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Food consumption and nutrient intake of Finnish preschool children according to parental educational level

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Abstract

We examined the association between parental educational level (PEL) and children's food consumption and nutrient intake in a sample of Finnish 3- to 6-year-old preschoolers (*n* 811). The data were obtained from the cross-sectional DAGIS project, conducted in eight municipalities in Finland during 2015–2016. The food consumption and nutrient intake were assessed using food records. The highest educational level of the family was used as the indicator of socio-economic status. Differences in diet by PEL were analysed using a hierarchical linear model adjusted for energy intake. Compared with high PEL, low PEL was associated with a child's lower consumption of fresh vegetables and salads, vegetarian dishes, berries, white bread, blended spread, skimmed milk and ice cream but higher consumption of milk with 1–1·5 % fat content, dairy-based desserts and sugar-sweetened soft drinks. Food consumption was also examined after disaggregating dishes into their ingredients. Low PEL was associated with lower consumption of vegetables, nuts and seeds, berries and fish but higher consumption of red meat. Children in the low PEL, compared with the high PEL group, had a lower intake of protein, fibre, EPA, DHA, vitamin D, riboflavin, vitamin B_6, folate, vitamin B_{12}, vitamin C, potassium, phosphorous, Ca, Mg, Zn and iodine but a higher intake of fat and saturated, trans and MUFA. The observed diet-related disparities highlight the need for policy actions and interventions supporting healthy eating patterns such as high consumption of vegetables, nuts and berries in childhood, paying special attention to those with low PEL.

Key words: Healthy diet: Day care: Socio-economic differences: Socio-economic position: Inequality

The health and eating habits of Finns have improved over the past decades, but socio-economic differences in food consumption remain a serious public health challenge[1,2]. Childhood is a particularly important period for preventing health inequalities in later life, since childhood living conditions and home environment influence children's eating[3], and dietary habits formed in childhood tend to track into adulthood[4,5]. Socioeconomically disadvantaged children are at higher risk of having a less healthy diet, and there is a link between childhood socio-economic status (SES) and adolescent and adult health[6]. In high-income countries, lower SES is associated with a higher prevalence of childhood overweight and obesity[7,8] and higher risk of metabolic syndrome, impaired fasting glucose and type 2 diabetes in later life[9,10].

Socio-economic differences in children's dietary habits exist in the majority of European countries[11]. Earlier studies in Finland[12–14] and other parts of Europe[15–17] show fairly systematically that higher SES is associated with a healthier diet in children. A mother's lower education has been associated with lower dietary quality and dietary diversity in children[17]. Studies have shown that children of a lower SES background tend to consume more sweets and sugar-sweetened beverages[11,14,18] and fewer fruits and vegetables (FV)[11,13,14,18,19] than children with a higher SES background. Socio-economic differences have also been seen in children's nutrient intake[14,20]. Most typically, studies have reported a lower intake of vitamins C and D[14,20] and fibre[14] and a higher intake of saturated fat[14] for the low SES group.

Abbreviations: FV, fruits and vegetables; PEL, parental educational level; SES, socio-economic status.

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In Finland, the association between SES and dietary habits is well-established in adults[21] but less is known about small children. A study of 6- to 8-year-old children (*n* 424) in Eastern Finland showed that children with higher parental education were more likely to eat fish and fibre-rich bread but less likely to use soft margarine[12]. In a recent study on 2- to 6-year-old Finnish children (*n* 766), a higher parental educational level (PEL) was associated with a better diet quality in the children, assessed by the Children's Index of Diet Quality[13]. This meant that they consumed more vegetables, fruits, berries, vegetable-oil-based spread and skimmed milk. Similar results have been obtained in older studies, where the consumption of vegetables, fat spreads, fish dishes and sugar-sweetened drinks differed between SES groups in favour of high SES[14]. However, studies reporting socio-economic differences in preschool-aged children in Finland, especially for nutrient intake, are scarce. The aim of this study was to examine the associations between PEL and both food consumption and nutrient intake in a sample of 3- to 6-year-old Finnish preschoolers.

Subject and methods

Study design and participants

We collected the data in the context of the DAGIS study (Increased Health and Wellbeing in Preschools) in Finland. The DAGIS study is a research project examining 3- to 6-year-olds' energy balance-related behaviours and stress in the preschool setting, aiming at producing knowledge on children's energy balance-related behaviours and improving health behaviours. The other main aim was to examine and diminish possible socio-economic differences in children's energy balance-related behaviours. The study protocol and the sampling design have been described in detail elsewhere[22]. The study was approved by the University of Helsinki Ethical Review Board in the Humanities and Social and Behavioural Sciences in February 2015 (Statement 6/2015).

The first phase of the DAGIS study consisted of a cross-sectional survey, conducted in eight municipalities in Southern and Western Finland during 2015–2016. We aimed to have municipalities with socioeconomically diverse populations and selected the municipalities based on following indicators: the Gini coefficient of the municipality and the proportion of single parents and people with a low education level. We contacted 169 preschools, of which sixty-seven did not wish to participate and sixteen were excluded because they did not meet the eligibility criteria (having at least one group consisting of 3- to 6-year-old children, providing early education only during the daytime, being Finnish or Swedish speaking and charging income-dependent fees). All families with children in a group of 3- to 6-year-olds were invited by an invitation letter distributed by preschool personnel. Parents provided written informed consent for a total of 983 children. Due to limited research resources, we then excluded preschools with a total parental consent rate less than 30 % in all groups. The final number of participating preschools was 66 (43 % of invited), and the number of children with parental consent was 892 (25 % of invited). From those participants, 864 children (24 % of invited) have at least some study data. Thus, that is considered to be the final number of participating children in the study.

Socio-economic status

Parents filled in a questionnaire concerning their level of education and other background information. The consenting parents reported the highest educational level for themselves and their partners living in the same household. The highest parental educational level (PEL) in the family was used as an SES indicator. The answer options for the question 'What is your highest educational achievement?' were (1) comprehensive school (primary and lower secondary school); (2) vocational school; (3) high school; (4) bachelor's degree or college; (5) master's degree and (6) licentiate/doctorate[23]. A three-class variable was then formed and used in the analyses: low educational level (high school/vocational school/comprehensive school), middle educational level (bachelor's degree or equivalent) and high educational level (master's degree or higher).

The parents also reported the average net income of the household per month and the number of people belonging to the household. The relative income of the household was then calculated, taking into account the number of household members and their ages[24]. For the analyses, the subjects were divided into thirds based on the relative income. The income thresholds by group were as follows: the lowest third (179–1894 €), the middle third (1895–2500 €) and the highest third (2501–5556 €).

Food record data

Data on children's food consumption and nutrient intake were obtained with food records, collected both at home and at preschool. The three-day food records were collected between September 2015 and April 2016. Some of the families (*n* 292, 34 % of participants) kept an additional two-day food record between June and September 2016 in order to capture seasonal variation in the diet (Table 1).

Each participating family was sent a 3-day food record including a validated Children's Food Picture Book to assist with portion size estimation[25,26]. The families were guided to fill the food record in exact given dates (two weekdays and one weekend day). The instruction was to record all foods, beverages that their child consumed during the recording days outside the preschool and describe foods as accurately as possible, either with exact brand and product names or by listing all the ingredients for composite dishes. The portion sizes were instructed to be estimated using the Children's Food Picture Book, by weighing or by using household measures or package labels. At the same time, the preschool personnel were instructed to fill in a separate pre-coded food record for foods and drinks consumed at preschool. They also received the Children's Food Picture Book and had the same instructions to estimate portion sizes. The parents also reported their child's dietary supplement use in a separate questionnaire.

Research assistants checked the completed food records and, if necessary, contacted parents or preschool personnel to complete missing details. In the checking process, special attention was paid to consumption of FV and sugar-contained

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Table 1. Characteristics of the study sample (*n* 811) according to parental educational level (PEL) in the DAGIS study

	All children (*n* 811)		Low PEL (*n* 175)		Middle PEL (*n* 342)		High PEL (*n* 294)	
Characteristics	*n*	%	*n*	%	*n*	%	*n*	%
Child								
Gender								
Girl	389	48·0	83	47·4	178	52·0	128	43·5
Boy	422	52·0	92	52·6	164	48·0	166	56·5
Age, years								
3	169	20·8	38	21·7	74	21·6	57	19·4
4	294	36·3	58	33·1	130	38·0	106	36·1
5	287	35·4	68	38·9	115	33·6	104	35·4
6	61	7·5	11	6·3	23	6·7	27	9·2
Food records, number of days								
1	7	0·9	3	1·7	1	0·3	3	1·0
2	30	3·7	8	4·6	14	4·1	8	2·7
3	572	70·5	140	80·0	241	70·5	191	65·0
4	10	1·2	1	0·6	4	1·2	5	1·7
5	192	23·7	23	13·1	82	24·0	87	29·6
Family								
Relative household income*								
Lowest tertile (< 1894 €)	211	26·0	65	37·1	99	28·9	47	16·0
Middle tertile (1895–2500 €)	225	27·7	41	23·4	109	31·9	75	25·5
Highest tertile (> 2501 €)	233	28·7	18	10·3	82	24·0	133	52·2
Missing	142	17·5	51	29·1	52	15·2	39	13·3

Categories for PEL: low PEL: high school, vocational school or lower education; middle PEL: bachelor's degree or equivalent; high PEL: master's degree or higher education.
* Net income, taking into account the number of people in the household[24].

products. Some individual days had to be excluded due to the incomplete recording (unrealistically long pauses between consecutive meals), but all valid days were still included in the data. Thus, the data consisted of 1–5 food record days for each participant. The food data were entered by trained research assistants using AivoDiet dietary software (version 2.2.0.0, Mashie FoodTech Solutions Finland Oy, Turku, Finland). The software included the Fineli food composition database (release 16, 2013)[27] maintained by the Finnish Institute for Health and Welfare. We updated the database with the up-to-date values of vitamin-D-fortified food items and added new food items and recipes. The recipes received from the preschool's food services were also added to the database. As the food composition database did not provide values for added sugar, we estimated the intake of added sugar by creating a formula to estimate the added sugar content for each food group containing added sugar. The process is described in more detail in another article[28]. Finally, we checked the entered food data for outlying values in food consumption and nutrient intake, and any data entry errors observed were corrected.

Data processing and statistical analyses

We extracted the food consumption data from the dietary software in two different ways. The first included single food items (e.g. skimmed milk, margarine and apple) and mixed dishes (e.g. pizza and chicken soup). The second, hereafter called the 'ingredient level', included single food items and the ingredients of mixed dishes (e.g. minced meat soup was disaggregated into minced meat, potatoes, carrots, etc.). For reporting food consumption in food groups, all dishes and food items were categorised with other similar foods, forming a total of twelve main food groups and several sub-groups. The presented analyses include eleven main groups as well as selected sub-groups (online Supplementary Table 4). The main group miscellaneous (including food items such as mustard, soya sauce and other spices) was excluded from the analyses due to not having nutritional significance. Similarly, each food item at an ingredient level was categorised into main groups and sub-groups. For reporting nutrient intake and food consumption, the means were calculated based on average intake for each participant over their completed 1–5 food record days. The results include the intake only from foods – not dietary supplements. In this study, we do not report intake from dietary supplements, as the supplement use was collected by a different method and is not directly comparable with the food consumption data. Differences in nutrient intake and food consumption by PEL were assessed using a multilevel hierarchical linear model adjusted for energy intake. Three-level models were used to take into account the clustering of the data due to (1) preschool-based recruitment strategy (preschool-level) and (2) multiple participants from the same household (family-level). The highest PEL group was considered a reference group. Analyses were conducted using R Statistical Software RStudio version 2022·02·3 (R Studio, Inc., 2021) and R package 'lme4' for linear model.

Sensitivity analyses

Families with low PEL had kept fewer additional food records (days 4 and 5) (Table 1), which may affect the results, especially the consumption of FV. Thus, we did sensitivity analyses with the core food groups and nutrients, including only 1–3 food record days from each participant. Because the results were similar to the one presented, we decided to keep the additional days included in the analyses.

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Results

Participants

The sample consisted of 811 (94 % of the participants) children, from whom we received at least a one-day food record and information about PEL. The descriptive characteristics of the studied sample are provided in Table 1. Of the participants, 52 % were boys and most of the children were 4 (36 %) or 5 (35 %) years old. The majority of the participants (95 %) had at least three days of food record data available.

Food consumption

The associations between PEL and children's food consumption are presented in Table 2, and the mean consumption of the main food groups and selected sub-groups according to PEL are presented in online Supplementary Table 1. Significant differences between PEL groups were found. Compared with high PEL, low PEL was associated with a child's lower consumption of fresh vegetables and salads, vegetarian dishes, berries, white bread, blended spread (mixture of vegetable and animal fats), skimmed milk and ice cream but higher consumption of milk (fat 1–1·5 %), dairy-based desserts and sugar-sweetened soft drinks. Children in middle-educated families also had lower consumption of fresh vegetables and vegetable salads, vegetarian dishes and skimmed milk compared with children in higher educated families. No PEL differences were found in the consumption of sweets and chocolate or sugar-sweetened juice.

At an ingredient level, compared with high PEL, low PEL was associated with the lower consumption of root vegetables and other vegetables, nuts and seeds, berries and fish and seafood but a higher intake of red meat (Table 3). The lower consumption of root vegetables and other vegetables was also seen in children in middle-educated families. The mean consumption of the selected food groups at an ingredient level is shown in online Supplementary Table 2.

Nutrient intake

Table 4 shows the association between PEL and children's nutrient intake, whereas the mean intake is presented in online Supplementary Table 3. There were no differences in energy intake between PEL groups. Compared with high PEL, low parental education was associated with a lower intake of protein; fibre; EPA; DHA; vitamins C, D, B_6 and B_{12}; folate; riboflavin; potassium; Ca; phosphorous; Mg; Zn and iodine but a higher intake of fat, SAFA, trans fatty acids and MUFA. Children in middle educated families also had a lower intake of protein, fibre, vitamin B_6, folate, potassium, Mg and Zn but a higher intake of SAFA compared with children in the highest educated families. There were no differences in added sugar or Na intake between the groups.

Discussion

The present study examined socio-economic differences in food consumption and nutrient intake according to PEL among Finnish preschool children. Our study produced detailed information at three levels: food group level, ingredient level and nutrient level.

Based on our results, there were significant differences between PEL groups. In general, compared with high PEL, low PEL was associated with a child's lower consumption of healthy food groups, such as fresh vegetables, berries and skimmed milk, and a lower intake of many beneficial nutrients. There were a few exceptions, such as higher consumption of white bread and ice cream in the higher educated group. Our main findings are in line with previous studies. The majority of studies have shown that higher PEL is related to a healthier diet in children[12–15,17,29].

Several studies have observed the positive association between SES and the consumption of fruit, vegetables or berries[13,15,19,29–31] In our study, the consumption of fresh vegetables and vegetable salads and vegetarian dishes was lower in children with low or middle educated parents compared with high PEL. The low PEL group also had lower consumption of berries and nuts and seeds. The use of legumes and plant-based proteins was low in our data, and there were no differences in the consumption between the groups. Typically, children's vegetable consumption is lower than their fruit consumption, since children tend to prefer sweet and avoid bitter flavours[32]. Higher fruit consumption was also observed in our data, and no differences between the PEL groups were observed in relation to it. In our study, the average consumption of fruit, vegetables and berries was nearest the recommendation (at least 250 g/d) in the high PEL group (248 g/d) but further away from the recommendation in the middle and low PEL groups (231 and 209 g/d, respectively). Our findings on nutrient intake are in line with the observed patterns of FV consumption. Compared with high PEL, middle PEL group had lower intake of fibre, folate and potassium, and the low PEL group also had lower intake of vitamin C. FV are important sources of these nutrients, and epidemiological evidence suggests that the consumption of FV is associated with reduced risk of CVD, cancer and all-cause mortality[33]. Therefore, our findings raise concern on the possible long-term health effects of less healthy food consumption among Finnish families with lower education levels.

It has been shown in many Western countries that lower SES groups tend to consume red and processed meat more often and in higher quantities[34]. The same was observed in our study, where children with low PEL had higher consumption of red meat than those in the high PEL group. The result is also in line with a study of 3- to 10-year-old French children (n 574) that found that children from lower educated families consumed more meat compared with those with higher education (81·1 *v.* 69·5 g/d)[29]. People in higher SES groups may consume less meat because of the greater awareness of the health effects associated with overconsumption of meat[34]. Instead of meat, they may prefer other more beneficial food groups, such as fish. This was seen in our study, where fish consumption was higher in children from higher educated families. The same has been observed in an earlier Finnish study examining children aged 3 and 6 years old, which found that children with higher educated fathers consumed more fish dishes[14]. Another Finnish study reported that recommended fish consumption was more

Table 2. Association between parental educational level (PEL) and children's daily food consumption in the DAGIS study, hierarchical linear model adjusted for energy intake. Main food groups (bold) and selected sub-groups are presented

	Model 1	
Food group (g/d)	Estimate	95 % CI
Vegetables and vegetable dishes		
High	ref.	
Middle	–20·06	–30·16, –9·96
Low	–31·36	–43·74, –19·01
Fresh vegetables and vegetable salads		
High	ref.	
Middle	–8·28	–15·60, –0·96
Low	–14·47	–23·37, –5·56
Vegetarian dishes		
High	ref.	
Middle	–10·71	–16·84, –4·59
Low	–13·55	–21·15, –5·97
Potatoes and potato dishes		
High	ref.	
Middle	0·60	–6·37, 7·58
Low	1·34	–7·20, 9·88
Boiled and mashed potatoes		
High	ref.	
Middle	0·25	–6·65, 7·17
Low	–3·16	–11·63, 5·31
Fried potatoes and potato dishes		
High	ref.	
Middle	0·24	–1·91, 2·38
Low	4·34	1·73, 6·95
Fruit, berries, fruit and berry products		
High	ref.	
Middle	–0·70	–19·20, 16·74
Low	–21·57	–42·71, –0·46
Fresh fruit		
High	ref.	
Middle	–3·01	–15·21, 9·18
Low	–12·13	–26·89, 2·63
Berries		
High	ref.	
Middle	–2·79	–6·12, 0·53
Low	–5·38	–9·43, –1·34
100 % juice		
High	ref.	
Middle	–5·91	–13·65, 3·13
Low	–5·29	–12·72, 0·90
Cereals and bakery products		
High	ref.	
Middle	–20·95	–39·84, –2·15
Low	–21·31	–36·91, –5·87
Rye bread		
High	ref.	
Middle	–0·98	–3·52, 1·55
Low	–2·87	–5·95, 0·22
Rye crispbread		
High	ref.	
Middle	0·50	–0·56, 1·55
Low	1·02	–0·27, 2·32
Multigrain bread		
High	ref.	
Middle	1·00	–2·36, 4·35
Low	–1·88	–5·98, 2·26
White bread		
High	ref.	
Middle	–1·74	–3·60, 0·13
Low	–2·60	–4·88, –0·31
Breakfast cereals, sugar-sweetened		
High	ref.	
Middle	0·33	–1·19, 1·85
Low	–0·60	–2·45, 1·25

Table 2. (*Continued*)

	Model 1	
Food group (g/d)	Estimate	95 % CI
Porridge		
High	ref.	
Middle	–13·57	–28·18, 0·94
Low	–12·73	–30·51, 4·99
Pasta, rice and other grain side dishes		
High	ref.	
Middle	–4·17	–9·35, 0·99
Low	1·59	–4·91, 7·93
Pizza, hamburgers and savoury pastries		
High	ref.	
Middle	–2·70	–6·85, 1·41
Low	1·61	–3·42, 6·63
Buns, doughnuts, cakes and sweet pastries		
High	ref.	
Middle	0·22	–2·39 2·83
Low	0·24	–2·95, 3·43
Biscuits and muesli bars		
High	ref.	
Middle	0·42	–1·02, 1·85
Low	–0·54	–2·32, 1·23
Fat spreads, oils and dressings		
High	ref.	
Middle	–0·05	–1·98, 1·86
Low	–0·32	–2·70, 2·07
Margarine and vegetable fat spread		
High	ref.	
Middle	–0·54	–1·86, 0·79
Low	–0·75	–2·37, 0·89
Blended spread		
High	ref.	
Middle	–0·54	–1·46, 0·37
Low	–1·43	–2·54, –0·31
Fish and fish dishes		
High	ref.	
Middle	1·44	–4·85, 7·69
Low	–6·17	–13·99, 1·56
Eggs and egg dishes		
High	ref.	
Middle	–0·21	–2·33, 1·92
Low	–1·12	–3·72, 1·47
Meat and meat dishes		
High	ref.	
Middle	7·77	–3·08, 26·02
Low	11·45	–4·12, 19·63
Cold cuts		
High	ref.	
Middle	0·09	–0·93, 1·11
Low	0·29	–0·95, 1·54
Poultry dishes		
High	ref.	
Middle	0·11	–5·79, 5·97
Low	0·63	–6·66, 7·89
Red meat dishes		
High	ref.	
Middle	0·95	–5·93, 7·82
Low	3·12	–5·33, 11·56
Sausage dishes		
High	ref.	
Middle	3·79	–0·67, 8·27
Low	1·01	–4·50, 6·52
Milk and dairy products		
High	ref.	
Middle	–19·04	–55·76, 17·47
Low	–43·38	–87·81, 1·02
Milk, skimmed		
High	ref.	

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Table 2. (*Continued*)

Food group (g/d)	Model 1 Estimate	95 % CI
Middle	−36·43	−68·80, −4·28
Low	−97·84	−137·58, −58·32
Milk (1–1·5 % fat)		
High	ref.	
Middle	11·28	−15·43, 38·07
Low	54·37	21·45, 87·44
Yoghurt and Finnish cultured milk, sugar-sweetened		
High	ref.	
Middle	0·06	−10·40, 10·60
Low	2·24	−10·48, 14·97
Yoghurt and Finnish cultured milk, unsweetened		
High	ref.	
Middle	−0·05	−5·06, 4·89
Low	−5·79	−11·89, 0·24
Cheese		
High	ref.	
Middle	0·49	−1·43, 2·40
Low	−1·18	−3·49, 1·15
Ice cream		
High	ref.	
Middle	−1·40	−3·77, 0·96
Low	−3·21	−6·08, −0·33
Dairy-based desserts		
High	ref.	
Middle	3·64	−2·49, 9·76
Low	7·84	0·31, 15·39
Sugar and sweets		
High	ref.	
Middle	1·77	−0·68, 4·22
Low	0·74	−2·24, 3·74
Sweets and chocolate		
High	ref.	
Middle	2·19	−0·23, 4·61
Low	1·28	−1·68, 4·25
Beverages		
High	ref.	
Middle	21·67	−8·41, 51·84
Low	46·26	9·82, 82·64
Sugar-sweetened juice		
High	ref.	
Middle	−2·40	−13·96, 9·16
Low	3·37	−10·63, 17·36
Sugar-sweetened soft drinks		
High	ref.	
Middle	4·27	−1·18, 9·71
Low	11·65	5·00, 18·29

Categories for PEL: low PEL: high school, vocational school or lower education; middle PEL: bachelor's degree or equivalent; high PEL: master's degree or higher education.

common in children in the highest PEL group[12]. We also observed that the children in the low PEL group had a lower intake of vitamin D, EPA, DHA and iodine, the source of which fish is one of the most significant in children's diet[35]. The average intake of vitamin D (from food sources) has been below recommendations in Finnish children[12,36]. In our data, the average intake was still below the recommended amount (9·1 µg) but highest among the high PEL group (9·6 µg). This supports the need for vitamin D supplementation in preschool-aged children.

We found differences in types of milk consumed. Parents' lower education was associated with a child's lower consumption of skimmed milk but higher consumption of a higher fat milk (fat content 1–1·5 %) compared to high PEL. Children in the middle PEL group also consumed less skimmed milk than the high PEL group. These results are in agreement with previous Finnish studies reporting an association between higher parental education and consumption of skimmed milk in children[1,12,14]. The type of milk may partly explain the higher intake of SAFA that was observed in the low PEL group, since milk products are the main sources of SAFA in preschool children[35]. These differences should be addressed because studies have shown that the intake of SAFA among Finnish children is higher than recommended[12,35,36], while a diet low in saturated fat is recommended because of the health effects[37]. Replacing SAFA with PUFA in children's diets may help to reduce blood LDL cholesterol and the risk of cardiovascular disease later in life[38].

In our data, the average consumption of sugar-sweetened beverages was relatively low (12 g/d), but the intake was higher in children with lower educated parents. The same has been

Table 3. Association between parental educational level (PEL) and children's daily food consumption (ingredient level) in the DAGIS study, hierarchical linear model adjusted for energy intake. Selected food groups are presented

Food group (g/d)	Model 1 Estimate	95 % CI
Root vegetables and other vegetables		
High	ref.	
Middle	−12·23	−20·53, −3·96
Low	−20·23	−30·33, −10·17
Legumes and plant-based protein-rich products		
High	ref.	
Middle	−0·61	−1·85, 0·63
Low	−1·25	−2·77, 0·27
Nuts and seeds		
High	ref.	
Middle	−0·58	−1·23, 0·07
Low	−0·93	−1·71, −0·14
Fruits		
High	ref.	
Middle	−1·57	−16·05, 9·17
Low	−6·01	−28·13, 2·42
Berries		
High	ref.	
Middle	−1·52	−5·26, 2·21
Low	−6·01	−10·57, −1·47
Fish and seafood		
High	ref.	
Middle	−1·97	−5·49, 1·54
Low	−5·43	−9·77, −1·12
Red meat		
High	ref.	
Middle	−0·69	−4·56, 3·20
Low	6·28	1·54, 11·07
Poultry		
High	ref.	
Middle	0·11	−2·92, 3·11
Low	0·12	−3·59, 3·80
Cold cuts and sausages		
High	ref.	
Middle	2·66	−0·91, 6·24
Low	2·20	−2·18, 6·60

CI: Confidence interval.
Categories for PEL: low PEL: high school, vocational school or lower education; middle PEL: bachelor's degree or equivalent; high PEL: master's degree or higher education.

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Table 4. Association between parental educational level (PEL) and children's daily nutrient intake from food sources in the DAGIS study, hierarchical linear model adjusted for energy intake

	Model 1	
Nutrient	Estimate	95 % CI
Energy, MJ/d		
High	ref.	
Middle	–92·32	–285·89, 99·73
Low	–3·44	–202·53, 196·13
Protein, g/d		
High	ref.	
Middle	–1·34	–2·64, –0·05
Low	–1·95	–3·52, –0·38
Carbohydrates, g/d		
High	ref.	
Middle	–0·08	–2·80, 2·63
Low	–1·70	–5·06, 1·63
Sucrose, g/d		
High	ref.	
Middle	1·96	–0·20, 4·14
Low	2·05	–0·61, 4·71
Added sugar, g/d		
High	ref.	
Middle	1·67	–1·13, 4·67
Low	1·77	–0·68, 4·03
Fibre, g/d		
High	ref.	
Middle	–0·73	–1·28, –0·18
Low	–1·45	–2·13, –0·78
Fat, g/d		
High	ref.	
Middle	0·85	–0·30, 2·00
Low	2·15	0·74, 3·57
SAFA, g/d		
High	ref.	
Middle	0·67	0·03, 1·32
Low	1·27	0·48, 2·07
Trans fatty acids, g/d		
High	ref.	
Middle	0·02	–0·03, 0·07
Low	0·10	0·04, 0·16
Cholesterol, mg/d		
High	ref.	
Middle	3·39	–5·89, 12·65
Low	1·57	–9·82, 12·92
MUFA, g/d		
High	ref.	
Middle	0·30	–0·15, 0·76
Low	0·88	0·32, 1·44
PUFA, g/d		
High	ref.	
Middle	–0·11	–0·41, 0·19
Low	0·03	–0·34, 0·40
Linoleic acid, mg/d		
High	ref.	
Middle	–92·20	–319·04, 135·35
Low	157·87	–122·73, 439·27
Alfa linolenic acid, mg/d		
High	ref.	
Middle	–45·53	–115·62, 24·89
Low	–22·42	–108·53, 64·11
EPA, mg/d		
High	ref.	
Middle	–9·91	–27·44, 7·57
Low	–32·56	–54·28, –10·94
DHA, mg/d		
High	ref.	
Middle	–27·66	–78·24, 22·63
Low	–98·90	–161·54, –36·69
Vitamin A, µg RAE/d		
High	ref.	
Middle	–48·45	–101·99, 5·23
Low	–45·45	–111·36, 20·85
Vitamin D, µg/d		
High	ref.	
Middle	–0·32	–0·80, 0·15
Low	–0·06	–1·19, –0·02
Vitamin E, mg/d		
High	ref.	
Middle	–0·24	–0·49, 0·01
Low	–0·10	–0·41, 0·20
Thiamine, mg/d		
High	ref.	
Middle	–0·01	–0·03, 0·02
Low	–0·03	–0·06, 0·00
Riboflavin, mg/d		
High	ref.	
Middle	–0·04	–0·10, 0·03
Low	–0·12	–0·12, –0·04
Niacin equivalents, mg/d		
High	ref.	
Middle	–0·40	–0·90, 0·10
Low	–0·61	–1·23, 0·01
Vitamin B_6, mg/d		
High	ref.	
Middle	–0·04	–0·08, –0·01
Low	–0·07	–0·11, –0·02
Folate, µg/d		
High	ref.	
Middle	–6·99	–13·36, –0·64
Low	–13·83	–21·65, –6·02
Vitamin B_{12}, µg/d		
High	ref.	
Middle	–0·26	–0·55, 0·02
Low	–0·52	–0·86, –0·17
Vitamin C, mg/d		
High	ref.	
Middle	–4·14	–9·24, 0·95
Low	–8·59	–14·83, –2·36
Na, mg/d		
High	ref.	
Middle	0·00	–47·18, 47·04
Low	–30·71	–89·12, 27·50
Potassium, mg/d		
High	ref.	
Middle	–72·51	–138·68, –6·67
Low	–176·60	–257·55, –95·96
Phosphorous, mg/d		
High	ref.	
Middle	–23·75	–54·04, 6·32
Low	–68·18	–105·11, –31·34
Ca, mg/d		
High	ref.	
Middle	–16·72	–55·03, 21·44
Low	–58·79	–105·29, –12·31
Mg, mg/d		
High	ref.	
Middle	–8·63	–13·97, –3·31
Low	–18·44	–25·02, –11·88
Fe, mg/d		
High	ref.	
Middle	–0·22	–0·47, 0·03
Low	–0·30	–0·61, 0·00
Zn, mg/d		
High	ref.	
Middle	–0·20	–0·40, –0·01
Low	–0·29	–0·53, –0·05
Iodine, µg/d		
High	ref.	
Middle	–2·30	–8·81, 4·17
Low	–9·06	–17·04, –1·13

Categories for PEL: low PEL: high school, vocational school or lower education, middle PEL: bachelor's degree or equivalent, high PEL: master's degree or higher education.

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observed in previous studies[15,17,19]. A study of 3·5- to 5·5-year-old preschoolers (n 7063) from six European countries found that preschoolers with less educated mothers consumed energy-dense and low-nutritious food, such as sugared beverages, more often[17]. Another study of 2- to 9-year-old European children (n 14 426) reported that children in the low and medium PEL groups had higher odds of more frequently consuming sugary beverages[15]. Another study of European children (n 12 041), including children in Finland, found that 5- to 12-year-old children with a high SES vulnerability score were more likely to consume soft drinks[19]. The consumption of sugar-sweetened soft drinks is associated with unfavourable health outcomes, such as increased risk of obesity[39,40], and thus, the results are worrying. Despite the differences in consumption of sugar-sweetened beverages, we did not find differences in children's added sugar intake. In our data, the intake of added sugar was in line with recommendations[34], whereas in some previous studies, the intake was higher[41]. This may be partly explained by the fact that the food industry has introduced fewer sugar-containing alternatives to yoghurts, for example, and parents' awareness of a healthy diet has increased.

Observed differences in children's diets can be partly explained by the better nutrition knowledge of higher educated parents[3]. Education is a commonly used SES indicator, and parental education is reflected in the child's situation[42]. Education expresses mostly non-material resources such as knowledge, skills, attitudes and values that may support health behaviours. In studies, higher SES is consistently positively associated with nutrition knowledge, parent modelling, home food availability and accessibility[3]. They may value healthy eating more and aim to eat according to the recommendations, such as preferring vegetables and low-fat dairy products and reducing the intake of red meat. Higher educated families may also have better material resources to eat healthy, since higher education partly explains higher income[43]. Our previous study showed that lower family income was associated with a less healthy diet in children[44]. Typically, energy dense but otherwise lower nutritional density nutrient-depleted foods are low cost, while fish, fruits and vegetables, for example, are among the most expensive food groups[45]. In this study, higher educated families also had higher incomes (Table 1), which may partly explain the observed differences.

The major strength of this study included the relatively large study sample and comprehensive food record data, as we managed to collect dietary data from over 800 children in eight municipalities in different parts of Finland. In comparison with FFQs used in most studies, food records provide more detailed information on food consumption and nutrient intake[46]. To the best of our knowledge, reporting food consumption on ingredient level is rarely used, even though it allows more accurate analysis of, for example, FV consumption, as the ingredient-level data includes FV in dishes (e.g. carrot in minced meat soup) as well as separately eaten (e.g. apple).

Additionally, in our study, food records were filled in both at home and at preschool, providing more accurate information on a child's diet compared with an assessment made by the parent alone.

Possible limitations of this study were the low participation rate in the DAGIS cross-sectional survey (24 %) and the fact that the education level of the participating parents was higher than in general in Finland, where 43 % of 35- to 39-year-olds have at least a bachelor's degree (in our data 78 %)[47]. Although the sample was socioeconomically biased, differences in the children's diet were seen. Thus, the actual differences may be even greater than observed in our study. We only reported nutrient intake from food, and thus, the results could have been slightly different if intake from dietary supplements had been taken into account. Few studies reporting children's supplement use have shown an association between higher PEL and more frequent use of dietary supplements[48,49]. In Finland, vitamin D supplementation is recommended for all children under 18 years old, but the prevalence of supplementation is not monitored. However, in this sample of 3- to 6-year-old pre-schoolers, 83% had used a supplement containing vitamin D during the previous month, and the use was associated with a higher household income (Master's thesis,[50]). The use of other dietary supplements was clearly lower. The results of this study are only generalisable to children attending day care, since the diet of the Finnish children attending day care outside the home seems to be more balanced and closer to the national nutrition recommendations than the diet of children being cared for at home[51]. It is also shown that Finnish preschool meals provide a significant proportion of many important nutrients and recommended food groups[35], so it is possible that preschool meals might diminish SES differences in children's diet. The food record as a method involves certain weaknesses, such as possible under-reporting[52]. During the recording days, parents may offer healthier food than usual or forget to record some dishes. Generally, foods that are considered unhealthy are more likely to be under-reported, whereas those considered healthy are more likely to be over-reported[53]. There is no consistent evidence of the impact of education level on reporting.

In conclusion, our study showed that compared with high PEL, low PEL was associated with a less healthy diet and lower nutrient intake in Finnish pre-schoolers. The observed diet-related disparities highlight the need for policy actions and interventions supporting healthy eating patterns such as high consumption of vegetables, nuts and berries in childhood, paying special attention to those with low PEL.

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E. S., H. V., E. R. and L. K. formulated the research questions. E. S., H. V., K. N., E. L., R. L., E. R., M. E. and L. K. contributed to the planning and design of the study. E. S., H. V., K. N., EL, RL and LK participated in the data collection and/or were involved in processing data. ES analysed the data and performed the statistical analyses. E. S. wrote the manuscript, and H. V., K. N., E. L,. R. L,. E. R., M. E. and L. K. reviewed the manuscript. E. R. and M. E. were responsible for obtaining funding for the study. All authors reviewed and approved the final version of the manuscript.

L. K. was a board member of the company TwoDads at the time of the study.

Supplementary material

For supplementary material/s referred to in this article, please visit https://doi.org/10.1017/S0007114523001460

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