Health & Place 74 (2022) 102745

Contents lists available at ScienceDirect

Health and Place

journal homepage: www.elsevier.com/locate/healthplace

Parental feeding practices and child eating behavior in different socioeconomic neighborhoods and their association with childhood weight. The STEPS study

Saija Tarro[a,b,*], Mirkka Lahdenperä[a,b], Jussi Vahtera[a,b], Jaana Pentti[a,b,c], Hanna Lagström[a,b]

[a] Department of Public Health, University of Turku and Turku Uniikversity Hospital, Turku, Finland
[b] Centre for Population Health Research, University of Turku and Turku University Hospital, Turku, Finland
[c] Clinicum, Faculty of Medicine, University of Helsinki, Helsinki, Finland

ARTICLE INFO

Keywords:
Neighborhood socioeconomic status
Socioeconomic disadvantage
Parental feeding practices
Children's eating behaviors
Overweight
BMI

ABSTRACT

Child obesity risk, child eating behavior and parental feeding practices show a graded association with individual level socioeconomic status. However, their associations with neighborhood socioeconomic disadvantage are largely unknown. In this study (n = 682), we investigated how parental feeding practices and child eating behaviors were associated with body mass index and risk of overweight at preschool age in affluent and disadvantaged neighborhoods. We found that high food approach tendency in disadvantaged neighborhoods predicted higher body mass index and increased the risk of overweight at the age of 6 years compared with affluent neighborhoods. Our results suggest that children's eating habits may have stronger impact on overweight risk in disadvantaged than in affluent neighborhoods.

1. Introduction

Children growing in disadvantaged neighborhoods are at greater risk for overweight or obesity (Carroll-Scott et al., 2013; McCurdy et al., 2014; Owen et al., 2017; Rautava et al., 2022). Poor health outcomes may be partly explained by the poor health behaviors, such as dietary habits, in disadvantaged neighborhoods (Algren et al., 2015; Kivimäki et al., 2018; Lagström et al., 2019) and suboptimal family food routines (Campbell, 2016; Finnane et al., 2017; McCurdy et al., 2014).

In addition to the living environment, home environment and family feeding behaviors play important roles in the development of child eating behaviors and weight status especially during first years of life (Birch and Ventura, 2009; Daniels, 2019; Kalhoff and Kersting, 2015; Liew et al., 2020). High maternal pressure on the child to eat has been linked with lower body mass index (BMI) (Jansen et al., 2012; Karp et al., 2014; Liew et al., 2020; Spill et al., 2019; Wardle and Carnell, 2007) and high maternal restriction of foods has been associated with higher BMI of child (Jansen et al., 2012; Joyce and Zimmer-Gembeck, 2009; Liew et al., 2020; McBride et al., 2013; Mitchell et al., 2013; Spill et al., 2019; Webber et al., 2010a). Longitudinal studies suggest that parental feeding practices might be a response to child unhealthy weight status and eating behavior, not vice versa (Derks et al., 2017; Jansen et al., 2014; Liszewska et al., 2018; Webber et al., 2010b), although it has been suggested that influence is bidirectional (Afonso et al., 2016; Hughes et al., 2021; Tschann et al., 2015). Thus, there is need of more studies in different study settings including cross sectional studies clarifying if the prevailing environment also impacts both the food behavior and associations with the child obesity risks. Furthermore, those few studies focusing on fathers role on child eating, stated that paternal feeding practices also matter in regard to children's weight status (Lloyd et al., 2014; Penilla et al., 2017) and they might moderate the effects of child eating behaviors on child BMI (Vollmer et al., 2015).

Food approach and avoidance traits have been previously used to characterize child eating behavior (Ek et al., 2016; Vilela et al., 2018). Child food approach traits (high enjoyment of food, food responsiveness, desire to drink and emotional overeating) and avoidance traits (satiety responsiveness, slowness in eating, food fussiness, and emotional under eating) are shown to be associated with child weight status. High food approach traits are shown to be associated with higher BMI (Boswell et al., 2018; Ek et al., 2016; Viana et al., 2008; Webber et al., 2009),

Abbreviations: CFQ, Child Feeding Questionnaire; CEBQ, Child Eating Behavior Questionnaire; BMI, Body Mass Index.

* Corresponding author. University of Turku, Kansanterveystiede, Turun yliopisto, 20014, Turun yliopisto, Finland.
E-mail addresses: saija.tarro@utu.fi (S. Tarro), mirkka.lahdenpera@utu.fi (M. Lahdenperä), jussi.vahtera@utu.fi (J. Vahtera), jaana.pentti@utu.fi (J. Pentti), hanna.lagstrom@utu.fi (H. Lagström).

https://doi.org/10.1016/j.healthplace.2022.102745
Received 22 December 2020; Received in revised form 28 December 2021; Accepted 21 January 2022
Available online 2 March 2022

while high food avoidance traits are associated with lower BMI (Ek et al., 2016; Viana et al., 2008).

We have already shown that neighborhood disadvantage was associated with unfavourable BMI development from birth to age of 7 (Rautava et al., 2022). However, there are no previous studies addressing child obesity risk, child eating behavior and parental feeding practices and simultaneously taking into account neighborhood socioeconomic disadvantage. In the present study, we examined the association of parental feeding practices and child eating behaviors with body mass index as well as risk of overweight in affluent and disadvantaged neighborhoods among preschool age Finnish children. Further, the aim was to investigate separately feeding practices of mothers and fathers.

2. Materials and methods

2.1. Study design and subjects

The present study is based on data from parents (both mother and father) and children participating in a prospective Steps to Healthy Development follow-up study (the STEPS Study), which has previously been described in detail elsewhere (Lagström et al., 2013). Briefly, all Finnish- and Swedish-speaking mothers, who delivered a living child between January 1, 2008 and April 31, 2010 in the Hospital District of Southwest Finland, formed the cohort population (in total 9811 mothers and their 9936 children). Altogether 1797 mothers (18.3% of the total cohort) and 1658 spouses with 1805 children volunteered as participants for the intensive follow-up group. All subjects in this study were ethnically homogeneous white Europeans.

In this study, full term infants (after $36^{6/7}$ weeks of pregnancy) and their parents from singleton pregnancies were included. We excluded those who had missing information on home addresses or neighborhood disadvantage (i.e. no information on the grid database as they lived in sparsely inhabited areas with <10 residents; n = 180). Further, children who did not have growth data (N = 249) at 5 or 6 years of age, were excluded. Finally, three datasets were created based on children's eating behavior questionnaire (N = 682) and child feeding questionnaires separately from mothers (N = 680) fathers (N = 520) (eFigure1).

The study was approved by the Ethics Committee of the Hospital District of Southwest Finland in February 2007. Written informed consent was obtained from all the families and parents of the children.

2.2. Measures

2.2.1. Outcome: Child growth

Child growth data were obtained from municipal follow-up clinics, which use standardized methods for the measurement of height and weight provided by the Finnish Institute for Health and Welfare. The anthropometric data −2 months/+3 months from the time point of 6 years of age were used in the analyses. If 6-year of age data was missing, data at child age of 5 years was used instead in the analysis (N = 127, 19%), due to very strong correlation between 5 and 6 years of data (r = 0.9). The Finnish growth references (Saari et al., 2011) were used to determine children BMI Z-score. Sex specific cut-off points were used for overweight categorization: ≥ 1.1629 for boys and ≥0.7784 for girls.

2.2.2. Explanatory factors

Parental feeding practices at the child age of 6 years were measured with a parental self-report questionnaire: *Child Feeding Questionnaire (CFQ)* (Birch et al., 2001) (Likert scale 1–5), assessing parental feeding styles. Two/five factors from the CFQ questionnaire were used to assess parental controlling feeding practices separately for mother and father: restriction (8 questions), measuring the extent to which parents restrict their child's access to foods (e.g. 'I intentionally keep some foods out of my child's reach') and pressure to eat (4 questions), measuring parent's tendency to pressure their children eat more food (e.g. 'My child should always eat all the food on her plate') (Birch et al., 2001). The variable score for restriction and pressure to eat was obtained by calculating the mean score for the questions on each variable. Mean (SD) of each score can be found in Supplementary Table 1. If CFQ questionnaire was available at child age of 6 years, it was used as a primary value. When empty, questionnaire data at child age of 5 years was used instead (Mothers N = 177, 26%, Fathers N = 156, 30%). The correlation between 5 and 6 years of data points was strong (r > 0.6).

Child eating behavior at the child age of 6 years were measured using *Child Eating Behavior Questionnaire (CEBQ)*, which is a 35-item parent-report questionnaire (Likert scale 1–5), measuring children's eating behavior and assessing eating styles related to obesity risk (Wardle et al., 2001). CEBQ is clustered into eight subscales from which food responsiveness, emotional overeating, enjoyment of food, and desire to drink, were grouped into food approach dimension. Food approach measures child's drive to eat in response to external food cues (e.g. 'Given the choice, my child would eat most of the time'), child's subjective pleasure from eating (e.g. 'My child loves food'), child's wanting for beverages (e.g. 'My child is always asking for a drink') and child's appetitive response to emotional stressors (e.g. 'My child eats more when worried'). Subscales satiety responsiveness, slowness in eating, emotional undereating, and food fussiness, were grouped into food avoidance dimension. Food avoidance measures child's sensitivity to internal cues of satiety (e.g. 'My child gets full up easily'), child's speed of meal consumption (e.g. 'My child eats slowly'), child's appetitive response to emotional stressors (e.g. 'My child eats less when s/he is tired') and child's pickiness about the flavour and texture of foods ('My child refuses new foods at first'). Similar groupings have also been used in earlier studies (Ek et al., 2016; Jansen et al., 2012; Liew et al., 2020; Zhou et al., 2020). A composite score of both food approach and food avoidance dimensions were created by taking the mean of the subscales based on questionnaire availability when 50% of the subscales were completed. Mean (SD) of each score can be found in Supplementary Table 2. The internal consistency was good both for food approach dimension (16 questions) and food avoidance dimension (19 questions) (Cronbach's alphas above 0.73 and 0.74, respectively). If CEBQ questionnaire was available at child age of 6 years, that was used as a primary value. When empty, questionnaire data at child age of 5 years was used instead (N = 184, 27%), to make the sample size as comprehensive as possible. The correlation between 5 and 6 years of data points was strong (r > 0.6).

2.2.3. Neighborhood socioeconomic disadvantage

Data regarding neighborhood socioeconomic disadvantage was derived from a grid database established and maintained by Statistics Finland. The database contains socio-economic information from each residence at a spatial resolution of 250 m by 250 m (Statistics Finland, 2013). The grid data were obtained for year 2009 from Statistics Finland. The neighborhood socioeconomic disadvantage score is based on the proportion of adults with low education, the unemployment rate, and household income in each 250 m × 250 m grid area (Halonen et al., 2016). Missing data (i.e. areas with fewer than 10 residents in the neighborhood) were replaced with the mean neighborhood socioeconomic disadvantage score of the eight adjacent map squares. For each of the three variables, we derived a standardized z score based on the total Finnish population (mean = 0, SD = 1). A score for neighborhood disadvantage (hereafter used to refer to neighborhood socioeconomic disadvantage) was then calculated by taking the mean value across the three z-scores.

High quality residential mobility data, based on a complete history of the residential addresses with latitude and longitude coordinates, were obtained from the Population Register Center for each child from birth to age 6 years. Using open-source Geographical Information Systems (QGIS, http://www.qgis.org/en/site/), data on the cumulative neighborhood disadvantage for each time point were linked to the cohort participants' home addresses by the latitude and longitude coordinates. A cumulative neighborhood disadvantage score at age of 6 years weighted by residential time at each location from birth to 6 years was

Table 1
Pre- and perinatal characteristics of the participants and their association with neighborhood disadvantage at 6 years of age. Sample sizes and percentages (in brackets) are reported for categorical variables, means and standard deviations (SD) for continuous variables. Statistical differences were tested with t-tests (continuous variables) and chi-square tests (categorical variables).

		Neighborhood disadvantage [a]		P-value
	All	Low (≤0) N (%)	High (>0) N (%)	
	682	513 (75%)	169 (25%)	
Maternal characteristics				
Age (years), Mean (SD)	31.21 (4.37)	31.5 (4.09)	30.33 (5.05)	0.007
17–29 years, N (%)	272 (40)	186 (36)	86 (51)	<0.001
30–45 years, N (%)	410 (60)	327 (64)	83 (49)	
Primiparous, N (%)				
Yes	407 (60)	298 (58)	109 (65)	0.17
No	275 (40)	215 (42)	60 (35)	
Mode of delivery, N (%)				
Vaginal	603 (88)	456 (89)	147 (87)	0.59
Cesarean section	79 (12)	57 (11)	22 (13)	
Mother BMI (kg/m^2), Mean (SD)	24.08 (4.49)	23.79 (4.40)	24.98 (4.66)	0.003
Mother overweight, N (%)[b]				
No	485 (71)	383 (75)	102 (60)	<0.001
Yes	196 (29)	129 (25)	67 (40)	
Family characteristics				
Father BMI (kg/m^2), Mean (SD)	26.06 (7.27)	26.01 (7.23)	26.23 (7.41)	0.74
Father overweight, N (%)[b]				
No	304 (45)	230 (47)	74 (47)	0.97
Yes	343 (51)	259 (53)	84 (53)	
Family education, N (%)[c]				
Advanced	496 (73)	401 (78)	95 (56)	<0.001
Low	145 (21)	87 (17)	58 (34)	
Family income, N (%)				
<3000	361 (53)	235 (46)	126 (75)	<0.001
≥3000	310 (46)	271 (53)	39 (23)	
Child characteristics				
Sex, N (%)				
Boy	353 (52)	275 (54)	78 (46)	0.11
Girl	329 (48)	238 (46)	91 (54)	
Duration of pregnancy (weeks), mean (SD)	40.08 (1.19)	40.05 (1.20)	40.18 (1.18)	0.21
Birthweight (grams), mean (SD)	3565 (443)	3572 (451)	3545 (417)	0.49
Birth weight, z-score, mean (SD)	−0.01 (1.01)	0.00 (1.03)	−0.04 (0.94)	0.61
Overweight at 5–6 years, N (%)[d]				
Yes	111 (16)	83 (16)	28 (17)	0.91
No	571 (84)	430 (84)	141 (83)	

[a] Cumulative neighborhood disadvantage from birth to age of 6 years, a standardized z score based on the total Finnish population.
[b] BMI ≥25.
[c] Highest education that one of the parents had completed for their professions. Those who had no professional training or a maximum of an intermediate level of vocational training were classified as "low". Those who had studied at a University of Applied Sciences or higher were classified as "advanced". The advanced level included any academic degree (bachelor's, master's, licentiate or doctoral degree).
[d] BMI z-score ≥ 1.1629 for boys and ≥0.7784 for girls.

calculated for each study subject (Rautava et al., 2022). For the statistical analyses, the neighborhood disadvantage score was classified into two categories based on national means: ≤ 0 SD (low) and >0 SD (high).

2.3. Potential confounders

Pre- and perinatal characteristics of the mothers and their children were extracted from the Medical Birth Register of Finland on parturients, deliveries and births maintained by the Finnish Institute for Health and Welfare: duration of the gestation (gwks: preterm <37; term 37–41; post term ≥41), birth weight (g), birth weight z-score and length (cm), and the mode of delivery (all caesarian (C-) section vs. all vaginal).

Maternal and paternal pre-pregnancy body weight and height were self-reported at the time of recruitment to calculate pre-pregnancy BMI. Maternal and paternal overweight including obesity was defined as pre-pregnancy body mass index (BMI) ≥ 25 kg/m^2. Information regarding parents' marital status, total family income, mother's age and parental education were obtained from self-administered questionnaires upon recruitment. Family income was classified into two categories: high income (≥3000 €/month net) and low income (<3000 €/month net). Parental education and family income were both used as a measure for family socioeconomic status. Mother's age was classified into two categories by the mean age of women giving birth in Finland 2019) (29.6 years of age) (Official Statistics of Finland (OSF), 2019). Parental education was classified into advanced education or low education based on the highest education that one of the parents had completed for their professions. Those who had no professional training or a maximum of an intermediate level of vocational training were classified as "low". Those who had studied at a University of Applied Sciences or higher were classified as "advanced". The advanced level included any academic degree (bachelor's, master's, licentiate or doctoral degree).

2.4. Statistical analysis

To examine the associations of the pre- and perinatal characteristics of the mother (potential confounders) with the categories of cumulative neighborhood disadvantage at 6 years of age, we used chi-square tests for categorical variables and *t*-test for continuous variables (Table 1).

Generalized linear models were used to model the associations of parental feeding practices/child eating behavior and cumulative neighborhood disadvantage with child BMI z-scores at 6 years of age. Separate models were run for parental restriction and parental pressure to eat, child food approach and food avoidance traits and neighborhood disadvantage variables. Neighborhood disadvantage was used as a categorical variable (high/low disadvantage). Child BMI z-score, parental restriction, parental pressure to eat, food approach and food avoidance traits were continuous variables. First, in order to study the main effects of explanatory variables and child BMI z-score, we included neighborhood disadvantage, parental feeding or child eating behavior as explanatory variables and child BMI z-score as dependent variable to the model. Secondly, we included 2-way interactions between neighborhood disadvantage and parental feeding or child eating behavior variables to investigate whether the associations of child eating/parental feeding on childhood BMI changes with neighborhood disadvantage. Finally, the models were adjusted for the pre- and perinatal characteristics of the family (mother's age, mother's pre-pregnancy BMI, father's pre-pregnancy BMI, parental education and family income). Normal distribution assumption was checked from studentized residuals. As a sensitivity analysis we ran similar models using only children with 6 year old data. Finally, using same methods but with logistic regression, we studied the risk of being overweight at 6 years of age. For each parental feeding or child eating behavior variable the odds ratios (ORs) and their 95% confidence limits (CLs) were calculated to represent an average of the risk of being overweight in high or low disadvantaged neighborhoods. To examine the bidirectionality in the association between BMI and parental controlling feeding practices, BMI z score at age 3 years was used as a predictor of parental controlling feeding practices when the child was at age 6.

Descriptive statistical analysis was mainly carried out using tools implemented in the R package (R Core Team, 2018). Inferential statistical analysis was performed using SAS software for Windows version 9.4 (SAS Institute Inc.). The level of significance was set at P value $<$ 0.05.

3. Results

The pre- and perinatal characteristics of the families in the study are presented in Table 1. Most of the children, 75%, lived in affluent neighborhoods whereas 25% of children were exposed to the high neighborhood disadvantage areas. Mothers were younger and their pre-pregnancy BMI was higher in the high disadvantage compared to low disadvantage neighborhoods. Corresponding differences were observed for maternal overweight before pregnancy (high neighborhood disadvantage 40% vs low disadvantage 25%). No similar differences were found in fathers' BMI and/or overweight status. Families in high disadvantage areas had lower education and lower income compared to low disadvantage areas. There were no differences between the neighborhoods in primiparosity, mode of delivery, gestational age, birth weight (g), birth weight SDS score and child overweight status at 6 years of age.

Parental controlling feeding practices were similar in low and high disadvantage neighborhoods (Table 2). Parental restriction was similar for both parents, but fathers pressured their children to eat slightly more than mothers (see Supplementary Table 1). Child food approach and food avoidance traits were also similar in low and high disadvantage neighborhoods.

Parental controlling feeding practices were associated with child BMI z-score at 6 years of age (Table 3). Higher amount of restriction was linked with higher child BMI z-score (beta for mother = 0.26, $p < 0.0001$ and father = 0.19, p = 0.002) while higher amount of pressure to eat linked with lower BMI z-score (mother adjusted beta = −0.29, $p <$ 0.0001, father adjusted beta = −0.19, p = 0.0002). Neighborhood disadvantage was not associated with child BMI z-score (Table 3) and there was no interaction between parental controlling feeding and neighborhood disadvantage on child BMI z-score (interaction p-values $>$ 0.05, Fig. 1).

Prospective analysis showed that higher child BMI z-score at the age of 3 years was associated with higher parental restriction at the age of 6 years (regression coefficient beta for mother = 0.15, $p < 0.0001$ and father = 0.09, p = 0.02) and lower child BMI with higher parental pressure to eat (regression coefficient beta for mother = −0.20, $p <$ 0.0001 and father = −0.19, p = $<$ 0.0001) (data not shown).

Higher maternal restriction was associated with 1.74-fold (95% CL 1.25, 2.43) risk of child overweight at the age of 6 years; (p = 0.0009) while no such an association was observed for paternal restriction (OR 1.25, 95% CL 0.82–1.91, p-value 0.31). Maternal pressure to eat associated with decreased risk of child overweight at the age of 6 years: OR 0.45 (0.33–0.60), p-value $<$ 0.0001, the corresponding figures for paternal pressure to eat were 0.66 (0.46–0.95), p-value = 0.03 (Table 3). There was no interaction between parental controlling feeding and neighborhood disadvantage on child's overweight (interaction p-values $>$ 0.05, Fig. 3).

As shown in Table 3, child eating behavior was associated with child BMI z-score at 6 years of age. Child food approach was positively associated with BMI (adjusted beta = 0.63, $p < 0.0001$) and child food avoidance was negatively associated (adjusted beta = −0.23, p = 0.003) with child BMI z-score. Moreover, the association between child food approach and BMI depended on neighborhood disadvantage (interaction p = 0.02). In disadvantaged neighborhoods, food approach tendency was more strongly associated with child BMI z-score (beta = 0.93 (95% CL 0.60–1.26) than in affluent neighborhoods (beta = 0.46 (95% CL 0.24–0.69) (Fig. 2a). However, regarding child food avoidance, no interaction with neighborhood disadvantage on BMI was observed (Fig. 2b). Sensitivity analyses including only children with 6-year of age data support these findings.

As shown in Table 3, there was a strong association between child food approach and the risk of child overweight at the age 6 years (OR 3.97, 95% CI (2.28–6.91) while no association was observed between food avoidance and overweight. The association of food approach depended, however, on neighborhood disadvantage (interaction p =

Table 2
Parental feeding practices, child eating behavior and their association with neighborhood disadvantage at 6 years of age. Sample sizes and percentages (in brackets) are reported for categorical variables, figures are means (standard deviations) unless otherwise stated. Statistical differences were tested with t-tests.

		Neighborhood disadvantage		P-value
	All	low (≤0), N (%)	high (>0), N (%)	
Mother, N (%)	680	516 (76%)	164 (24%)	
Restriction, mean (SD)	2.56 (0.72)	2.57 (0.71)	2.54 (0.75)	0.35
Pressure to eat, mean (SD)	2.85 (0.88)	2.86 (0.88)	2.80 (0.90)	0.45
Father, N (%)	520	395 (76%)	125 (24%)	
Restriction, mean (SD)	2.68 (0.73)	2.70 (0.73)	2.62 (0.71)	0.31
Pressure to eat, mean (SD)	3.15 (0.84)	3.13 (0.83)	3.20 (0.85)	0.41
Child, N (%)	682	513 (75%)	169 (25%)	
Food approach, mean (SD)	1.95 (0.40)	1.94 (0.38)	1.96 (0.46)	0.59
Food avoidance, mean (SD)	2.85 (0.52)	2.84 (0.53)	2.89 (0.50)	0.28

Table 3
The main effect of parental controlling feeding practices, child eating behavior and child BMI z-score at 6 years of age and the risk of overweight at 6 years of age.

Outcome = BMI z-score	Unadjusted model			Adjusted model 1 [a]			Adjusted model 2 [b]		
	Beta	95% CL	p-value	Beta	95% CL	p-value	Beta	95% CL	p-value
Restriction, mother	0.25	0.15, 0.35	<0.0001	0.24	0.14, 0.35	<0.0001	0.26	0.16, 0.37	<0.0001
Restriction, father	0.16	0.05, 0.28	0.006	0.17	0.05, 0.29	0.004	0.19	0.07, 0.30	0.002
Pressure to eat, mother	−0.28	−0.36, −0.2	<0.0001	−0.28	−0.36, −0.19	<0.0001	−0.29	−0.37, −0.2	<0.0001
Pressure to eat, father	−0.22	−0.32, −0.13	<0.0001	−0.21	−0.31, −0.11	<0.0001	−0.19	−0.29, −0.09	0.0002
Food approach, child	0.58	0.39, 0.77	<0.0001	0.6	0.41, 0.79	<0.0001	0.63	0.44, 0.82	<0.0001
Food avoidance, child	−0.22	−0.37, −0.08	0.003	−0.24	−0.39, −0.09	0.002	−0.23	−0.38, −0.08	0.003
Neighborhood disadvantage	0.05	−0.03, 0.14	0.21	0.04	−0.05, 0.13	0.34	0.05	−0.04, 0.14	0.31
Outcome = Overweight	**OR**	**95% CL**	**p-value**	**OR**	**95% CL**	**p-value**	**OR**	**95% CL**	**p-value**
Restriction, mother	1.67	1.24, 2.26	0.0008	1.75	1.27, 2.41	0.0007	1.74	1.25, 2.43	0.0009
Restriction, father	1.12	0.77, 1.61	0.56	1.21	0.81, 1.81	0.35	1.25	0.82, 1.91	0.31
Pressure to eat, mother	0.52	0.40, 0.67	<0.0001	0.49	0.38, 0.65	<0.0001	0.45	0.33, 0.60	<0.0001
Pressure to eat, father	0.63	0.46, 0.87	0.005	0.61	0.44, 0.86	0.005	0.66	0.46, 0.95	0.03
Food approach, child	3.22	1.97, 5.26	<0.0001	3.64	2.14, 6.18	<0.0001	3.97	2.28, 6.91	<0.0001
Food avoidance, child	0.66	0.45, 0.99	0.04	0.71	0.46, 1.08	0.11	0.71	0.46, 1.10	0.12
Neighborhood disadvantage	1.18	0.95, 1.46	0.13	1.21	0.95, 1.53	0.12	1.24	0.96, 1.60	0.10

OR = Odds ratio.
[a] Adjusted for sex, mother's age and mother pre-pregnancy BMI.
[b] Adjusted for sex, mother's age, mother & father pre-pregnancy BMI, parental education and family income.

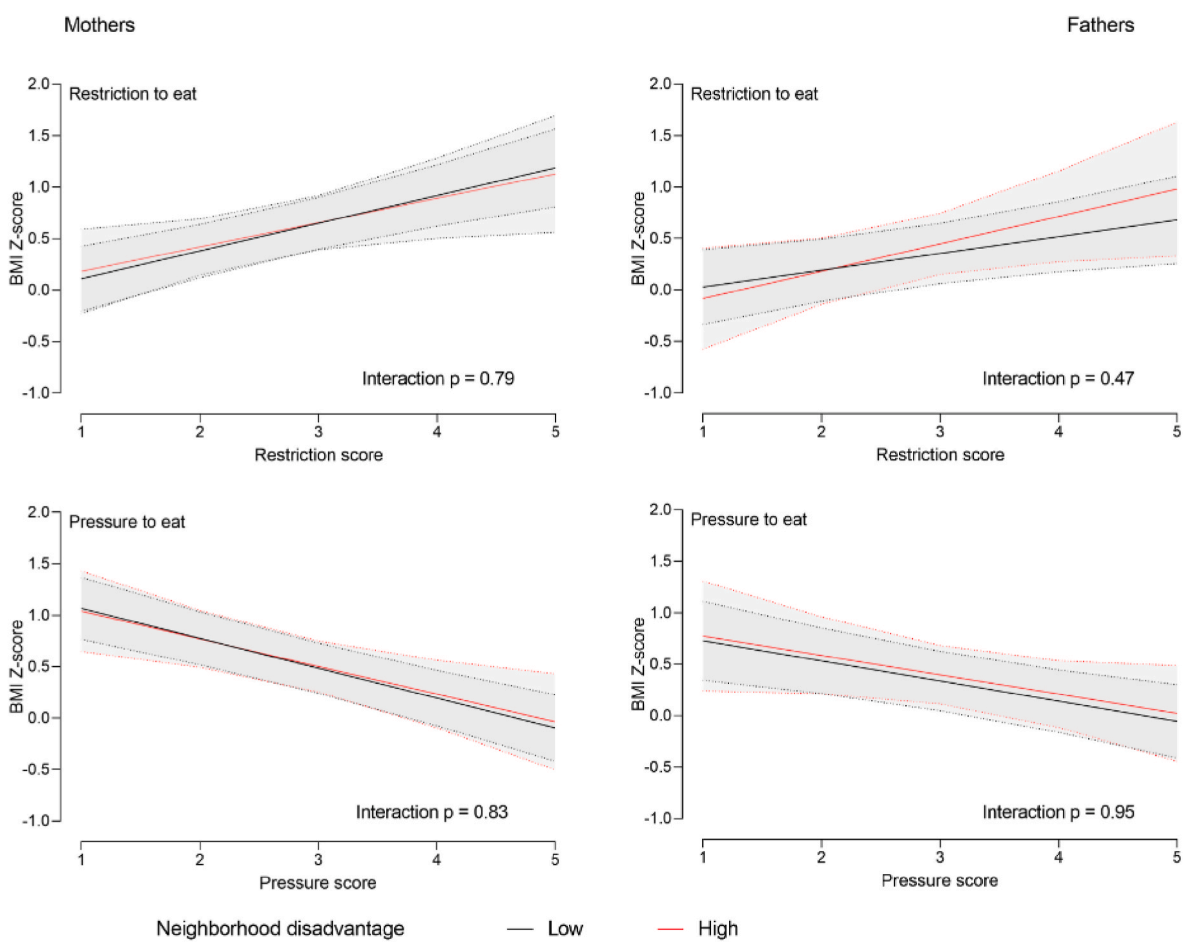

Fig. 1. Parental feeding behavior in low and high cumulative disadvantage neighborhoods and child BMI z-score at 6 years of age with 95% confidence limits. Adjusted for covariates (sex = boys, mother pre-pregnancy BMI = overweight, father BMI = overweight, mother age = 17–29 years, family education = low education, family income <3000 EUR).

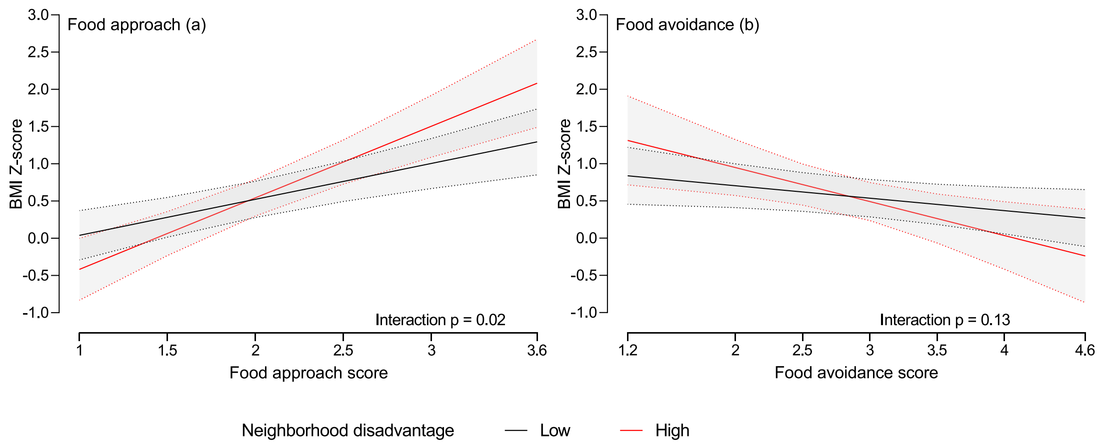

Fig. 2. Food approach (a) and Food avoidance (b) in low and high cumulative disadvantage neighborhoods and child BMI z-score at 6 years of age with 95% confidence limits. Adjusted for covariates (sex = boys, mother pre-pregnancy BMI = overweight, father BMI = overweight, mother age = 17–29 years, family education = low education, family income <3000 EUR).

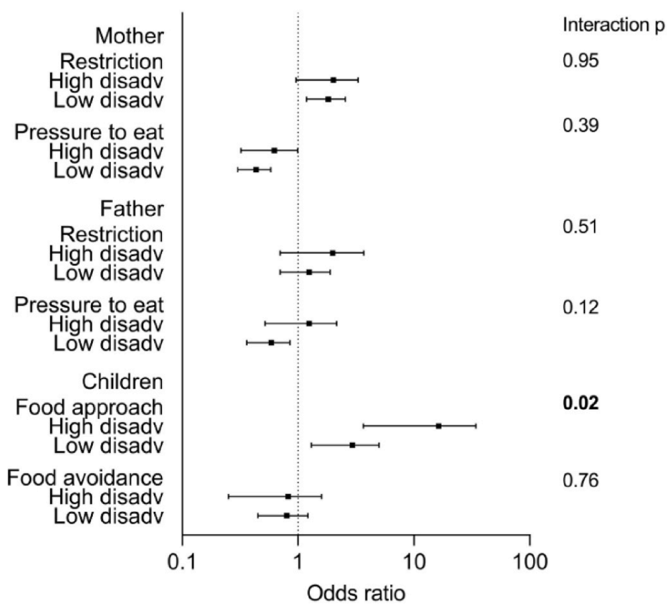

Fig. 3. Parental feeding and child eating behavior odds ratios for overweight in high and low disadvantage neighborhood groups with 95% confidence limits and p-values for interaction. Adjusted for covariates: sex, mother's age, mother & father pre-pregnancy BMI, parental education and family income.

0.019). Risk of overweight was greatly increased with higher food approach score in disadvantaged neighborhoods (OR (95% CL): 11.17 (3.65–34.22), p-value < 0.0001) compared to affluent neighborhoods (OR (95% CL): 2.54 (1.30–4.97), p-value 0.006) (Fig. 3).

4. Discussion

To our knowledge, this is the first study to investigate the effects of parental feeding practices (separately for fathers and mothers), child eating behavior and neighborhood disadvantage on child BMI. The results show that both parental feeding practices and child eating behavior are important factors affecting child weight development. However, these effects may depend on socioeconomic living environment as the highest risk of overweight was observed in children with high child food approach trait in combination with high neighborhood disadvantage.

Our results partially support earlier findings (Jansen et al., 2012; Karp et al., 2014; Spill et al., 2019; Wehrly et al., 2014) suggesting that children whose parents use high level of restrictive feeding, have higher BMI. Similarly, children whose parents use high pressuring in feeding, have lower BMI. In addition, our results support the bidirectionality hypothesis stating that parents both respond to and influence their child's BMI (Afonso et al., 2016; Tschann et al., 2015). However, there were noticeable differences between mothers and fathers. Partly contrary to earlier findings (Khandpur et al., 2016; Scaglioni et al., 2018), in our sample fathers used more pressuring in feeding compared with mothers (see Supplementary Table 1). Furthermore, the odds of being overweight at 6 years of age was significantly higher for the children whose mothers used restrictive feeding practices both in disadvantaged and affluent neighborhoods. On the contrary, the association was not seen with fathers restrictive feeding. This might reflect the view that mothers may be the primary actors in establishing the home food environment and responsible for determining how much food is offered to their children (Campbell, 2016; Scaglioni et al., 2018). The previous studies have suggested that the father's feeding practices are not associated with children's weight status directly, but merely by moderating the effects of child eating behaviors and BMI z-score (Vollmer et al., 2015). In our study, the lack of associations might also be due to lower statistical power for fathers in our study as the linear associations between child BMI and parental feeding practices were similar for both parents. As fathers have an increasingly important role in early feeding (Daniels, 2019), further studies are needed to investigate the influence of fathers feeding on child weight or vice versa.

Further, child food approach trait was associated with child BMI and with increased risk of overweight. This is in line with previous studies showing positive association between child food approach traits and child BMI (Boswell et al., 2018; Carnell and Wardle, 2007; Ek et al., 2016; Jansen et al., 2012; Viana et al., 2008; Webber et al., 2009). A novel finding of our study was that these associations were significantly higher in disadvantaged neighborhoods compared with affluent neighborhoods. The children growing up in the most disadvantaged neighborhoods and with high food approach, exhibited with highest BMI z-scores at the age of 6 years. In addition, the risk of being overweight at 6 years of age was highest in food approaching children living in disadvantaged neighborhoods.

In the present study, parental pre-pregnancy BMI, mother age, family income and family education at the time of childbirth were significantly associated with child BMI. In the statistical models adjusted for these confounding factors, an independent and significant association between neighborhood disadvantage, child food approach trait and childhood BMI development was apparent. There is existing evidence with adult populations that socioeconomic disparities are associated with poor health outcomes, such as obesity, independent of individual socio-economic standing (Kivimäki et al., 2018; Miller et al., 2016). Growing number of studies have also addressed the impact of neighborhood disadvantage on overweight in childhood or adolescence and the majority of them suggest an association between neighborhood disadvantage and BMI or the risk of overweight or obesity (Alvarado, 2016; Carter and Dubois, 2010; Greves Grow et al., 2010; Rautava et al., 2022). It is especially interesting that we were able to indicate that the neighborhoods people live in, add up an own layer to the risk factor in Finland, a country with modest socioeconomic differences and income inequalities (Saikkonen, 2018). However, income and ethnic segregation have increased during last years in the City of Turku region where the study population live (Saikkonen, 2018).

The underlying reasons for the differences in food-approaching children's BMI according to neighborhood disadvantage are complex. It has been suggested, that a high total energy intake rather than low total energy expenditure is the main cause behind overweight development in children (Spence et al., 2011). Typically the relationship between socioconomic disadvantage and higher obesity risk is explained by so called availability hypothesis (Caldwell and Sayer, 2019). As earlier research indicates, individuals who live in disadvantaged neighborhoods typically have less access to healthy food, greater availability of fast-food restaurants and tend to consume less fruits and vegetables and more of energy-dense foods (Matthews, 2009; Ranjit et al., 2015; Ribeiro et al., 2019). In addition, a recent study from Denmark found that soft drink intake was more frequent among residents in disadvantaged neighborhoods compared to residents in affluent neighborhoods (Bernsdorf et al., 2016). However, availability hypothesis does not explain why individuals living in disadvantaged neighborhoods choose to consume energy dense foods (Caldwell and Sayer, 2019). Price in addition to availability could act as one barrier to purchasing healthy foods even if they would be available in close proximity (Caldwell and Sayer, 2019).

Psychosocial factors may also explain the neigborhood effects on BMI. Overweight is suggested to spreads through social networks in neighborhoods (Christakis and Fowler, 2007), which again have shared values and norms (Bernsdorf et al., 2016; Ribeiro et al., 2019). In addition, as humans tend to eat more nutrient-dense foods when stressed (Torres and Nowson, 2007) higher parental stress in disadvantaged neighborhoods might explain food-approaching children's susceptibility obesogenic environment (Boswell et al., 2018; Gemmill et al., 2013). Further, child emotional self-regulation and eating self-regulation processes are related to one another and poor self-regulation has been linked to food approach tendency (Liew et al., 2020; Zhou et al., 2019). Previous studies suggest that while general self-regulation improves across childhood, there is a trend of increased disinhibited eating from infancy to 7 years of age (Russell and Russell, 2021), which might explain the associations of food approach and weight at 6 years of age. This might reflect the fact that top-down regulatory capacities of young children are still poor and with environment full of palatable food cues, genetically predisposed children tend to overeat. Moreover, children's temperament might add an own layer to children's susceptibility to the adverse effects of disadvantage (Zhou et al., 2019).

Reason why influence of neighborhood disadvantage on BMI was found only related to food approach traits, but not related to food avoidance traits might lie partly in the gene-environment interplay. Previous studies suggest that heritability is especially high for slowness in eating and satiety responsiveness (Wood, 2018). Thus, children with food avoidance tendency might not be particularly vulnerable to the obesogenic environment. Interestingly, the effects of parental feeding practices on the BMI of children did not differ in disadvantage and affluent neighborhoods. This finding is partly contrary to prior research evidence showing that lower socioeconomic status is generally associated with increased controlling feeding practices (Arlinghaus and Laska, 2021; Cardel et al., 2012). Some previous studies have indicated that food parenting practices might not be related to socioeconomic indicators, but more to personal and other contextual factors, such as parent dieting status (Roberts et al., 2018), parent childhood experiences, family health concern (Mena et al., 2015). Thus, more research is needed on this area.

There is evidence, that developmental environments at childhood might have a persistent effects on obesity risk in adulthood and low socioeconomic status in childhood could contribute to eating in the absence of energy need in adulthood (Caldwell and Sayer, 2019; Hill et al., 2016). Even in the first year of life, socioeconomic disadvantage has been strongly linked to increased risk of obesity in adulthood (Gilman et al., 2019). Thus, it would be even more important to pay attention to the home food environment of the vulnerable children, such as availability of healthy foods at the dinner table and food parenting behaviors (Ranjit et al., 2015; Zhou et al., 2020). In a family where unhealthy foods are available individuals predisposed genetically to be highly responsive to external food cues and have weaker internal satiety signals, are more likely to overeat (Carnell and Wardle, 2007).

The present study has several strengths and limitations. The large sample size in combination with the use of a population registry, make the study particularly robust. The utilization of a high-resolution 250 m × 250 m grid database containing cumulative neighborhood disadvantage information from each participant is the major strength of this study. In addition, our data included answers to child feeding questionnaire from both parents and thus widened understanding on the similarities or differences in feeding practices between mothers and fathers. Further, controlling for individual-level sociodemographic factors and including several possible confounding factors in the analysis add to the validity of our findings. This study has also some limitations. Our large population-based sample consisted mainly of individuals of European origin living in a welfare society, thus, the generalizability of our findings to other populations and cultures needs to be confirmed in other studies. This study also did not include child dietary intake, which may be associated both with parental feeding, and with child BMI status. In addition, we cannot put aside self-report bias and it may be possible that parents provided socially desirable responses. However, the bias was probably similar in both neighborhoods.

5. Conclusions

To our knowledge, this study is the first one to investigate the link between parental feeding practices, child eating behavior, neighborhood disadvantage and risk of overweight among pre-school age children. Our study gives valuable insight into social environmental variables associated with child eating behaviors. While parental feeding practices might not be as sensitive to neighborhood effects, high food approach trait in children especially in combination with high neighborhood disadvantage increases the risk of overweight before school age. It is possible, for example, that disadvantaged neighborhoods might offer unhealthier food environments than affluent neighborhoods. Thus, this association may constitute one explanatory pathway linking socioeconomic disadvantage to overweight. As overweight children tend to grow into obese adults, it is important to understand how obesogenic environments affect and transform individual eating behaviors.

Authorship

All authors are responsible for reported research. ST, ML, HL conceptualized the study. HL participated in the data collection and ST, ML, JV, JP and HL in data analysis. Original draft was written, and statistical analyses were performed by ST. The manuscript was reviewed and edited by ST, ML, JV, JP, HL. Funding was provided by HL. All authors have had sufficient access to the data to verify the manuscript's scientific integrity and they approved the final manuscript as submitted and agree to be accountable for all aspects of work.

Acknowledgements

The authors are grateful to all the families who took part in this study and the whole STEPS Study research team for data collection. We also thank biostatistician Helena Ollila for compiling the data and her kind help with data-analysis. This study was financially supported by the Academy of Finland (HL, grant number SA121569 and SA321409) and Juho Vainio Foundation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.healthplace.2022.102745.

References

Afonso, L., Lopes, C., Severo, M., Santos, S., Real, H., Durão, C., Moreira, P., Oliveira, A., 2016. Bidirectional association between parental child-feeding practices and body mass index at 4 and 7 y of age. Am. J. Clin. Nutr. 103 (3), 861–867. https://doi.org/10.3945/ajcn.115.120824.

Algren, M.H., Bak, C.K., Berg-Beckhoff, G., Andersen, P.T., 2015. Health-risk behaviour in deprived neighbourhoods compared with non-deprived neighbourhoods: a systematic literature review of quantitative observational studies. In: PLoS ONE. https://doi.org/10.1371/journal.pone.0139297.

Alvarado, S.E., 2016. Neighborhood disadvantage and obesity across childhood and adolescence: evidence from the NLSY children and young adults cohort (1986–2010). Soc. Sci. Res. 57, 80–98. https://doi.org/10.1016/j.ssresearch.2016.01.008.

Arlinghaus, K.R., Laska, M.N., 2021. Parent feeding practices in the context of food insecurity. Int. J. Environ. Res. Publ. Health 18 (2), 366. https://doi.org/10.3390/ijerph18020366.

Bernsdorf, K.A., Lau, C.J., Robinson, K., Toft, U., Andreasen, A.H., Glümer, C., 2016. Temporal changes in sugar-sweetened soft drink intake and variation across municipalities in the Capital Region of Denmark. Prev. Med. Rep. 4, 364–369. https://doi.org/10.1016/j.pmedr.2016.08.005.

Birch, L.L., Fisher, J.O., Grimm-Thomas, K., Markey, C.N., Sawyer, R., Johnson, S.L., 2001 Jun. Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. Appetite 36 (3), 201–210. https://doi.org/10.1006/appe.2001.0398. PMID: 11358344.

Birch, L.L., Ventura, A.K., 2009. Preventing childhood obesity: what works? Int. J. Obes. 33 (1), S74–S81. https://doi.org/10.1038/ijo.2009.22.

Boswell, N., Byrne, R., Davies, P.S.W., 2018 Jan 1. Eating behavior traits associated with demographic variables and implications for obesity outcomes in early childhood. Appetite 120, 482–490. https://doi.org/10.1016/j.appet.2017.10.012. Epub 2017 Oct 9. PMID: 29024677.

Caldwell, A.E., Sayer, R.D., 2019 Jan 1. Evolutionary considerations on social status, eating behavior, and obesity. Appetite 132, 238–248. https://doi.org/10.1016/j.appet.2018.07.028. Epub 2018 Aug 3. PMID: 30078673; PMCID: PMC7039671.

Campbell, M.K., 2016. Biological, environmental, and social influences on childhood obesity. Pediatr. Res. 79 (1–2), 205–211. https://doi.org/10.1038/pr.2015.208.

Cardel, M., Willig, A.L., Dulin-Keita, A., Casazza, K., Beasley, T.M., Fernández, J.R., 2012. Parental feeding practices and socioeconomic status are associated with child adiposity in a multi-ethnic sample of children. Appetite 58 (1), 347–353. https://doi.org/10.1016/j.appet.2011.11.005.

Carnell, S., Wardle, J., 2007. In: Measuring Behavioural Susceptibility to Obesity: Validation of the Child Eating Behaviour Questionnaire. Appetite. https://doi.org/10.1016/j.appet.2006.07.075.

Carroll-Scott, A., Gilstad-Hayden, K., Rosenthal, L., Peters, S.M., McCaslin, C., Joyce, R., Ickovics, J.R., 2013. Disentangling neighborhood contextual associations with child body mass index, diet, and physical activity: the role of built, socioeconomic, and social environments. Soc. Sci. Med. 95, 106–114. https://doi.org/10.1016/j.socscimed.2013.04.003.

Carter, M.A., Dubois, L., 2010. Neighbourhoods and child adiposity: a critical appraisal of the literature. Health Place 16 (3), 616–628. https://doi.org/10.1016/j.healthplace.2009.12.012.

Christakis, N.A., Fowler, J.H., 2007. The spread of obesity in a large social network over 32 years. N. Engl. J. Med. 357 (4), 370–379. https://doi.org/10.1056/NEJMsa066082.

Daniels, L.A., 2019. Feeding practices and parenting: a pathway to child health and family happiness. Ann. Nutr. Metabol. 74, 29–42. https://doi.org/10.1159/000499145.

Derks, I.P.M., Tiemeier, H., Sijbrands, E.J.G., Nicholson, J.M., Voortman, T., Verhulst, F.C., Jaddoe, V.W.V., Jansen, P.W., 2017. Testing the direction of effects between child body composition and restrictive feeding practices: results from a population-based cohort. Am. J. Clin. Nutr. 106, 783–790. https://doi.org/10.3945/ajcn.117.156448.

Ek, A., Sorjonen, K., Eli, K., Lindberg, L., Nyman, J., Marcus, C., Nowicka, P., 2016. Associations between parental concerns about preschoolers' weight and eating and parental feeding practices: results from analyses of the child eating behavior questionnaire, the child feeding questionnaire, and the lifestyle behavior checklist. PLoS One 11 (1), 1–20. https://doi.org/10.1371/journal.pone.0147257.

Finnane, J.M., Jansen, E., Mallan, K.M., Daniels, L.A., 2017. Mealtime structure and responsive feeding practices are associated with less food fussiness and more food enjoyment in children. J. Nutr. Educ. Behav. 49, 11–18. https://doi.org/10.1016/j.jneb.2016.08.007.

Gemmill, A.W., Worotniuk, T., Holt, C.J., Skouteris, H., Milgrom, J., 2013. Maternal psychological factors and controlled child feeding practices in relation to child body mass index. Child. Obes. 9, 326–337. https://doi.org/10.1089/chi.2012.0135.

Gilman, S.E., Huang, Y.T., Jimenez, M.P., Agha, G., Chu, S.H., Eaton, C.B., Goldstein, R.B., Kelsey, K.T., Buka, S.L., Loucks, E.B., 2019. Early life disadvantage and adult adiposity: tests of sensitive periods during childhood and behavioural mediation in adulthood. Int. J. Epidemiol. 48, 98–107. https://doi.org/10.1093/ije/dyy199.

Greves Grow, H.M., Cook, A.J., Arterburn, D.E., Saelens, B.E., Drewnowski, A., Lozano, P., 2010. Child obesity associated with social disadvantage of children's neighborhoods. Soc. Sci. Med. 71 (3), 584–591. https://doi.org/10.1016/j.socscimed.2010.04.018, 1982.

Halonen, J.I., Pulakka, A., Stenholm, S., Pentti, J., Kawachi, I., Kivimäki, M., Vahtera, J., 2016. Change in neighborhood disadvantage and change in smoking behaviors in adults: a longitudinal, within-individual study. Epidemiology 27 (6), 803–809. https://doi.org/10.1097/EDE.0000000000000530.

Hill, S.E., Prokosch, M.L., DelPriore, D.J., Griskevicius, V., Kramer, A., 2016. Low childhood socioeconomic status promotes eating in the absence of energy need. Psychol. Sci. 27, 354–364. https://doi.org/10.1177/0956797615621901.

Hughes, S.O., Power, T.G., O'Connor, T.M., Fisher, J.O., Micheli, N.E., Papaioannou, M.A., 2021. Maternal feeding style and child weight status among Hispanic families with low-income levels: a longitudinal study of the direction of effects. Int. J. Behav. Nutr. Phys. Activ. 18 (1), 30. https://doi.org/10.1186/s12966-021-01094-y.

Jansen, P.W., Roza, S.J., Jaddoe, V.W.V., Mackenbach, J.D., Raat, H., Hofman, A., Verhulst, F.C., Tiemeier, H., 2012. Children's eating behavior, feeding practices of parents and weight problems in early childhood: results from the population-based Generation R Study. Int. J. Behav. Nutr. Phys. Activ. 9 https://doi.org/10.1186/1479-5868-9-130.

Jansen, P.W., Tharner, A., van der Ende, J., Wake, M., Raat, H., Hofman, A., Verhulst, F.C., van Ijzendoorn, M.H., Jaddoe, V.W.V., Tiemeier, H., 2014. Feeding practices and child weight: is the association bidirectional in preschool children? Am. J. Clin. Nutr. 100 (5), 1329–1336. https://doi.org/10.3945/ajcn.114.088922.

Joyce, J.L., Zimmer-Gembeck, M.J., 2009 Jun. Parent feeding restriction and child weight. The mediating role of child disinhibited eating and the moderating role of the parenting context. Appetite 52 (3), 726–734. https://doi.org/10.1016/j.appet.2009.03.015. Epub 2009 Apr 5. PMID: 19501772.

Kalhoff, H., Kersting, M., 2015. Nutrition. In: Pediatric and Adolescent Medicine, 19, pp. 40–52. https://doi.org/10.1159/000368105.

Karp, S.M., Barry, K.M., Gesell, S.B., Po'E, E.K., Dietrich, M.S., Barkin, S.L., 2014. Parental feeding patterns and child weight status for Latino preschoolers. Obes. Res. Clin. Pract. 8, e88–e97. https://doi.org/10.1016/j.orcp.2012.08.193.

Khandpur, N., Charles, J., Blaine, R.E., Blake, C., Davison, K., 2016. Diversity in fathers' food parenting practices: a qualitative exploration within a heterogeneous sample. Appetite 101, 134–145. https://doi.org/10.1016/j.appet.2016.02.161.

Kivimäki, M., Vahtera, J., Tabák, A.G., Halonen, J.I., Vineis, P., Pentti, J., Pahkala, K., Rovio, S., Viikari, J., Kähönen, M., Juonala, M., Ferrie, J.E., Stringhini, S., Raitakari, O.T., 2018. Neighbourhood socioeconomic disadvantage, risk factors, and diabetes from childhood to middle age in the Young Finns Study: a cohort study. Lancet Public Health 3 (8), e365–e373. https://doi.org/10.1016/S2468-2667(18)30111-7.

Lagström, H., Halonen, J.I., Kawachi, I., Stenholm, S., Pentti, J., Suominen, S., Kivimäki, M., Vahtera, J., 2019. Neighborhood socioeconomic status and adherence to dietary recommendations among Finnish adults: a retrospective follow-up study. Health Place 55, 43–50. https://doi.org/10.1016/j.healthplace.2018.10.007. December 2017.

Lagström, H., Rautava, P., Kaljonen, A., Räihä, H., Pihlaja, P., Korpilahti, P., Peltola, V., Rautakoski, P., Österbacka, E., Simell, O., Niemi, P., 2013. Cohort profile: Steps to the healthy development and well-being of children (the STEPS Study). Int. J. Epidemiol. 42 (5), 1273–1284. https://doi.org/10.1093/ije/dys150.

Liew, J., Zhou, Z., Perez, M., Yoon, M., Kim, M., 2020. Parental child-feeding in the context of child temperament and appetitive traits: evidence for a biopsychosocial process model of appetite self-regulation and weight status. Nutrients 12 (11), 3353. https://doi.org/10.3390/nu12113353.

Liszewska, N., Scholz, U., Radtke, T., Horodyska, K., Luszczynska, A., 2018. Bi-directional associations between parental feeding practices and children's body mass in parent-child dyads. Appetite 129, 192–197. https://doi.org/10.1016/j.appet.2018.07.011.

Lloyd, A.B., Lubans, D.R., Plotnikoff, R.C., Collins, C.E., Morgan, P.J., 2014. Maternal and paternal parenting practices and their influence on children's adiposity, screen-time, diet and physical activity. Appetite 79, 149–157. https://doi.org/10.1016/j.appet.2014.04.010.

Matthews, K.A., 2009. Psychological perspectives on pathways linking socioeconomic status and physical health. Annu. Rev. Psychol. 62, 501–530. https://doi.org/10.1146/annurev.psych.031809.130711.

McBride, B., Fiese, B., Dev, D.A., Mcbride, B.A., Fiese, B.H., Jones, B.L., Cho, H., Harrison, K., Bost, K., Donovan, S., Grigsby-Toussaint, D., Liechty, J., Wiley, A., Teran-Garcia, M., 2013. Risk factors for overweight/obesity in preschool children: an ecological approach. Child. Obes. 9, 399–408. https://doi.org/10.1089/chi.2012.0150.

McCurdy, K., Gorman, K.S., Kisler, T., Metallinos-Katsaras, E., 2014 Aug. Associations between family food behaviors, maternal depression, and child weight among low-

income children. Appetite 79, 97–105. https://doi.org/10.1016/j.appet.2014.04.015. Epub 2014 Apr 21. PMID: 24768937; PMCID: PMC4096897.
Mena, N.Z., Gorman, K., Dickin, K., Greene, G., Tovar, A., 2015. Contextual and cultural influences on parental feeding practices and involvement in child care centers among hispanic parents. Child. Obes. 11 (4), 347–354. https://doi.org/10.1089/chi.2014.0118.
Miller, G.E., Engen, P.A., Gillevet, P.M., Shaikh, M., Sikaroodi, M., Forsyth, C.B., Mutlu, E., Keshavarzian, A., 2016. Lower neighborhood socioeconomic status associated with reduced diversity of the colonic microbiota in healthy adults. PLoS One 11 (2), 1–17. https://doi.org/10.1371/journal.pone.0148952.
Mitchell, G.L., Farrow, C., Haycraft, E., Meyer, C., 2013 Jan. Parental influences on children's eating behaviour and characteristics of successful parent-focussed interventions. Appetite 60 (1), 85–94. https://doi.org/10.1016/j.appet.2012.09.014. Epub 2012 Sep 24. PMID: 23017468.
Official Statistics of Finland (OSF), 2019. Births [e-publication]. ISSN=1798-2413. Statistics Finland, Helsinki [referred: 7.2.2022]. Access method: http://www.stat.fi/til/synt/2019/synt_2019_2020-04-24_tie_001_en.html.
Owen, G., Jones, K., Harris, R., 2017. Does neighbourhood deprivation affect the genetic influence on body mass? Soc. Sci. Med. 185, 38–45. https://doi.org/10.1016/j.socscimed.2017.05.041.
Penilla, C., Tschann, J.M., Deardorff, J., Flores, E., Pasch, L.A., Butte, N.F., Gregorich, S.E., Greenspan, L.C., Martinez, S.M., Ozer, E., 2017. Fathers' feeding practices and children's weight status in Mexican American families. Appetite 117, 109–116. https://doi.org/10.1016/j.appet.2017.06.016.
R Core Team, 2018. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna. https://www.R-project.org.
Ranjit, N., Wilkinson, A.V., Lytle, L.M., Evans, A.E., Saxton, D., Hoelscher, D.M., 2015. Socioeconomic inequalities in children's diet: the role of the home food environment. Int. J. Behav. Nutr. Phys. Activ. 12 https://doi.org/10.1186/1479-5868-12-S1-S4.
Rautava, S., Turta, O., Vahtera, J., Pentti, J., Kivimäki, M., Pearce, J., Kawachi, I., Rautava, P., Lagström, H., 2022. Neighborhood socioeconomic disadvantage and childhood body mass index trajectories from birth to 7 Years of age. Epidemiology 33 (1), 121–130. https://doi.org/10.1097/EDE.0000000000001420.
Ribeiro, A.I., Santos, A.C., Vieira, V.M., Barros, H., 2019. Hotspots of childhood obesity in a large metropolitan area: does neighbourhood social and built environment play a part? Int. J. Epidemiol. 49, 934–943. https://doi.org/10.1093/ije/dyz205.
Roberts, L.T., Goodman, L.C., Musher-Eizenman, D.R., 2018. Parental correlates of food parenting practices: socioeconomic status, weight, and dieting status. Ecol. Food Nutr. 57 (4), 330–345. https://doi.org/10.1080/03670244.2018.1492381.
Russell, A., Russell, C.G., 2021. Appetite self-regulation declines across childhood while general self-regulation improves: a narrative review of the origins and development of appetite self-regulation. Appetite 162, 105178. https://doi.org/10.1016/j.appet.2021.105178.
Saari, A., Sankilampi, U., Hannila, M.L., Kiviniemi, V., Kesseli, K., Dunkel, L., 2011. New Finnish growth references for children and adolescents aged 0 to 20 years: length/height-for-age, weight-for-length/height, and body mass index-for-age. Ann. Med. 43, 235–248. https://doi.org/10.3109/07853890.2010.515603.
Saikkonen, P., 2018. Sosiaalinen kestävyys : asuminen, segregaatio ja tuloerot kolmella kaupunkiseudulla. Terveyden ja hyvinvoinnin laitos, 978-952-343-084-6. https://urn.fi/URN:ISBN:978-952-343-084-6.
Scaglioni, S., De Cosmi, V., Ciappolino, V., Parazzini, F., Brambilla, P., Agostoni, C., 2018. Factors Influencing Children's Eating Behaviours. Nutrients 10 (6), 706. https://doi.org/10.3390/nu10060706.
Spence, J.C., Carson, V., Casey, L., Boule, N., 2011. Examining behavioural susceptibility to obesity among Canadian pre-school children: the role of eating behaviours. Int. J. Pediatr. Obes. 6, 501–507. https://doi.org/10.3109/17477166.2010.512087.
Spill, M.K., Callahan, E.H., Shapiro, M.J., Spahn, J.M., Wong, Y.P., Benjamin-Neelon, S.E., Birch, L., Black, M.M., Cook, J.T., Faith, M.S., Mennella, J.A., Casavale, K.O., 2019. Caregiver feeding practices and child weight outcomes: a systematic review. Am. J. Clin. Nutr. 109, 990S–1002S. https://doi.org/10.1093/ajcn/nqy276.
Statistics Finland, 2013. Grid Database.
Torres, S.J., Nowson, C.A., 2007. Relationship between stress, eating behavior, and obesity. Nutrition 23 (11), 887–894. https://doi.org/10.1016/j.nut.2007.08.008.
Tschann, J.M., Martinez, S.M., Penilla, C., Gregorich, S.E., Pasch, L.A., de Groat, C.L., Flores, E., Deardorff, J., Greenspan, L.C., Butte, N.F., 2015. Parental feeding practices and child weight status in Mexican American families: a longitudinal analysis. Int. J. Behav. Nutr. Phys. Activ. 12 (1), 66. https://doi.org/10.1186/s12966-015-0224-2.
Viana, V., Sinde, S., Saxton, J.C., 2008. Children's eating behaviour questionnaire: associations with BMI in Portuguese children. Br. J. Nutr. 100, 445–450. https://doi.org/10.1017/S0007114508894391.
Vilela, S., Hetherington, M.M., Oliveira, A., Lopes, C., 2018. Tracking diet variety in childhood and its association with eating behaviours related to appetite: the generation XXI birth cohort. Appetite 123, 241–248. https://doi.org/10.1016/j.appet.2017.12.030.
Vollmer, R.L., Adamsons, K., Foster, J.S., Mobley, A.R., 2015. Association of fathers' feeding practices and feeding style on preschool age children's diet quality, eating behavior and body mass index. Appetite 89, 274–281. https://doi.org/10.1016/j.appet.2015.02.021.
Wardle, J., Guthrie, C.A., Sanderson, S., Rapoport, L., 2001. Development of the children's eating behaviour questionnaire. J. Child Psychol. Psychiatry Allied Discip. 42, 963–970. https://doi.org/10.1111/1469-7610.00792.
Wardle, Jane, Carnell, S., 2007. Parental feeding practices and children's weight. Acta Paediat. Intern. J. Paediat. 96 (Suppl. 454), 5–11. https://doi.org/10.1111/j.1651-2227.2007.00163.x.
Webber, L., Hill, C., Saxton, J., Van Jaarsveld, C.H.M., Wardle, J., 2009. Eating behaviour and weight in children. Int. J. Obes. 33, 21–28. https://doi.org/10.1038/ijo.2008.219.
Webber, L., Cooke, L., Hill, C., Wardle, J., 2010 Nov. Associations between children's appetitive traits and maternal feeding practices. J. Am. Diet Assoc. 110 (11), 1718–1722. https://doi.org/10.1016/j.jada.2010.08.007. PMID: 21034886.
Webber, Laura, Cooke, L., Hill, C., Wardle, J., 2010b. Child adiposity and maternal feeding practices: a longitudinal analysis. Am. J. Clin. Nutr. 92 (6), 1423–1428. https://doi.org/10.3945/ajcn.2010.30112.
Wehrly, S.E., Bonilla, C., Perez, M., Liew, J., 2014. Controlling parental feeding practices and child body composition in ethnically and economically diverse preschool children. Appetite 73, 163–171. https://doi.org/10.3945/ajcn.2010.30112. https://doi.org/10.1016/j.appet.2013.11.009.
Wood, A.C., 2018. Gene-environment interplay in child eating behaviors: what the role of "nature" means for the effects of "nurture. Curr. Nutri. Rep. 7 (4), 294–302. https://doi.org/10.1007/s13668-018-0254-x.
Zhou, Z., Liew, J., Yeh, Y.-C., Perez, M., 2020. Appetitive traits and weight in children: evidence for parents' controlling feeding practices as mediating mechanisms. J. Genet. Psychol. 181 (1), 1–13. https://doi.org/10.1080/00221325.2019.1682506.
Zhou, Z., SooHoo, M., Zhou, Q., Perez, M., Liew, J., 2019. Temperament as risk and protective factors in obesogenic eating: relations among parent temperament, child temperament, and child food preference and eating. In: Journal of Genetic Psychology, 180. Taylor & Francis Ltd, 1. http://10.0.4.56/00221325.2019.1575180.