foods and more intake of healthy items) on children with more 'favourable' characteristics (Fig. 2). With regard to the children's behavioural style, the first cluster only had an impact ($p < 0.01$) on cookie and cake intake in non-depressed children (depressed score = 0, $N = 1412$; see Fig. 2a). Depressed behaviour of the child further weakened the relationship between cluster 1 (snacking restriction) and crisps intake ($p < 0.05$; see Fig. 2b). High anxious behaviour (above median) nullified the positive influence of cluster 1 on vegetable intake ($p < 0.05$; Fig. 2c). Furthermore, the unfavourable influence of cluster 2 on sugar-sweetened soft drink intake was only found in overactive children ($p < 0.05$; Fig. 2d). An eating style in which the child liked many foods strengthened the influence of cluster 1 (restricting snacks) on sweets intake ($p < 0.05$; Fig. 2e). The influence of the first cluster on chocolate intake was weaker for children who ate with reluctance ($p < 0.05$; see Fig. 2f), and was only present in children who were not reported to be slow eaters ($p < 0.05$; Fig. 2g). As regards vegetable intake, cluster 1 had a positive influence for children who were not reported to be slow eaters ($p < 0.05$; Fig. 2h). With regard to weight status, BMI at age 1 interacted with the second cluster ($p < 0.01$), in such a way that the positive influence of restrictive parenting on cookie and cake intake was only found for children with a below-median BMI (BMI = 17.01; Fig. 2i). BMI at age 2 moderated the influence of cluster 1 on both sugar-sweetened soft drink and crisps intake ($p < 0.05$), with a weaker impact in overweight or obese children (see Fig. 2j and k).

Discussion

The current study demonstrated the existence of clusters of diet-related restrictive parenting practices. The first cluster was

Table 4

Association between diet-related parenting practice cluster scores and dietary intake (standardized regression coefficients, $N = 1931^a$).

	Sweets intake	Chocolate intake	Cookies and cake intake	Sugared soft drinks intake	Light soft drinks intake	Crisps intake	Vegetable intake	Fruit intake
Cluster 1	-0.19**	-0.18**	-0.05*	-0.16**	-0.14**	-0.23**	0.06*	0.09**
Cluster 2	-0.08**	-0.05*	-0.08**	0.06**	0.04	0.01	0.07**	0.05*

Notes: Scores on the second cluster were multiplied by -1 so that a higher score means more restriction. Cluster 1: restrictive practices regarding snacking; Cluster 2: restrictive practices regarding cookies and cake. Reported β -weights are corrected for confounding influence of background characteristics (child's behaviour, eating style, number of hours at day care, BMI at age 1 and 2; mothers' age, education level, number of hours at work, country of birth; fathers' number of hours at work; parents' obesity and alternative lifestyle).

^a N deviates from total sample due to missing values.

* $p \leq 0.05$.

** $p \leq 0.01$.

characterized by prohibition of consumption of sugar, snacks such as sweets and crisps, and soft drinks. A second cluster was characterized by prohibition of cookies and cake.

From the lifestyle point of view, it is obvious why practices prohibiting the intake of unhealthy food cluster together: rules are part of parents' views on child rearing and lifestyle, and may thus reflect a more general parenting style. A parenting style is the constellation of attitudes held towards and communicated to the child that create an emotional climate in which the parents'

behaviours are expressed (Darling & Steinberg, 1993). This general climate probably influences which parenting practices are applied (Kremers, Brug, de Vries, & Engels, 2003). It is not clear why a separate cluster was found for restrictions regarding cookies and cake. The fact that cookies and cake are consumed at different moments and occasions than the items in the first cluster could play a role.

The parenting practice clusters seemed primarily dependent on parental lifestyle, as those parents with an alternative lifestyle

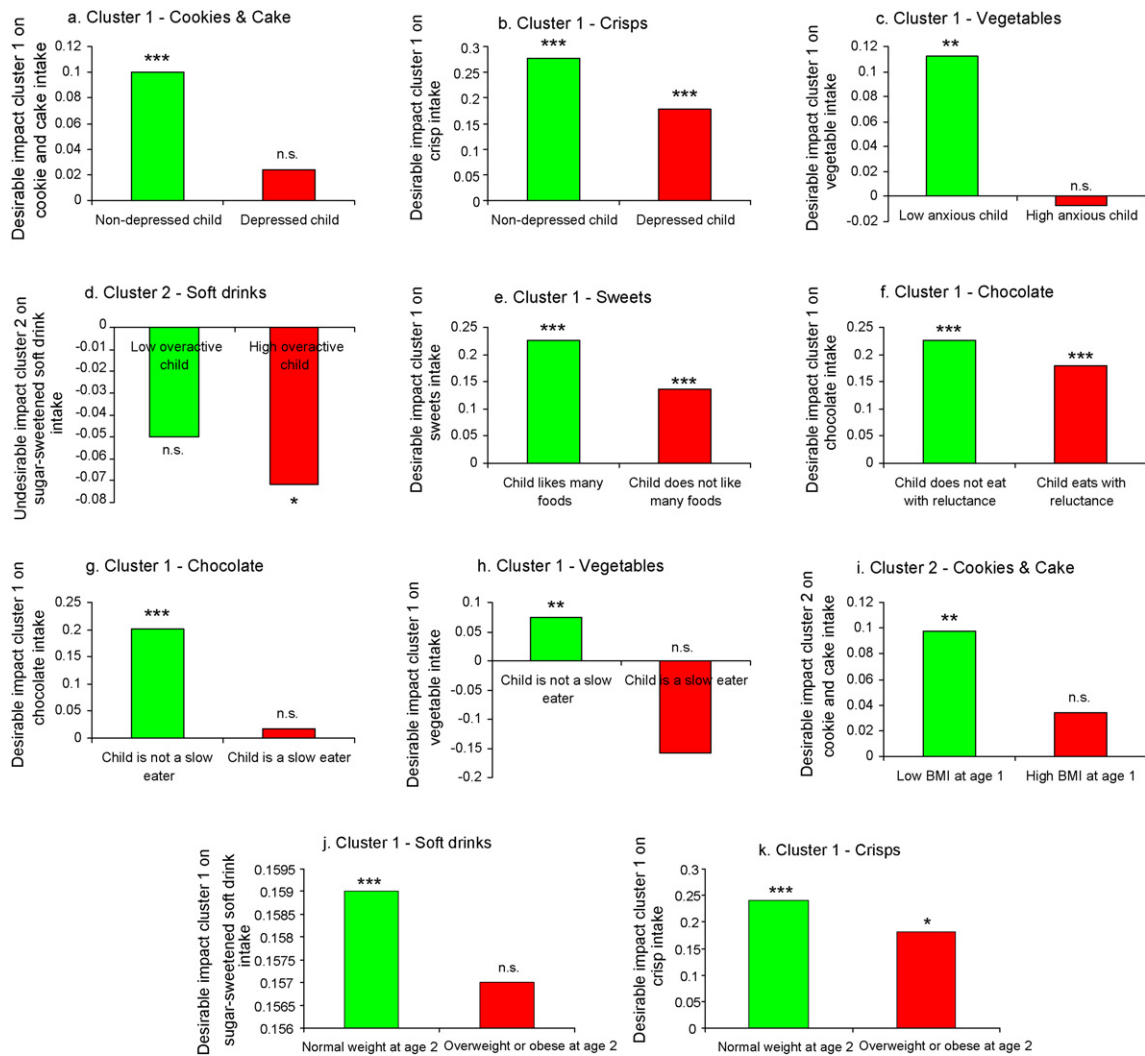


Fig. 2. Significant moderating effects of child characteristics on the influence of the parenting practice clusters on intake behaviours. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; n.s. $p =$ non-significant. Notes: Cut-off point for high BMI at age 1: BMI > median. Cut-off point for overweight at age 2: BMI > 18.41 for boys, BMI > 18.02 for girls. Measured child characteristics that did not significantly moderate the influence of the parenting practice clusters on dietary intake: Behaviour style: oppositional, aggressive; eating style: eager, eating with pleasure, eating fast.

were stricter with respect to diet than traditional parents. This probably reflects the parents' own dietary habits, which they may also want their child to practise. Some of these alternative lifestyle parents (24.7%) practiced a vegetarian, organic or other type of alternative dietary style, which are characterized by relatively healthy eating habits and which are associated with a lower risk of various chronic diseases (American Dietetic Association & Dietitians of Canada, 2003). High educational level of the mother was significantly related to more restrictive parenting practices with respect to snack intake (cluster 1), and a higher total number of rules. Other studies also found a positive relationship between educational level and strictness (Brown et al., 2008). Furthermore, older mothers imposed more restrictions regarding cookies and cake, which is also in agreement with previous research (Brown et al., 2008; Keller et al., 2006; Liem et al., 2004). The current study found no association between parental obesity and the parenting practice clusters.

The children's behavioural style was significantly related to the degree of strictness of the parents: the more oppositional (e.g., stubborn, demanding, jealous) the child, the higher the scores on the practice clusters, and the more rules were imposed. A potential explanation for this finding is that parents may feel that these children need more guidance and rules. An alternative explanation might be that these children became oppositional because of the restrictions their parents imposed on them. A familial component might also be involved: the parents of these oppositional children might be oppositional themselves, which may be reflected in the food rules they apply, especially when food rules diverge from conventional rules. Furthermore, children's depressed and aggressive behaviours were associated with less dietary restrictions. Parents may be less strict to a depressed child and may impose fewer rules to avoid their child engaging in aggressive behaviour. Few studies have examined the influence of child behaviour in general on diet-related parenting practices. De Bruijn et al. (2007) found a significant moderating effect of a personality factor referred to as 'agreeableness' (i.e. a tendency to be pleasant and accommodating in social situations) on the influence of parenting practices on soft drink consumption, but they did not examine whether agreeableness was associated with the use of certain parenting practices. In addition, several studies reported an association between specific eating behaviours, such as inhibited eating and eating in the absence of hunger, and parenting practices (see for instance the review of Faith & Kerns, 2005), but as Birch and Fisher (2000) elucidated, this influence is likely to be bi-directional. The current study did not find a significant relation between the children's general eating styles and BMI on the one hand and the parenting practice clusters on the other.

In line with several other studies (De Bourdeaudhuij & Van Oost, 2000; De Bruijn et al., 2007; Zabinski et al., 2006), the current study found that diet-related parenting practices did have the intended effect on food intake. However, the previous studies showing these results all involved adolescents. To our knowledge, the current study is the first to find a favourable influence of restriction on the intake of energy-dense foods and snacks in young children. Thus, we failed to confirm the paradoxical effect of increased consumption of restricted foods reported in several studies (e.g., Brown & Ogden, 2004; Fisher & Birch, 1999; Matheson et al., 2006; Montgomery et al., 2006), including studies among toddlers. However, these studies generally involved intake in an unrestricted setting, with free access to food. The current study measured mean intake in normal life, a setting that is seldom unrestricted for 2 year olds.

The practice clusters not only influenced the intake behaviours they specifically related to, but were also associated with other dietary behaviours: higher scores on the clusters were associated with higher fruit and vegetable intake. Similar results were found

in a study among adolescents, in which restricting unhealthy food was associated with higher fruit and vegetable intake (Zabinski et al., 2006). This wide-ranging influence of parenting practices could possibly be due to clustering of intake behaviours (e.g., Lioret et al., 2008). An alternative explanation may be that other parenting practices, which we did not measure, play a role.

The influence of both parenting practice clusters on intake was moderated by several child characteristics. Restrictive parenting practices were found to have greater impact in children with 'favourable' characteristics, and smaller impact on children with higher depressive, anxious or overactive behavioural scores. In addition, higher BMI at both age 1 and 2 was associated with a weaker influence of the parenting practices on intake. A final child characteristic that was found to moderate the influence of parenting practices on dietary intake was the child's eating style. The influence of parenting practices proved stronger in children who liked many foods, whereas the influence was weaker for children who were slow or reluctant eaters. Although our study did not confirm the paradoxical adverse effects of parenting practices found in some studies, it provides some indication why parenting practices do not always result in favourable effects. In contrast to what was found in earlier studies (Fisher & Birch, 1999; Montgomery et al., 2006; Zabinski et al., 2006), the current study did not find that gender moderated the influence of parenting practices on intake.

A strength of the current study is the large number of participants ($N=2578$). Previous research on the effect of parenting practices on intake mostly included no more than 200 participants, and none included more than 900 participants. However, caution is warranted when generalizing the results to the larger population, as the current sample has an overrepresentation of highly educated parents and parents with an alternative lifestyle, as well as relatively low overweight and obesity prevalence rates. In addition, since the cross-sectional design does not allow any inferences regarding causality, we cannot ascertain whether certain child factors actually evoke the parenting practices, or whether parenting practices influence these child factors. Another possible limitation is that all data were reported by the parents of the children, and could therefore be biased, and that the measures of eating style, parenting practices and dietary intake were not validated. A fourth limitation is that the current study took only restrictive parenting practices into account. Other practices, like encouragement to eat healthy food and instrumental and emotional feeding might reinforce the positive influence of the restrictive practices found in this study. Moreover, these other parenting practices may interact with child characteristics in such a way that they have a greater impact on the children for whom restriction was found to have less impact, such as depressed or anxious children or slow eaters.

Practical implications and further research

The current research has shown that restrictive parenting practices regarding dietary intake cluster, and that these clusters seem to have a wide-ranging, favourable influence on children's specific dietary behaviours. This knowledge helps to identify a more general dietary and child rearing view among parents, and can provide valuable insights for preventive efforts, which are not obtained when focussing on individual parenting practices. The favourable influence of restrictive parenting practice clusters seemed to be more pronounced in children with 'favourable' characteristics. This indicates that these children in particular can gain a great deal from interventions focussing on diet-related parenting practices. Future interventions should focus on teaching parents effective parenting practices, even before the child reaches the age of 2. This approach is in line with current increased

attention for parent guidance in child rearing, stressed by professional organizations such as the American Academy of Pediatrics (Krebs & Jacobson, 2003). In addition, we hypothesize that children who possess characteristics associated with lower effectiveness of restrictive parenting practices (e.g., higher BMI, anxiousness, depressiveness, overactivity, slow or reluctant eating style, not liking many foods) may benefit from more empathic diet-related parenting practices such as support and encouragement.

The results of the present study suggest that preventive interventions targeted at parenting practices, but tailored to individual child characteristics, could be effective. This hypothesis should be further examined in future research. In addition, longitudinal and experimental research is needed to examine the interactive nature of the relationship between child behaviour and parenting practices.

Acknowledgements

The KOALA Birth Cohort Study's conception and follow-up to the age of 2 was financially supported by the Triodos Foundation, Royal Friesland Foods, University Hospital Maastricht, and funds unrelated to commercial organizations (Iona Foundation, Phoenix Foundation, Foundation for the Advancement of Heilpädagogiek), all in the Netherlands. In addition, the research by Jessica S. Gubbels is financed by the Nutrition and Toxicology Research Institute Maastricht (NUTRIM).

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