RESEARCH
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Parental and Child Factors Associated With 2- to 6-Year-Old Children's Diet Quality in Finland

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ABSTRACT

Background There is limited evidence about diet quality and associated factors in a representative population-based sample of preschool-aged children in Finland.

Objective The aims of this study were to investigate (1) the extent to which child diet quality and the consumption of health indicator foods (vegetables, fruits, berries, vegetable oil-based spread, nonfat milk) are in accordance with Finnish recommendations for preschool-aged children, (2) whether diet quality differs between children with underweight or normal weight compared with children with overweight or obesity, and (3) whether parental or child factors are related to children's diet quality.

Design This was a cross-sectional study.

Participants/setting Healthy children aged 2 to 6 years (n = 766) were recruited from child health clinics across Finland from February to June 2016.

Main outcome measures Diet quality and consumption of the health indicator foods were assessed by the Children's Index of Diet Quality (CIDQ, score 0-21, values < 10 indicate poor; 10-13.5, moderate; and ≥14, good diet quality). Parental information was collected with a self-administered questionnaire. Child weight and height were measured by child health clinic nurses.

Statistical analyses The overweight/obesity status and diet quality of the children were compared with 1-way analysis of variance. One-way analysis of variance was used as the preliminary analysis between child and parental factors and CIDQ scores, and linear mixed model analysis to further analyze the relationship between child and parental factors and CIDQ data.

Results Only a small minority (13.7%) of the children had a good diet quality, 55.4% had a moderate diet quality, and 30.9% had a poor diet quality. Only 1% of the children consumed the key health indicator foods, namely vegetables, fruits, and berries, as recommended. Diet quality did not differ between children with underweight/normal weight and overweight/obesity. Instead, the child's younger age, parents' higher education, and parents' self-perceived healthy diet were related to good diet quality in the child.

Conclusions The diet quality was moderate or poor in the majority of the children. Parental characteristics were the main factors related to the child's diet quality. The results suggest that future efforts to improve preschool-aged children's diet quality are needed including efforts to counsel families in pediatric care. Whether the findings from the current study also apply to Finnish school-aged children should be investigated further.

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ACQUIRING HEALTHY EATING HABITS IN EARLY childhood is of vital importance because this period is the foundation for lifelong dietary habits with putative beneficial health impacts.[1,2] Of particular concern is the increasing prevalence of obesity in children: globally, as many as every fifth child experiences overweight or obesity.[3] Obesity, primarily caused by an imbalance in energy intake, has been linked with a high consumption of unhealthy foods, including sugary beverages and sweet and savory snacks, and a low consumption of healthy foods, such as vegetables, fruits, and berries.[4] Consuming too few vegetables[5-7] and too many foods that are high in saturated fatty acids,[5-7] sugar,[5-7] and sodium[5] appears to be the major contributor to poor diet quality in Western society. Surprisingly, only a few studies have investigated the association between weight and overall diet quality in preschool-aged children. Previous evidence emerging from a cross-sectional setting suggested that children with a higher

body mass index (BMI) may consume a poorer quality diet compared with their peers with a lower BMI,[8,9] but also no differences in diet quality according to BMI classes have been reported.[10]

In addition to the child's weight, there is evidence that other factors may also affect diet quality in children. In some studies, children's diet quality has decreased with increasing age,[11] but also opposite results have been reported.[10] Similarly, a better diet quality has been observed in girls compared with boys[12]; here too, opposite results have been described,[10] and some investigators have not detected any association between diet quality and the child's sex.[6] In addition, parental factors including older age,[13] income,[12,14] and education[12,14] as well as nonsmoking status[14] and parental examples of healthy eating[15] have been linked to a better diet quality in their children. In contrast, other researchers have reported that there is no association between a child's diet quality and family income,[16] education,[17] and parental age.[17] Thus, there appears to be a paucity of evidence identifying what factors are associated with children's diet quality especially in representative nationwide population samples. Further investigations are needed to clarify which factors are related to child's diet quality and whether diet quality is linked with obesity. This information could be utilized in dietary assessments and could be considered when conducting lifestyle counseling in health clinics.

The objectives of this study were firstly to define the extent to which the diet quality and the consumption of health indicator foods (vegetables, fruits, and berries; vegetable oil-based spread; and nonfat milk) of 2- to 6-year-old children as assessed by the Children's Index of Diet Quality (CIDQ)[18] would be in accordance with Finnish recommendations for preschool-aged children. The second objective was to determine whether diet quality would differ in children with underweight or normal weight compared with children with overweight or obesity, and the third objective was to identify the potential parental or child factors associated with children's diet quality. The investigators hypothesized that the diet quality of children with overweight/obesity would be lower than that of children with underweight/normal weight and furthermore that several parental and child factors would be associated with children's diet quality.

RESEARCH SNAPSHOT

Research Question: In Finland, is the diet quality of preschool-aged children in accordance with dietary recommendations? Does diet quality differ between children with underweight/normal weight compared with children with overweight/obesity, and are parental or child factors associated with children's diet quality?

Key Findings: In this cross-sectional study that included 2- to 6-year-old children, the majority of the 766 children had a moderate or poor diet quality. Diet quality did not differ between children with underweight/normal weight and overweight/obesity. Instead, factors associated with a good diet quality were child's younger age, parents' higher education, and parents' self-perceived healthy diet.

METHODS

Study Design and Study Population

Study data were collected with a cross-sectional design in Finnish child health clinics nationwide from February to June 2016. In Finland, the growth and development of all children are followed from early pregnancy onward until school age, first in the maternity clinic, then in the child health clinics, and later within the school health care system.[19] Between birth and 7 years of age, a total of 15 free-of-charge health clinic visits is guaranteed; in these, registered nurses conduct physical examinations, monitor the child's growth, as well as provide health and dietary counseling for the children and/or their families.[19] These clinics are attended by about 99% of all families; additionally, those requiring specific dietary or medical care are referred to dietitians or a general physician as appropriate. A sample of 1000 children was aimed to be gathered from across Finland such that they would be representative of the whole country. The size of the sample is similar to that used in previous studies examining children's diet.[20,21] The target group was 2- to 6-year-old children attending a child health clinic with at least 1 parent. Children with chronic and food-related diseases such as celiac disease, multiple food allergies, single food allergies that clearly would influence dietary intake including milk allergy, and children with other special diets were excluded.

The participating health clinics represented almost all (18 of 20) of the hospital districts in mainland Finland. The largest towns in each district were included in the study by default; 3 other towns per district were chosen by a random number generator in Excel software.[22] Towns with at least 300 children under 6 years of age were invited to participate in the study to ensure that enough families would be attending clinic visits during the recruitment period. A few extra towns were included to account for potential refusals to participate in the study, for example, due to limited time and resources in the health clinics. Ultimately, 118 health clinics from 118 towns were invited to participate in the study. Nurses in each health clinic were asked to invite 15 parents with their children to participate in the survey: 3 children from each of the following age groups; 2-, 3-, 4-, 5-, and 6-year-olds. The recruitment process is depicted in detail in Figure 1. The nurses were instructed to recruit the first 15 families in the waiting room in the order they were queueing for their health clinic appointment to minimize any selection bias. The parents were given the study information leaflet describing the aims of the study, the content of the questionnaires, and the ethical considerations for the study prior to study participation. Each child health clinic's consent to participate in the study was obtained from the person in charge of the clinics in each town. All parents provided written informed consent prior to participation. The study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the Ethics Committee of the University of Turku, Finland.

Dietary Intake

Diet quality was evaluated by self-administered, paper- and pencil-based CIDQ filled in by the parent in the child health clinic waiting room before the health clinic visit. The CIDQ, previously developed and validated in a population of Finnish 2- to 6-year-old children, consists of 15 structured questions

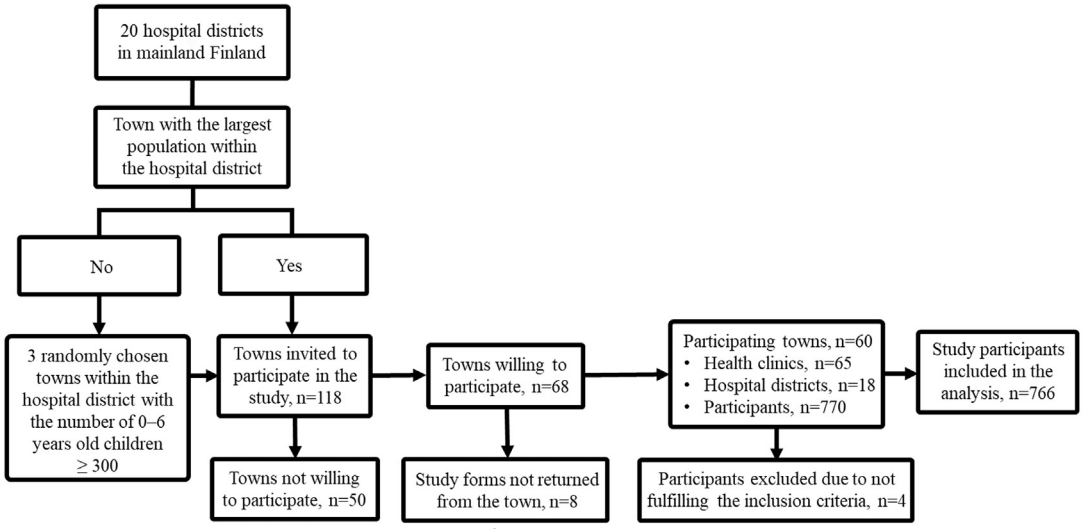


Figure 1. Flowchart describing the recruitment process for a nationwide cross-sectional study in Finland examining factors associated with 2- to 6-year-old children's diet quality (n = 766), February to June 2016.

on the frequency and amount of consumption of typical foods of the age group including porridge or gruel, fruits, vegetables, berries, spread, vegetable oil, cheese, milk, and sugary yoghurts and juices over the previous week.[18] The questions were based on 6 criteria (intake of whole grain foods and dietary fiber ≥ 8.4 g/1000 kcal/d; saturated fatty acids <10% of energy intake; polyunsaturated fatty acids 5% to 10% of energy intake; sucrose <10% of energy intake; vegetables, fruits, and berries ≥250 g/d; and calcium ≥600 mg/d (2- to 5-year-old children) or ≥700 mg/d (6-year-olds) as defined in the Finnish and Nordic nutrition recommendations.[23,24] Each question was scored with 0, 0.5, 1, 2, or 3 points depending on the question, the range of the total scores being 0 to 21 points. Diet quality was categorized into 3 groups: poor (<10 points), moderate (10-13.5 points), and good (14-21 points) based on receiver operating characteristic curves, which were used to examine if there was any connection between sensitivity and specificity for every possible cutoff for a test, as defined in the original validation study.[18] The CIDQ cutoff score for good diet quality (14 points) had a sensitivity of 0.59 and a specificity of 0.82 with the respective values for at least moderate diet quality (10 points) being 0.77 and 0.69.[18] The index scores were calculated with Excel software[22] by the researchers.

Adherence to dietary recommendations was further evaluated by comparing the consumption of health indicator foods, that is, foods that typically have been used as indicators for health particularly for monitoring purposes,[25] with national dietary recommendations[23] (Table 1, available at www.jandonline.org). The health indicator foods, chosen from the CIDQ questions, were as follows: consumption of vegetables, fruits, and/or berries of at least 5 servings per day (yes or no); choice of nonfat milk for consumption (instead of milk containing fat) (yes or no), and choice of vegetable oil-based spread with fat content of 60% to 80% (instead of butter or spread with less than 60% fat) (yes or no).

Questionnaire for Parents

The parents filled in a self-administered, paper- and pencil-based semistructured questionnaire concerning child sex, age, and health conditions as well as parental background information potentially associated with diet quality[12,20,26-29] including age, education, if the parent held a degree in the field of health or nutrition, employment status, household income, self-perceived level of physical activity and healthiness of diet, and smoking habits. Information on any health conditions was collected about both parents even if only 1 parent answered the questionnaire. The response options in the questionnaire are shown in Table 2. Parents also self-reported their weight and height from which their BMI was calculated as kilograms per meters squared. Underweight was defined as BMI < 18.5, normal weight as BMI 18.5 to 24.9, overweight as BMI 25.0 to 29.9, and obesity as BMI ≥ 30.0.

Growth and Overweight/Obesity Status

Children's weight and height were measured in the child health clinic by the nurses. Standing height was measured with a stadiometer to the nearest 0.1 cm, and standing weight with mechanical or electronic scales to the nearest 0.1 kg with calibrated equipment according to the standardized procedures in Finnish child health clinics. Children's growth measures were obtained by using Finnish growth reference data.[30] The overweight/obesity status of the children was primarily defined by using BMI standard deviation score (BMI SDS); other growth data are reported in Table 2 to support these findings. Based on the Finnish growth reference curves,[30] underweight was defined as BMI SDS ≤ −1.6482 for girls and BMI SDS ≤ −1.8344 for boys, normal weight as BMI SDS −1.6481 to 1.1628 for girls and BMI SDS −1.8343 to 0.7783 for boys, overweight as BMI SDS 1.1629 to 2.1064 for girls and BMI SDS 0.7784 to 1.7015 for boys, and obesity as BMI SDS ≥ 2.1065 for girls and BMI SDS ≥ 1.7016 for boys.

Statistical Analyses

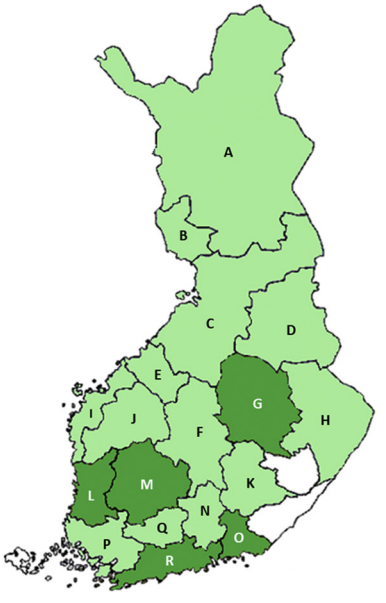
Nurses were asked to transfer all the study forms collected in the health clinics to the researchers by mail promptly after the data collection period. Only children meeting the inclusion criteria were included in the analyses (4 children were excluded). All anthropometric data from children with height SDS outside the growth screening limit of ±2.7 SD[30] (n = 11) were excluded from the analysis for diet quality in relation to their overweight/obesity status as their growth was considered abnormal, potentially due to unknown or undiagnosed diseases or due to recording errors made by the nurses.

No imputations regarding missing data were conducted. The normality of the data was visually examined from histograms. For categorical variables, the data are presented as frequencies and percentages and for normally distributed continuous variables as means and standard deviations. The data that were not normally distributed are summarized as medians and interquartile ranges. To compare the differences in CIDQ scores among children with underweight, normal weight, overweight, and obesity, 1-way analysis of variance with Tukey method was used in further pairwise comparisons. Categorized CIDQ was compared in terms of child's weight by using the χ^2 test. When analyzing the association between the prespecified child and parental background factors (such as the child's age and sex, mother's age and BMI, parent's self-perceived healthiness of diet and level of physical activity, education and income), 1-way analysis of variance with Tukey method was used for CIDQ scores in the preliminary analyses. A linear mixed-model analysis was used to analyze further the relationship between possible contributing background variables (chosen for analysis if the *P* value was <.2 in the preliminary analyses) and CIDQ scores (complete case analysis). Town was included as a random effect in the model. Potential contributing variables that could be associated with diet quality and thus were included in the multivariable model were the child's age and sex, parental education, income, smoking habits, self-perceived level of physical activity and healthiness of diet, and mother's age. The collinearity of the variables was examined by φ coefficients and Spearman's correlations. The data are reported as adjusted means with standard errors. A *P* value < .05 was considered significant. Data were analyzed with SPSS software.[31]

RESULTS

Descriptive Characteristics

A total of 65 health clinics in 60 towns from 18 of the 20 country's hospital districts took part in the study. In these hospital districts, a total of 766 children with their parents participated in the study (Figure 2). Mothers were the parent most likely to have completed the questionnaire (88%, 674 of 766); 8.1% (62 of 766) of the forms were filled in by fathers and 0.4% (3 of 766) of the parents answered the questionnaire together (27 missing answers). The descriptive characteristics of the children and the parents are presented in Table 2. When assessing BMI values of the children, 4.3% (31 of 713) had underweight, 76% (542 of 713) had normal weight, 15.4% (110 of 713) had overweight, and 4.2% (30 of 713) had obesity. The overweight/obesity status of the participants is shown in more detail in Table 3 (available online at www.jandonline.org).



	Hospital district	Number of children participating in the area	Number of participants per 1000 children born in the area in 2009 – 2014
A	Lapland	8	1.1
B	Länsi-Pohja	36	8.9
C	Northern Ostrobothnia	49	1.4
D	Kainuu	60	13.8
E	Central Ostrobothnia	48	8.0
F	Central Finland	49	2.9
G	North Savo	57	3.9
H	North Karelia	52	5.4
I	Vaasa	15	1.2
J	South Ostrobothnia	49	3.7
K	South Savo	30	5.8
L	Satakunta	16	1.2
M	Pirkanmaa	14	0.4
N	Päijänne Tavastia	95	7.9
O	Kymenlaakso	36	3.9
P	Southwest Finland	60	2.1
Q	Kanta-Häme	51	4.8
R	Helsinki and Uusimaa	41	0.4
	In total	766	2.2

Figure 2. Geographical distribution of the hospital districts in Finland (n = 18) from which the participating children (n = 766) were recruited from February to June 2016.

Diet Quality and Consumption of Health Indicator Foods

Based on the CIDQ scores, the diet quality was good in 13.7% (101 of 738), moderate in 55.4% (409 of 738), and poor in 30.9% (228 of 738) of the children. Only 1% (7 of 726) of the children consumed 5 portions of vegetables, fruits, and/or berries per day as recommended. Consumption of nonfat milk was recorded in 41.3% (305 of 739) and vegetable oil-based spread in 38.2% (282 of 738) of the children.

Diet Quality in Relation to Child Overweight/Obesity Status

Since the number of participants with underweight was small and there were no significant differences in the diet quality of children with underweight or normal weight, the children with underweight were combined with children with normal weight in the analysis of how diet quality is related to the overweight/obesity status of the children. For the same reason, the children with obesity were combined with children with overweight in this analysis. In the combined underweight and normal weight group of children, the diet quality was good in 14% (77 of 551), moderate in 54.3% (299 of 551), and poor in 31.8% (175 of 551); the corresponding values for the combined overweight and obesity group of children were 9% (12 of 134), 59% (79 of 134), and 32.1% (43 of 134, $P = .283$, Figure 3). No significant difference was evident when comparing the CIDQ scores in the underweight and normal weight group vs the overweight and obesity group (11.1 $\pm$ 2.6 and 10.8 $\pm$ 2.6 respectively, $P = .347$). Detailed information on the CIDQ scores and categorized CIDQ according to the weight group and the child's age is reported in Table 4 (available at www.jandonline.org).

The Association Between Diet Quality and Child and Parental Factors

When evaluating factors including child's age and sex, parental education, income, smoking, self-perceived level of physical activity and healthiness of diet, and mother's age together in the linear mixed model analysis, it was found that the child's age, parent's education, as well as parent's self-perceived healthiness of diet were associated with child CIDQ score (Table 5). Children aged 2 years had significantly higher CIDQ scores (adjusted mean 11.7 $\pm$ 0.3) than children aged 4 years (adjusted mean 10.6 $\pm$ 0.3, $P = .006$) and 5 years (adjusted mean 10.5 $\pm$ 0.3, $P = .001$). Children whose parents had a university education had significantly higher CIDQ scores (adjusted mean 11.6 $\pm$ 0.4) than the children of parents with a college education (adjusted mean 10.7 $\pm$ 0.3, $P = .026$) or a vocational school or lower education (adjusted mean 10.6 $\pm$ 0.2, $P = 0.018$). Children of parents with a self-perceived healthier diet had higher CIDQ scores (adjusted mean 11.4 $\pm$ 0.3) than those with a self-perceived less healthy diet (adjusted mean 10.6 $\pm$ 0.3, $P < .001$).

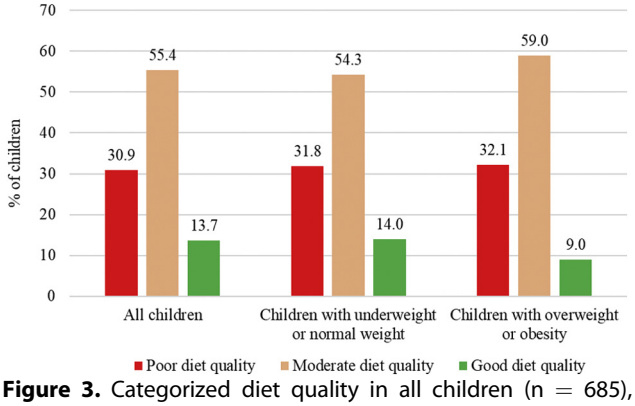


Figure 3. Categorized diet quality in all children (n = 685), children with underweight and normal weight (n = 551) and children with overweight and obesity (n = 134). Differences in the diet quality categories between the children with underweight and normal weight and their counterparts with overweight and obesity were not statistically significant (χ^2 test), Finland, February to June 2016.

DISCUSSION

The results suggest that the diet quality of 2- to 6-year-old preschool-aged children was poor or moderate in most of the participants; only 13.7 % of the children were consuming a good-quality diet. This finding was further supported by the data for the key health indicator foods, for instance, only 1% of the children consumed the recommended amounts of vegetables, fruits, and berries. No association was found between the CIDQ and the children's overweight/obesity status; instead, the key determinants of the CIDQ were the children's age of 2 years, parent's university education, and self-perceived healthiness of diet.

The present study population was a representative sample of Finnish preschool-aged children; in our sample, 24% of the boys and 16% of the girls had overweight or obesity, with the national average of preschool-aged children being 25% and 15%, respectively.[32] The children were recruited from across Finland, all but 2 of the Finnish hospital districts being represented, and the proportion of girls and boys (54% and 46%, respectively) in the study population was close to the national distribution (49% and 51%, respectively).[33]

The results on children's diet quality are in line with previous studies; it does seem that many preschool-aged children in Europe[5,6,10] and the United States[11,16] consume a poor-quality diet. For example, it was reported that only 0.4% of Greek children consumed a good-quality diet,[10] and a study with preschoolers from multiple European countries found that the children achieved less than 60% of the highest diet quality score.[6] Previous studies have indicated that the issues often encountered in children's diet include low intakes of vegetables, fruits, and berries; dietary fiber; and polyunsaturated fatty acids as well as high intakes of saturated fatty acids and sugar.[5,6,10,34-36] In a Finnish study examining children aged 6 to 8 years, only 5% of the children consumed the recommended 5 portions of vegetables, fruits, and berries per day,[5] and a study with US children reported that only about one-third of preschool-aged children ate vegetables at least twice a day.[35] Similar issues have also been encountered in the diets of adults,[37-39] supporting the previous findings of the important role that parents play in shaping the eating behavior of their children.[40,41] Overall, the results suggest that more efforts are needed to improve children's diet quality, including efforts to counsel families in pediatric care.

Table 4. Children's Index of Diet Quality categories and scores according to age and overweight/obesity status determined by BMI[a] SDS[b] in all 2- to 6-year-old children participating in a cross-sectional study on factors associated with diet quality in Finland, February to June 2016

	Diet Quality Categories				Diet quality scores[c]		
	Total	Poor[d]	Moderate[e]	Good[f]			
2-year-olds[g]	*n (%)*				*n*	*Mean (SD)*	*Range*
Underweight	5 (3.7)	1 (20.0)	4 (80.0)	—			
Normal weight	106 (77.9)	27 (25.5)	59 (55.7)	20 (18.9)			
Overweight	22 (16.2)	4 (18.2)	14 (63.6)	4 (18.2)			
Obesity	3 (2.2)	2 (66.7)	1 (33.3)	—			
All	136 (100)	34 (25.0)	78 (57.4)	24 (17.6)	168	11.7 (2.6)	5.0-18.5
3-year-olds							
Underweight	3 (2.4)	2 (66.7)	1 (33.3)	—			
Normal weight	95 (75.4)	29 (30.5)	51 (53.7)	15 (15.8)			
Overweight	23 (18.3)	9 (39.1)	12 (52.2)	2 (8.7)			
Obesity	5 (4.0)	1 (20.0)	1 (20.0)	3 (60.0)			
All	126 (100)	41 (32.5)	65 (51.6)	20 (15.9)	133	11.2 (2.8)	4.5-18.5
4-year-olds							
Underweight	11 (7.3)	4 (36.4)	6 (54.5)	1 (9.1)			
Normal weight	108 (72.0)	42 (38.9)	54 (50.0)	12 (11.1)			
Overweight	25 (16.7)	6 (24.0)	17 (68.0)	2 (8.0)			
Obesity	6 (4.0)	1 (16.7)	5 (83.3)	—			
All	150 (100)	53 (35.3)	82 (54.7)	15 (10.0)	152	10.7 (2.5)	2.5-18.0
5-year-olds							
Underweight	7 (5.0)	2 (28.6)	5 (71.4)	—			
Normal weight	105 (75.0)	39 (37.1)	52 (49.5)	14 (13.3)			
Overweight	18 (12.9)	8 (44.4)	10 (55.6)	—			
Obesity	10 (7.1)	3 (30.0)	6 (60.0)	1 (10.0)			
All	140 (100)	52 (37.1)	73 (52.1)	15 (10.7)	145	10.6 (2.6)	4.0-18.0
6-year-olds							
Underweight	5 (3.8)	1 (20.0)	2 (40.0)	2 (40.0)			
Normal weight	106 (79.7)	28 (26.4)	65 (61.3)	13 (12.3)			
Overweight	16 (12.0)	9 (56.3)	7 (43.8)	—			
Obesity	6 (4.5)	—	6 (100)	—			
All	133 (100)	38 (28.6)	80 (60.2)	15 (11.3)	140	11.0 (2.5)	5.5-17.5
All children with underweight	31 (4.5)	10 (32.3)	18 (58.1)	3 (9.7)	31	10.8 (2.4)	6.5-16.0
All children with normal weight	520 (75.9)	165 (31.7)	281 (54.0)	74 (14.2)	520	11.1 (2.7)	2.5-18.5
All children with overweight	104 (15.2)	36 (34.6)	60 (57.7)	8 (7.7)	104	10.7 (2.6)	4.5-18.5
All children with obesity	30 (4.4)	7 (23.3)	19 (63.3)	4 (13.3)	30	11.2 (2.7)	5.5-17.0
All children	685 (100)	218 (31.8)	378 (55.2)	89 (13.0)	685	11.1 (2.6)	2.5-18.5

[a]BMI = body mass index, calculated as kilograms per meters squared.
[b]SDS = standard deviation score.
[c]Potential scores for the Children's Index of Diet Quality range from 0 to 21 points.
[d]Less than 10 points scored from the diet quality index.
[e]Ten to 13.5 points scored from the diet quality index.
[f]Fourteen to 21 points scored from the diet quality index.
[g]Underweight was defined as BMI SDS ≤ -1.6482 for girls and BMI SDS ≤ -1.8344 for boys, normal weight as BMI SDS -1.6481 to 1.1628 for girls and BMI SDS -1.8343 to 0.7783 for boys, overweight as BMI SDS 1.1629 to 2.1064 for girls and BMI SDS 0.7784 to 1.7015 for boys, and obesity as BMI SDS $\geq$ 2.1065 for girls and BMI SDS $\geq$ 1.7016 for boys.

Table 5. Linear mixed model analysis for the association of child and parental factors and CIDQ[a] scores (n = 582) in a cross-sectional study in Finland, February to June 2016

Child and parental factors	CIDQ scores	Overall *P* value	*P* value[c]
Child's age (y)	*adjusted mean*[b] *(SE)*	.001	
2	11.7 (0.3)		reference
3	11.1 (0.3)		.553
4	10.6 (0.3)		.006[d]
5	10.5 (0.3)		.001[d]
6	10.9 (0.3)		.069
Child's sex		.714	
Male	10.9 (0.3)		
Female	11.0 (0.3)		
Mother's age (y)		.059	
<30.0	11.0 (0.3)		>.999
30.0-34.9	10.6 (0.3)		.041[d]
35.0-39.9	11.4 (0.3)		reference
≥40.0	10.9 (0.3)		.974
Parental education		.015	
Comprehensive school/upper secondary school/vocational school	10.6 (0.2)		.018[d]
College[e]	10.7 (0.3)		.026[d]
University[e]	11.6 (0.4)		reference
Annual household income (€)		.236	
<20,000 (<US $24,300)	10.5 (0.4)		reference
20,000-40,000 (US $24,300-$48,600)	11.0 (0.3)		>.999
40,001-60,000 (US $48,601-$72,900)	11.2 (0.3)		.444
>60,000 (>US $72,900)	11.3 (0.3)		.389
Parents' self-perceived level of physical activity		.404	
Not at all/very little	10.6 (0.4)		reference
Moderate	11.2 (0.2)		.646
Very much	11.0 (0.3)		>.999
Extremely much	11.1 (0.6)		>.999
Parents' self-perceived healthiness of diet		<.001	
Not at all/very little/moderately	10.6 (0.3)		
A lot/extremely much	11.4 (0.3)		
Parental smoking		.729	
Yes	10.9 (0.4)		
No	11.0 (0.2)		

[a]CIDQ = Children's Index of Diet Quality.
[b]Adjusted for all other variables included in the model. Town was included as a random effect.
[c]*P* values for pairwise comparisons after Bonferroni correction.
[d]Significant difference after Bonferroni correction compared to reference category.
[e]In Finland, college education is practice oriented with the goal of educating students for professional working life. University education is more research oriented and provides theoretical knowledge.

Surprisingly, the children's overweight/obesity status was not associated with the quality of their diet. Although the diet quality scores are similar regardless of weight, children with overweight may have higher energy intakes than children with normal weight,[42] which could be the main contributor for the excess weight gain. The index does not account for the

consumption of various unhealthy snacks, as this was not found relevant in the validation study[18] due to the pervasive use of snacks by children. Therefore, the index does not potentially recognize if children with overweight eat more of these products than children with normal weight in addition to having an intake of healthy foods. Yet another reason could be that the potential effect of a poor-quality diet on weight does not appear at such an early age. Furthermore, the cross-sectional study design does not allow for an evaluation of the role of diet quality with the onset of obesity. In previous studies, it has been shown that adhering to dietary recommendations could protect an individual from obesity risk factors,[43] and it has been linked with a decreased risk for childhood obesity in preschool-aged children.[44,45] However, in some studies, diet quality has not been associated with a preschool-aged child's BMI,[10,46] but instead, there does seem to be a strong association between diet quality and body fat mass of preschool-aged children.[46] In fact, it has been proposed that body fat mass could be used to define overweight/obesity in children more accurately than either weight or even BMI, since it is difficult to recognize normal weight children with excess adiposity.[47] Future longitudinal research is needed to explore the impact of dietary intake on child body composition, a parameter not routinely assessed in child health clinics in Finland.

As reported earlier,[11,13,16] here too the child's younger age was associated with good diet quality. One explanation could be that as children grow older, they might be allowed to select for themselves the foods they want to eat, which may result in a lower diet quality.

In this study, the children had higher CIDQ scores if their parents reported that they themselves were following a healthy diet. It has been observed that children have similar food preferences as their parents,[48,49] and thus parents that have a healthy diet potentially offer their children healthy food choices. Moreover, a maternal example of healthy eating has been linked to a better diet quality in preschool-aged children.[15] Therefore, dietary counseling should likely to be directed toward the dietary habits of the whole family, not only that of the child.[50]

Similarly to the current study's findings, a high maternal education has previously been linked with good dietary habits in children,[10,12,13,51,52] possibly since parents with a lower educational level may have less nutritional knowledge,[53,54] thus potentially limiting the recommended food choices they offer to their children.

The major strengths of this study include the relatively large and representative, nationwide study sample and the use of a validated diet quality index. The data were collected by trained nurses thus providing accurate growth data. There are also potential limitations. Self-reported data may always be subject to misreporting; for example, the CIDQ method depends extensively on the memory of the parents, and they may not always be aware of what their child is eating, for example, in the day care center. It has been suggested that recall of liking would be a cognitively simpler method for assessing diet quality than behavioral recall.[55] As the CIDQ is a stand-alone index for measuring diet quality, it does not account for energy intake, which might be considered as a limitation. Since the recruitment of the participants was conducted by the nurses, there is no information available on whether it was done according to the instructions and how many parents might have refused to participate. The results of this study might also be best applicable to families with a high education, since the education levels of the parents in this study were higher than the average in Finland; 33% of Finnish adults are highly educated.[56] Furthermore, although the children's physical activity level was not assessed, the physical activity of preschool children is mostly based on play, and this could be hard to measure reliably but it is unlikely to be of major importance with regard to diet quality.

CONCLUSIONS

In conclusion, the diet quality score reflecting adherence to dietary recommendations was observed to be moderate or poor in the majority of the preschool-aged Finnish children. A higher diet quality was observed in younger children, those of parents who perceived their diet as healthy, and those of parents with higher education levels. No significant difference in diet quality was noted when comparing CIDQ scores between children with underweight/normal weight and children with overweight/obesity. The poor diet quality and low consumption of selected health indicator foods highlight the need to strive to improve the majority of preschool-aged children's diet, especially in older (4- to 5-year-old) as compared with younger (2-year-old) children, the children of parents who perceive the healthiness of their diet to be little to moderate, as well as those of parents with a lower education level. Whether these findings apply to Finnish children in other age groups should be investigated further.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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AUTHOR CONTRIBUTIONS

K. Laitinen designed the study. E. Koivuniemi, J. Gustafsson, V. J. Koivisto, and I. Mäkelä contributed to the data preparation. E. Koivuniemi and T. Vahlberg performed the statistical analysis and analyzed the data. E. Koivuniemi, K. Laitinen, H. Niinikoski, and U. Schwab interpreted the results. E. Koivuniemi and K. Laitinen drafted the manuscript. K. Laitinen has the primary responsibility for the final content. All authors have reviewed and revised the final manuscript.

Table 1. Finnish dietary recommendations[23] for preschool-aged children

Food item	Recommendation
Vegetables, fruits, and berries	At least 5 portions[a] (250 g)/d
Spread	4 to 6 tsp of vegetable oil–based spread with fat content of 60% to 80%/d
Milk	4 dL of nonfat milk or low-fat milk (1%)/d
Whole grain products	At least 4 portions[b]/d
Fish	2-3 times/wk

[a]One portion = 1 child's handful of vegetables, fruits, and/or berries.
[b]One portion = 1 dL of cooked pasta, rice, or porridge or one piece of bread.

Table 2. Characteristics of 766 Finnish preschool-aged children and their parents participating in a cross-sectional study on factors associated with child diet quality, February to June 2016

Characteristics	Total n[a]	Median (IQR[b]) or n (%)	Missing data, n
Child characteristics			
Sex, female	766	417 (54.4)	—
Age (y)	766	4.0 (3.0-5.0)	—
2		170 (22.2)	
3		137 (17.9)	
4		157 (20.5)	
5		156 (20.4)	
6		146 (19.1)	
Height SDS[c]	735	−0.3 (−1.0-0.5)	31
Weight-for-age SDS	735	−0.1 (−0.8-0.6)	31
Weight-for-height SDS	735	0.2 (−0.5-0.8)	31
Weight-for-height percent	735	1.3 (−3.8-7.5)	31
BMI[d] SDS[e]	713		53
Underweight		31 (4.3)	
Normal weight		542 (76.0)	
Overweight		110 (15.4)	
Obesity		30 (4.2)	
ISO[f] BMI	735		31
Underweight		31 (4.2)	
Normal weight		560 (76.2)	
Overweight		115 (15.6)	
Obesity		29 (3.9)	
Has a health condition[g]	740	67 (9.1)	26
Lactose intolerance		5 (0.7)	
Single food allergy (other than milk allergy)		2 (0.3)	
Other allergies		10 (1.4)	
Asthma and/or atopic eczema		44 (5.9)	
Gastroesophageal reflux		4 (0.5)	
Other[h]		17 (2.3)	

	Both parents		Mother		Father		
	Total n	Median (IQR) or n (%)	Total n	Median (IQR) or n (%)	Total n	Median (IQR) or n (%)	
Parental characteristics							
Age (y)	735	34.0 (31.0-38.0)	673	34.0 (31.0-38.0)	62	35.5 (32.8-39.0)	31
BMI	715	24.3 (21.6-27.3)	654	24.2 (21.5-27.3)	61	25.2 (23.5-27.3)	51
Underweight		17 (2.4)		15 (2.3)		2 (3.3)	
Normal weight		391 (54.7)		366 (56.0)		25 (41.0)	
Overweight		199 (27.8)		174 (26.6)		25 (41.0)	
Obesity		108 (15.1)		99 (15.1)		9 (14.8)	
Education	750						16
Comprehensive school/upper secondary school/vocational school		388 (51.7)					
College[i]		244 (32.5)					
University[i]		118 (15.7)					

(*continued on next page*)

Table 2. Characteristics of 766 Finnish preschool-aged children and their parents participating in a cross-sectional study on factors associated with child diet quality, February to June 2016 (*continued*)

	Both parents		Mother		Father		
	Total n	Median (IQR) or n (%)	Total n	Median (IQR) or n (%)	Total n	Median (IQR) or n (%)	
Has a degree in the field of health or nutrition	735	252 (34.3)					31
Employment status	720						46
Full-time		464 (64.4)					
Part-time		86 (11.9)					
Job applicant		47 (6.5)					
Stay-at-home parent		78 (10.8)					
Student		45 (6.3)					
Annual household income (€)	713						53
<20,000 (<US $24,300)		58 (8.1)					
20,000-40,000 (US $24,300-$48,600)		183 (25.7)					
40,001-60,000 (US $48,601-$72,900)		223 (31.3)					
>60,000 (>US $72,900)		249 (34.9)					
Smokers	739	106 (14.3)					27
Self-perceived level of physical activity	737						29
Not at all/very little		84 (11.4)					
Moderate		417 (56.6)					
Very much		203 (27.5)					
Extremely much		33 (4.5)					
Self-perceived level of healthy diet	738						28
Not at all/very little		13 (1.8)					
Moderate		329 (44.6)					
A lot		348 (47.2)					
Extremely much		48 (6.5)					
Health conditions[j]							
Diabetes			747	11 (1.5)	743	12 (1.6)	19/23[k]
Hypertension			737	31 (4.2)	742	64 (8.6)	29/24[k]
Atopic eczema, asthma, allergic rhinitis			743	208 (28.0)	744	195 (26.2)	23/22[k]
Food allergy			742	121 (16.3)	743	87 (11.7)	24/23[k]
Cancer			743	3 (0.4)	743	8 (1.1)	23/23[k]

[a]Number of participants with information available.
[b]IQR = interquartile range.
[c]SDS = standard deviation score.
[d]BMI = body mass index, calculated as kilograms per meters squared.
[e]Underweight was defined as BMI SDS ≤ −1.6482 for girls and BMI SDS ≤ −1.8344 for boys, normal weight as BMI SDS −1.6481 to 1.1628 for girls and BMI SDS −1.8343 to 0.7783 for boys, overweight as BMI SDS 1.1629 to 2.1064 for girls and BMI SDS 0.7784 to 1.7015 for boys, and obesity as BMI SDS ≥ 2.1065 for girls and BMI SDS ≥ 1.7016 for boys.
[f]ISO-BMI = Age and sex adjusted BMI.
[g]Twelve children had more than 1 health condition.
[h]Of the children, 2 (0.3%) had Legg-Calve-Perthes disease, 2 (0.3%) had supraventricular tachycardia, 2 (0.3%) had a hearing defect, and 11 participants had 1 of the following health conditions: type 1 diabetes, juvenile rheumatoid arthritis, epilepsy, attention-deficit/hyperactivity disorder, alopecia areata, borreliosis, cerebral palsy, cleft palate, dysphasia, or only 1 kidney or was small for gestational age.
[i]In Finland, college education is practice oriented with the goal of educating students for professional working life. University education is more research oriented and provides theoretical knowledge.
[j]Health conditions for both parents are reported by the responding parent.
[k]Mother/father.

Table 3. Weight status of 2- to 6-year-old children in Finland participating in a cross-sectional study on factors associated with diet quality determined by BMI[a] SDS[b] according to age and sex, February to June 2016

	Underweight[c]	Normal weight	Overweight	Obesity	Total
Children	←		*n (%)*		→
2-year-olds					
Female	4 (4.9)	68 (84.0)	9 (11.1)	—	81 (58.7)
Male	1 (1.8)	40 (70.2)	13 (22.8)	3 (5.3)	57 (41.3)
All	5 (3.6)	108 (78.3)	22 (15.9)	3 (2.2)	138 (100)
3-year-olds					
Female	3 (4.3)	52 (75.4)	11 (15.9)	3 (4.3)	69 (53.1)
Male	—	46 (75.4)	13 (21.3)	2 (3.3)	61 (46.9)
All	3 (2.3)	98 (75.4)	24 (18.5)	5 (3.8)	130 (100)
4-year-olds					
Female	8 (9.4)	67 (78.8)	8 (9.4)	2 (2.4)	85 (54.8)
Male	3 (4.3)	46 (65.7)	17 (24.3)	4 (5.7)	70 (45.2)
All	11 (7.1)	113 (72.9)	25 (16.1)	6 (3.9)	155 (100)
5-year-olds					
Female	5 (6.0)	63 (75.0)	9 (10.7)	7 (8.3)	84 (55.6)
Male	2 (3.0)	51 (76.1)	11 (16.4)	3 (4.5)	67 (44.4)
All	7 (4.6)	114 (75.5)	20 (13.2)	10 (6.6)	151 (100)
6-year-olds					
Female	1 (1.5)	54 (79.4)	10 (14.7)	3 (4.4)	68 (48.9)
Male	4 (5.6)	55 (77.5)	9 (12.7)	3 (4.2)	71 (51.1)
All	5 (3.6)	109 (78.4)	19 (13.7)	6 (4.3)	139 (100)
All females	**21 (5.4)**	**304 (78.6)**	**47 (12.1)**	**15 (3.9)**	**387 (54.3)**
All males	**10 (3.1)**	**238 (73.0)**	**63 (19.3)**	**15 (4.6)**	**326 (45.7)**
All children	**31 (4.3)**	**542 (76.0)**	**110 (15.4)**	**30 (4.2)**	**713 (100)**

[a]BMI = body mass index, calculated as kilograms per meters squared.

[b]SDS = standard deviation score.

[c]Underweight was defined as BMI SDS ≤ -1.6482 for girls and BMI SDS ≤ -1.8344 for boys, normal weight as BMI SDS -1.6481 to 1.1628 for girls and BMI SDS -1.8343 to 0.7783 for boys, overweight as BMI SDS 1.1629 to 2.1064 for girls and BMI SDS 0.7784 to 1.7015 for boys, and obesity as BMI SDS $\geq$ 2.1065 for girls and BMI SDS $\geq$ 1.7016 for boys.