

Longitudinal associations between family characteristics and measures of childhood obesity

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Abstract

Objectives The objective of this study was to investigate cross-sectional and longitudinal associations between different family characteristics and body mass index (BMI) and waist-to-height ratio (WHtR) in children.

Methods This was a prospective follow-up study conducted in Helsinki region with data collected in 2006 and 2008. The sample consisted of 550 children aged 9–11 at baseline. Children were measured and weighed by research staff, and they completed a questionnaire about their family characteristics.

Results More meals together with the family, more parenting practices at meals, less time home without adult company after school, and child's perception of receiving care from mother in 2006 predicted a lower BMI in 2008 and partly a smaller increase in BMI from 2006 to 2008. Fewer associations were found to WHtR. Physical activity with either parent was not associated with BMI or WHtR.

Conclusions Several family characteristics predicted child BMI and WHtR 2 years later. These results contribute new knowledge about parental influence on child

weight and weight gain and should be taken into account when planning interventions on the matter.

Keywords Family characteristics · Body mass index · Children · Waist-to-height ratio

Introduction

Childhood overweight and obesity have increased dramatically in Western countries during recent decades (Lobstein et al. 2004). Measurements of central adiposity have begun to garner attention having been found to increase even more than children's body mass index (BMI) (McCarthy et al. 2003; Moreno et al. 2001). Waist-to-height ratio (WHtR) is one measure of central adiposity, which also is found to be a good indicator of cardiometabolic disease risk factors even in children (Cossio et al. 2009; Kahn et al. 2005; Kondaki et al. 2010).

The study of the association of different family characteristics to child weight status and/or health behavior has attracted increasing interest in recent times. Many studies have investigated parenting style or parenting practices. Parenting style is the way in which a parent performs his/her parenthood (Darling and Steingberg 1993) and is commonly considered to be stable over time, generating the environmental and emotional context for child rearing. Parenting style typologies are categorized using two dimensions: first, the degree of warmth/responsiveness and second, the degree of control/demandingness of the parent (Maccoby and Martin 1983). Of the four parenting styles formed from these dimensions, authoritative parenting style, with high degree of both responsiveness and demandingness, is found to be associated with many beneficial characteristics in children and adolescents (Berge

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2009; Cohen and Rice 1997; Newman et al. 2008). Other parenting styles; authoritarian (high in demandingness, low in responsiveness), permissive (low in demandingness, high in responsiveness), and neglectful (low in both demandingness and responsiveness) are generally regarded as less preferential. Parenting practices instead are specific practices that parents perform (Darling and Steingberg 1993). They are situation and context dependent, and they include specific behavioral strategies by which parents try to socialize their child. Parenting practices can include, for example, controlling, modeling or encouraging a certain behavior. In numerous studies regarding parenting style and parenting practices, these factors have been measured in a variety of ways (Berge et al. 2010b; De Bourdeaudhuij et al. 2009; Hennessy et al. 2010b; Topham et al. 2010; Young and Fors 2001).

Associations between parenting style and child/adolescent weight status have been observed in several cross-sectional studies, suggesting that an authoritative parenting style is related to a lower BMI or normal weight (Berge 2009; Berge et al. 2010a; Chen et al. 2005; Kim et al. 2008; Ventura and Birch 2008). However, non-significant results do also exist (Hennessy et al. 2010b; Chen et al. 2005; Brann and Skinner 2005; Gibson et al. 2007). There are a few longitudinal studies on parenting style and child/adolescent weight, including Berge et al. (2010c) that describe maternal, but not paternal authoritative parenting style predicted lower BMI in adolescents. Concordantly, Rhee et al. (2006) found that maternal authoritative parenting style predicted lower BMI compared with authoritarian, permissive and neglectful parenting styles. However, Agras et al. (2004) did not find any longitudinal associations between parenting style and child weight status.

Less research has been reported for the association of parenting practices to child weight status. Relevant studies have investigated different practices that have mostly dealt with children's eating behavior, such as parents' control over a child's eating, pressure to eat, modeling of healthy eating habits, or availability of certain foods. Most studies have concentrated on parenting practices and their association with children's or adolescent's health behavior, mostly eating habits or nutritional intake (Ventura and Birch 2008). Some of the studies have found an association with modeling/encouraging of healthy eating and lower BMI (Berge et al. 2010a).

Other family characteristics may also play a role when it comes to children's weight status. Parental presence and encouragement can influence children's eating habits and physical activity and thus children's weight status also. These factors can be measured by reviewing activities such as eating family meals, measuring the amount of time a child spends at home alone after school, or assessing the

time that parents spend being physically active together with the child.

Family meals or dinner and its association with child/adolescent overweight have been studied to some extent. Most, but not all cross-sectional studies have shown that eating more family dinners or meals is associated with normal weight or lower BMI (Fulkerson et al. 2008; Lehto et al. 2010; Utter et al. 2008; Veugelers and Fitzgerald 2005). Results from prospective studies are less clear (Fulkerson et al. 2008; Sen 2006; Taveras et al. 2005).

To our knowledge, there have been no studies to date that investigate the amount of time that a child spends at home without adult company compared with a child's weight status, but the time a child/adolescent spends home without adult company in regard to a child's eating habits has been investigated at least in one study. It was reported that more time at home alone was associated with eating fruits and vegetables less often and not eating a healthy breakfast or a healthy lunch (Young and Fors 2001).

Many different family characteristics can influence child weight status; however, child weight status can also influence family characteristics, for example practices at meals and parenting style. Therefore, it is important to investigate these associations in a prospective study setting. Also, widening the focus from parenting style to a broader concept of different family characteristics, such as parental presence or encouragement, can bring new insights to the topic.

In this study, we aim to examine different family characteristics and their association with school children's BMI and WHtR both cross-sectionally and longitudinally with 2-year's follow-up. In order to achieve this, we have assessed parental encouragement and presence by measuring the time a child spends at home without adult company after school, the frequency of family meals and if parents are physically active together with their child. Parenting practices are measured as practices at meals. Furthermore, we have assessed one dimension of the parenting style, warmth, or parental care as we call it, and its association with the child's BMI and WHtR both in cross-section and longitudinally.

Methods

Participants

This investigation was performed as a part of a project called Hälsoverkstaden (Health workshop), which studies the health behaviors of 9- to 11-year-old children. The work described here was a 2-year follow-up study done in Swedish-speaking elementary schools in the capital region of Finland. The baseline study was carried out in 2006 and

the follow-up in 2008. All 44 Swedish-speaking schools with more than 50 pupils in the region were asked to take part in the study. The headmasters in 27 schools decided that their school would participate. No trends in the socioeconomic status of the neighborhoods were evident regarding participation, or non-participation, of schools. In Finland, all schools serve a free school lunch as part of the curricula. Other meals are not common during the school day, which is usually about 5–6 h per day.

Half of the schools studied also implemented an intervention, the aim of which was to improve health behaviors (increase physical activity, increase the intake of fruits and vegetables, and increase sleep duration) of the children. The intervention was carried out in Swedish-speaking schools because the organization Folkhälsan mainly promotes health of the Swedish-speaking population in Finland.

Our investigation was approved by the ethical committee of the Department of Public Health of the University of Helsinki.

In the spring of 2006, all children in grades three and four from participating schools ($n = 1,146$) and their parents were contacted. Informed consent for participation in the study was given by 677 children and their parents. For the collection of baseline data, two school visits were made. In the spring, 630 children in total were measured and weighed by the research staff, thus giving the response rate 55%. The 47 children who gave their consent but were not measured were either absent during the visit or declined to be measured. In the fall of 2006, 604 of those children who were measured completed a questionnaire on their health behavior and family characteristics. The questionnaire was administered in a classroom setting, and a member of the research staff was always present. The follow-up was made in spring 2008, when the children were measured again and they also filled in the same questionnaire. Approximately 93% of the 604 children participating in 2006 (550 children) participated again in 2008. For 16 of these children, no anthropometric data existed for baseline and follow-up. The number of observations used in analyses is therefore equal to 534.

Anthropometrics

Children's height measurements taken in both 2006 (baseline) and 2008 (follow-up) and were taken without shoes to the nearest 0.5 cm with the same study measure. Waist circumference was always measured on top of a t-shirt to the nearest 1-cm midway between iliac crest and the lowest rib. WHtR was calculated as waist circumference (cm) divided by height (cm). The children were weighed with the same study scale (Microlife Body Fat Scale WS 100) to the nearest 0.1 kg wearing only

underwear and a t-shirt. The measurements were always carried out before lunch time.

Family characteristics

Family characteristics in 2006 were assessed as parental care, parenting practices at meals, frequency of family meals, a parent being physically active together with the child, and the time child spends home without adult company after school. Many of the questions have been previously used in the Health Behaviours of School-aged Children (HBSC) study (Currie et al. 2008).

Parental care was assessed with 3 variables: care from both parents, care from mother, and care from father. All of these were assessed with 4 statements. The statements were the following: my mother/father helps me whenever I need help, my mother/father shows or tells that she/he cares about me, my mother/father understands my problems and worries, and my mother/father comforts me when I have worries. The answer options were as follows: almost always, sometimes, never, I have no mother/father or I do not meet her/him. If the child answered "almost always" to all statements about one parent, it was classified as receiving care from that parent. All others were classified as not receiving care from that parent. Being classified as receiving care from both parents required receiving care from mother and father. If the child reported not having or not meeting with the other parent, answers about the other parent were doubled. The internal consistency for care from mother, as measured by Cronbach's alpha, was 0.60 and for care from father 0.81.

The children assessed three statements about parenting practices at meals: There are rules at meals I have to follow, I have to eat all meals at the dinner table, and I have to taste the served food even if I do not like it. The answer options for the statements were the following: I do not agree at all, I do not agree, I agree, and I definitely agree. The scores from the three statements were summed up into a variable ranging from 3 to 12 points with higher scores meaning a higher agreement with the statements. The internal consistency of parenting practices at meals, as measured by Cronbach's alpha, was 0.58.

Having family meals together during weekdays was asked by two questions. In the first question, children described how they usually have their breakfast on schooldays with answer options being: nobody eats breakfast, everyone takes something to eat self, there is a served breakfast but the family does not eat together, there is a served breakfast and mostly the family eats together. A similar question was asked about family's dinner habits, with the same answer options except that no one eats dinner was not an option. The child was classified as eating family breakfast/dinner, if he/she answered that "served

Table 1 Anthropometrics in the study sample at baseline (2006) and at follow-up (2008), schoolchildren, capital region, Finland

	Girls (<i>n</i> = 280)		Boys (<i>n</i> = 254)		Difference between genders <i>P</i> value
	2006	SD	2006	SD	
Age (years)	9.6	0.6	9.7	0.6	0.61
Length (cm)	144	7.9	144	6.6	0.23
Weight (kg)	36	8.0	37	7.4	0.53
Waist circumference (cm)	65	7.2	66	7.4	0.004
Waist-to-height ratio (WHtR)	0.449	0.043	0.459	0.044	0.007
Body mass index (BMI)	17.5	2.6	17.5	2.5	0.83
Overweight ^a (%)	17		17		0.88
	Girls (<i>n</i> = 280)		Boys (<i>n</i> = 254)		Difference between genders <i>P</i> value
	2008	SD	2008	SD	
Age	11.6	0.6	11.7	0.6	0.61
Length (cm)	156	7.9	156	8.2	0.79
Weight (kg)	46	9.7	46	9.7	0.99
Waist circumference (cm)	66	7.1	68	6.9	0.005
WHtR	0.426	0.040	0.437	0.039	0.001
BMI	18.5	2.9	18.6	2.7	0.93
Overweight ^a (%)	13		16		0.40

^a According to Cole et al. (2000)

breakfast/dinner and mostly the family eats together” best describes his/her family’s breakfast/dinner habits. A variable with 3 categories was formed: no family meals, either family breakfast or dinner, and both family breakfast and dinner.

Being physically active together with a parent was asked separately about both parents. The answer options were the following: very much, much, sometimes, quite seldom, not at all, and I cannot say. A dichotomous variable was formed, where being physically active with either parent very much or much was categorized as being physically active with a parent and all other answers as not being physically active with a parent.

Children reported the time they spend at home without adult company after school as never, 1–2, 3–4, 4–5 h, and more than 5 h.

Confounders

Because the children were too young to answer questions on family’s socioeconomic status, it was not taken into account directly. Instead, family structure and parents’ employment status were used as substitutes. Based on the answers about the family structure, the subjects were divided into those who lived with both parents and those who had other family structures. Based on questions on mother’s and father’s employment, both mothers and fathers were divided to those who worked fulltime and those who did not.

Statistical methods

Gender differences in anthropometrics and family characteristics were tested with the *t* test and chi-squared test. Covariance analysis was used to examine the association of family characteristics with BMI and WHtR in 2006 and 2008 and with BMI and WHtR in 2008 controlled for baseline. Time spent home without adult company, family meals, and parenting practices at meals were used as continuous variables in these analyses, since they appeared to have a linear association with BMI. Being physically active with parent and parental care were used as dichotomous variables. PASW for Windows 18.0 was used for the analyses. The analyses were initially controlled for by gender and age of the child, and then further regarding the family structure and parents’ employment status.

Results

The descriptive anthropometric data for the study sample are seen in Table 1. Gender differences are only evident for waist circumference and WHtR values at both baseline and follow-up demonstrating that boys have a larger waist circumference and WHtR than girls. Family characteristics of the study sample are found in Table 2. Most children stayed a maximum of 2 h at home without adult company after school, agreed that they had practices at meals, had

Table 2 Family characteristics at baseline (2006) in the study sample of schoolchildren in the capital region of Finland

	%
Hours at home without adult company in the afternoons (<i>n</i> = 596)	
Never	14
1–2 h	47
3–4 h	32
4–5 h	5
>5 h	2
Parenting practices at meals (<i>n</i> = 589)	
Least 3	1
4	1
5	1
6	3
7	7
8	11
9	21
10	23
11	19
Most 12	14
Family meals (<i>n</i> = 589)	
No family meals	18
Breakfast or dinner	58
Breakfast and dinner	25
Physical activity with a parent (<i>n</i> = 579)	
Often	56
Not often	44
Care from both parents (<i>n</i> = 591)	
Yes	35
No	65
Care from mother (<i>n</i> = 595)	
Yes	58
No	42
Care from father (<i>n</i> = 593)	
Yes	40
No	60

usually either family breakfast or dinner during weekdays, were often physically active with either parent, and perceived not receiving care from both parents. More children perceived receiving care from mothers than from fathers.

Being a longer time at home after school without adult company at baseline was associated with higher BMI at follow-up 2 years later also when controlled for baseline BMI (Table 3). Having more practices at meals at baseline was associated with lower BMI at baseline and at follow-up also when baseline BMI was taken into account. More family meals at baseline predicted lower BMI at baseline and at follow-up, but not when baseline BMI was controlled for. Physical activity with a parent was not associated with BMI at baseline or at follow-up. Total

parental care was not associated with BMI at any point, but care from mother predicted lower BMI at follow-up. Controlling for family structure and parents' employment status did not significantly alter the results (Table 4).

Fewer associations were found between family characteristics and WHtR (Table 5). Having more practices at meals was associated with lower WHtR at baseline and at follow-up, but not at follow-up when baseline WHtR was controlled for. Having more family meals at baseline was also associated with lower WHtR at baseline and at follow-up. No other associations were found. Here as well, the associations remained almost unchanged after controlling for family structure and parents' employment status (Table 6).

Discussion

In this study, we have assessed 9- to 11-year-old children's BMI and WHtR in association with different family characteristics, in both cross-sectional and longitudinal fashion, with a follow-up 2 years later. Several associations were found showing that having more parenting practices at meals, having more family meals, spending less time at home after school without adult company, and receiving care from mother predicted smaller BMI or WHtR.

The prevalence of overweight and mean BMI in our data were lower compared with other national studies with school children (Hakanen et al. 2006; Vuorela et al. 2009). The data are not quite comparable because none of these data, including our, are nationally representative. No published national representative data exist.

Many of our results, for example, the association between being home without adult company after school and BMI/WHtR cannot be directly compared with previous studies, because results on the matter have not been reported. To our knowledge, there are no previous studies on physical activity together with a parent and child weight status, but several studies have looked into parental support or parenting practices about child physical activity and child physical activity (Dollman and Lewis 2009; Hennessey et al. 2010a; Loprinzi and Trost 2010; Trost et al. 2003). Most studies have found that parental support, which in some cases has included parents doing sports together with their child, is associated with more physical activity in children or adolescents (Dollman and Lewis 2009; Loprinzi and Trost 2010; Trost et al. 2003). As a consequence, we expected that this could lead to an association between parental support (in this case, parents being physically active with their child) and child weight status. Nonetheless, our results do not suggest such an association, perhaps explained by the fact that physical activity with a parent is only one dimension of parental support for

Table 3 Associations of family characteristics with body mass index (BMI) at baseline (2006), follow-up (2008) and at follow-up when controlled for baseline BMI among schoolchildren from capital region, Finland (*n* varies between 518 and 595)

Family characteristics 2006	BMI 2006		BMI 2008		BMI 2008 controlled for BMI 2006	
	Beta coeff.	<i>P</i> value	Beta coeff.	<i>P</i> value	Beta coeff.	<i>P</i> value
Home alone, hours after school	0.11	0.38	0.29	0.05	0.22	0.00
Parenting practices at meals	-0.16	0.01	-0.22	0.00	-0.07	0.04
Physical activity with a parent ^a	0.02	0.94	0.1	0.68	-0.05	0.68
Family meals	-0.39	0.01	-0.49	0.01	-0.07	0.42
Care from both parents ^a	0.31	0.16	0.29	0.24	0.05	0.67
Care from mother ^a	0.28	0.18	0.49	0.04	0.21	0.08
Care from father ^a	0.21	0.33	0.27	0.27	0.08	0.49

Confounders: age and gender of the child

Bold values are statistically significant ($P < 0.05$)

^a No versus yes

Table 4 Associations of family characteristics with body mass index (BMI) at baseline (2006), follow-up (2008) and at follow-up when controlled for baseline BMI, family structure and parents' employment status among schoolchildren from capital region, Finland (*n* varies between 508 and 587)

Family characteristics 2006	BMI 2006		BMI 2008		BMI 2008 controlled for BMI 2006	
	Beta coeff.	<i>P</i> value	Beta coeff.	<i>P</i> value	Beta coeff.	<i>P</i> value
Home alone, hours after school	0.06	0.63	0.29	0.06	0.25	0.00
Parenting practices at meals	-0.15	0.013	-0.21	0.002	-0.07	0.05
Physical activity with a parent ^a	-0.01	0.97	0.06	0.81	-0.06	0.61
Family meals	-0.39	0.016	-0.48	0.011	-0.06	0.52
Care from both parents ^a	0.30	0.17	0.30	0.24	0.06	0.64
Care from mother ^a	0.30	0.16	0.52	0.03	0.22	0.06
Care from father ^a	0.21	0.33	0.27	0.28	0.08	0.50

Confounders: age and gender of the child, family structure, parents' employment status

Bold values are statistically significant ($P < 0.05$)

^a No versus yes

Table 5 Associations of family characteristics with waist-to-height ratio (WHtR) at baseline (2006), follow-up (2008) and at follow-up when controlled for baseline WHtR among schoolchildren from capital region, Finland (*n* varies between 502 and 582)

Family characteristics 2006	WHtR 2006		WHtR 2008		WHtR 2008 controlled for WHtR 2006	
	Beta coeff.	<i>P</i> value	Beta coeff.	<i>P</i> value	Beta coeff.	<i>P</i> value
Home alone, hours after school	0.001	0.58	0.001	0.61	0.00	0.76
Parenting practices at meals	-0.003	0.00	-0.002	0.02	0.00	0.63
Physical activity with a parent ^a	0.004	0.32	0.001	0.74	-0.003	0.74
Family meals	-0.007	0.01	-0.006	0.03	0.000	0.94
Care from both parents ^a	0.006	0.08	0.004	0.24	0.000	0.99
Care from mother ^a	0.002	0.52	0.004	0.22	0.003	0.25
Care from father ^a	0.007	0.07	0.006	0.08	0.002	0.52

Confounders: age and gender of the child

Bold values are statistically significant ($P < 0.05$)

^a No versus yes

Table 6 Associations of family characteristics with waist-to-height ratio (WHtR) at baseline (2006), follow-up (2008) and at follow-up when controlled for baseline WHtR, family structure and parents' employment status among schoolchildren from capital region, Finland (*n* varies between 492 and 574)

Family characteristics 2006	WHtR 2006		WHtR 2008		WHtR 2008 controlled for WHtR 2006	
	Beta coeff.	<i>P</i> value	Beta coeff.	<i>P</i> value	Beta coeff.	<i>P</i> value
Home alone, hours after school	0	0.99	0	0.92	0	0.93
Parenting practices at meals	0.003	0.003	-0.002	0.04	0	0.72
Physical activity with a parent ^a	0.004	0.31	0.001	0.87	-0.004	0.09
Family meals	0.007	0.01	-0.005	0.04	0	0.99
Care from both parents ^a	0.007	0.08	0.004	0.25	0	0.95
Care from mother ^a	0.002	0.50	0.005	0.19	0.003	0.21
Care from father ^a	0.007	0.06	0.006	0.09	0.001	0.58

Confounders: age and gender of the child, family structure, parents' employment status

Bold values are statistically significant ($P < 0.05$)

^a No versus yes

physical activity, or that such association does not truly exist.

Our results compliment previous research reporting the association of family meals with BMI in children. Although cross-sectional results on the matter have quite consistently shown an association between fewer family meals and a higher BMI (Fulkerson et al. 2008; Lehto et al. 2010; Utter et al. 2008; Veugelers and Fitzgerald 2005), longitudinal results on the matter are inconsistent (Fulkerson et al. 2008; Sen 2006; Taveras et al. 2005). Our results suggest that fewer family meals predict a higher BMI 2 years later, but not when baseline BMI is controlled for.

To our knowledge, practices at meals and child weight status have not been studied previously as such. Instead, the associations between practices and consumption of certain foods have been reported. Verzeletti et al. (2010a, b) have studied the association between practices at meals, calling them family obligation rules, and intake of fruits, vegetables, and soft drinks. Results showed that high family obligation rules, meaning more practices at meals, were associated with higher intake of fruits and vegetables (Verzeletti et al. 2010a), and low family obligation rules were associated with higher intake of soft drinks, but only before controlling for other factors (Verzeletti et al. 2010b). These results, although not measuring child weight status, are consistent with our results showing that practices at meals are associated with lower BMI and WHtR. In addition, our results show that more practices at meals predicts lower BMI two years later, also when controlling for baseline BMI.

Our results relating parental care to child weight status were mostly insignificant, although care from a mother was associated with a lower BMI at follow-up when not taking baseline BMI into account. In other studies, associations have been found between authoritative parenting style and lower BMI, but null results also exist (Brann and Skinner 2005; Berge et al. 2010c; Rhee et al. 2006; Agras et al. 2004). A

reason for null results can for some studies be small sample sizes (Berge et al. 2010c; Agras et al. 2004). Parental care forms only one dimension of parenting style; therefore, our results cannot be directly compared with others.

Fewer associations were found between family characteristics and WHtR than family characteristics and BMI. Reasons for this are unknown, but it is clear that BMI and WHtR measure different aspects of body size.

The results showed quite consistently that at baseline assessed determinants, which were associated with baseline weight, were also associated with weight at follow-up. However, some factors did not predict a more favorable change in weight (= models adjusted with baseline weight). Being a longer time at home after school without adult company predicted a less favorable change in BMI even if the same factor was not associated with BMI at baseline. This means that children spending longer time at home without adult company had a higher risk of increased weight 2 years later.

The mechanisms behind the observed associations can be many, but they must logically be mediated by children's health behavior. For example, the time that a child spends at home without adult company after school may be related to more screen time and unhealthy snacking. One study has described that more time at home alone is associated with less healthy eating habits (Young and Fors 2001). More parenting practices at meals can be an indicator of parents' stricter attitude toward eating in general, which could include regular eating habits, less snacking, and healthier food choices. For example, parenting practices at meals and family meals were positively correlated in our data (data not shown). Also, as cited earlier, more parenting practices at meals are associated with healthier food choices in children (Verzeletti et al. 2010a, b). A number of studies have also shown that eating family dinner/meals is positively associated with the quality of diet in children and adolescents both in cross-sectional (Utter et al. 2008;

Gillman et al. 2000; Neumark-Sztainer et al. 2003) and in prospective studies. (Burgess-Champoux et al. 2009; Larson et al. 2007).

Several limitations were evident in our study. First, the study sample was formed of Swedish-speaking children in the capital region of Finland and thus was not representative. A higher proportion of children lived together with both parents and with parents with higher educational level compared with children in the general Finnish population. This could be an explanation of why the prevalence of overweight and BMI were lower in our data compared with other national studies (Hakanen et al. 2006; Vuorela et al. 2009). Second, the response rate was quite low. This was partly due to a tight schedule, because of which reminders about the study consent were not sent. Third, because the weight measurements were taken approximately 6 months earlier than the questionnaire was filled in at baseline, caution is needed when interpreting the cross-sectional results. The reliability of the variable parenting practices at meals was quite low, which could be due to the fact that the statements measured somewhat different practices. Still, the variable formed a logical entity.

This investigation was originally a school intervention study, which aimed to increase fruit and vegetable intake, sleep duration, and physical activity in school children. Half of the participating schools were intervention schools, and the other half were control schools. The intervention was assessed at follow-up, and no clear effects in children's health behavior or BMI were seen. Thus, we have analyzed the data here from both intervention and control schools.

There were also several strengths to this work. Prospective study design is a notable strength, since these kinds of studies where family characteristics are predicting child weight status are very few. Additionally, some of the variables used here have not been studied before. Also, previous studies between lifestyle factors and WHtR are very few. The anthropometric data in this work are reliable, because the children were weighed and measured specifically by research staff. The fact that children reported the family characteristics themselves can be seen as strength or a limitation. By asking children about the family characteristics, we aimed to get children's conception of parenting practices and how they perceived receiving care from parents, which might be more relevant than a parents' view on the same things.

Here, we have investigated 9- to 11-year-old children's BMI and WHtR with relation to different family characteristics in cross-section with a longitudinal follow-up. We conclude that several family characteristics predicted children's BMI 2 years later. These included the time a child spends at home without adult company after school, parenting practices at meals, family meals, and perceived care from a mother. Similar, but fewer, associations were

found concerning WHtR. Several of the variables employed have not been studied before in relation to child weight status, and therefore these results require further confirmation in different settings. Still, taking family characteristics into account could bring new fruitful insights into intervention studies on childhood overweight.

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