

Article

The contribution of preschool meals to the diet of Finnish preschoolers

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Abstract: Preschool meals may influence the formation of children's dietary habits and health. We assessed the contribution of preschool meals to the diet of Finnish children. We used food record data from the cross-sectional DAGIS survey and selected recording days which included all three meals (breakfast, lunch, afternoon snack) at preschool. We analysed the diet of three- to four-year-olds (n=324) and five- to six-year-olds (n=233). Preschool meals accounted for 54% of the weekday's energy intake in both age groups, and provided $\geq 60\%$ of total fibre, polyunsaturated fatty acids, and vitamins D and E. More than 60% of fish dishes, but only one third of total daily fresh fruit were consumed at preschool. The mean (SD) percentages of energy from protein and fat at preschool were 17% (3%) and 30% (7%) in the younger and 17% (3%) and 31% (6%) in the older age group, respectively. The mean proportions of energy from added sugar at preschool were below 5% in both age groups. On average, salt intake exceeded recommendations and 60% of salt came from preschool food. Tackling high salt intake should be a future goal of guidance for early childhood education and care food services.

Keywords: preschool-aged children; kindergarten; day care centre; catering; food consumption; dietary intake

1. Introduction

Food behaviours are learnt during childhood and track into adulthood [1,2]. Dietary habits influence health over the long term [3,4] and for this reason, ensuring health-promoting food habits both at home and in early childhood education and care (ECEC) is of vital importance. Studies reporting the food consumption and/or nutrient intake of the same children both at home and in ECEC are limited [5–9] and only a few have been conducted in Europe [6,8]. A study in Finland [10]

22 found that the diet of three-year-old children attending ECEC outside the home was closer to the
23 Finnish nutrition recommendations than the diet of home-cared children. Studies conducted in the
24 USA have reported that lunches at ECEC are, with regard to some micronutrients, more nutrient-dense
25 than lunches at home or away [11] or dinners at home [9]. In contrast, Gubbels et al. [8] reported that
26 more vegetables were consumed at home than in day care in the Netherlands. The same study found
27 that sweet snacks were mostly eaten in day care. In the study by Gubbels et al. [8], all food in the
28 participating day care centres was provided by the centre (Jessica Gubbels, personal communication
29 May 9, 2019). The results regarding the contribution of ECEC to food consumption and nutrient intake
30 are contradictory. The discrepancies may be due to differences in food culture and food service systems,
31 regulations, recommendations and laws, which need to be taken into account when comparing studies.

32 The aim of this study was to assess the contribution of preschool meals to the diet of children who
33 attend full-time care in municipal preschools in Finland. We specifically aimed to calculate what is the
34 percentage contribution of each meal to the total daily intake of energy and nutrients on weekdays
35 when the child eats three meals at preschool and to describe the amounts of foods consumed and the
36 sources of nutrients at preschool and at outside preschool. In this paper, we use the term preschool to
37 mean municipally arranged centre based ECEC, which in Finland is voluntary until the age of six, and
38 compulsory for one year before school starts at the age of seven.

39 2. Materials and methods

40 2.1. Early childhood education and care and food services in Finland

41 In Finland, parents can choose municipal (public) or private ECEC. In addition to preschools,
42 children can attend to group family day care, or family day care, which is typically in the caregiver's
43 home. Of one- to six-year old Finnish children in ECEC, 76% are in preschools [12]. The ECEC
44 fee is moderate but depends on family's size and income level. Children from all socio-economic
45 backgrounds are entitled to high-quality ECEC throughout the country. Early education is based on
46 the Act on Early Childhood Education and Care [13] and the National Core Curriculum for Early
47 Childhood Education and Care [14].

48 According to Finnish law, municipal preschools must provide healthy food which fulfils the
49 child's nutritional requirements [13]. If a child is in full-time care, three meals (breakfast, lunch and
50 afternoon snack) must be offered. A target has been set that these three meals should cover two-thirds
51 of a child's daily energy intake [15]. Food for preschool is provided by the either municipality's
52 own food service or an external food service provider. Food recommendations with meal-specific
53 nutritional criteria are available to guide ECEC food services. The recent updates to children's food
54 recommendations [16] and the first national food recommendations for ECEC [15] were not yet in
55 effect at the time of the data collection for this study, but older nutrition recommendations for families
56 with children were valid [17].

57 Lunch generally consists of typical Finnish foods: a warm main course with salad or a soup; bread
58 and spreadable fat; and a drink (milk, sour milk, or non-dairy milk substitute suitable for special diets).
59 Breakfast typically consists of porridge with milk and/or berry soup, fruit puree, or jam; and/or bread,
60 spreadable fat and a cold cut; and possibly a piece of fruit or vegetable. A typical afternoon snack is
61 a combination of two or more of the following: bread, yoghurt, Finnish cultured milk ('*viili*'), quark
62 ('*rahka*', also a cultured milk product), smoothie, berry soup, flavored porridge, pancakes, a piece of
63 fruit or vegetable, a cold cut, and milk or juice. All meals are included in the client fee and no separate
64 fees can be charged. This catering is part of the national effort to establish good nutrition, health and
65 welfare for children. According to the guidelines [15], mealtimes are part of early childhood education.
66 They must be appropriately organized and supervised. The health-related and social role of meals, the
67 objectives of nutritional education and learning manners and food culture, as well as the recreational
68 aspect of eating occasions should be taken into account when arranging mealtimes. Meals are used as

69 a pedagogical tool. The entire educational community should have commonly determined objectives
70 and implementation policies for food education [15].

71 2.2. Study participants

72 We used data from the Increased Health and Wellbeing in Preschools (DAGIS) research project.
73 As a part of the larger DAGIS study, a cross-sectional survey of preschool children was conducted
74 in 2015–2016. Details of the sampling process are described in open access format elsewhere [18]. In
75 short, the cross-sectional survey was conducted in eight municipalities. Five of these were in Southern
76 Finland and three were in Western Finland. Altogether 86 municipal (public) preschools consented to
77 participate (Figure 1). From these preschools, all children in the target age of three to six years ($n=3592$)
78 and their families were invited to participate through an invitation letter. Children in preschools with a
79 low participation rate ($\leq 30\%$ in each of the preschool groups for three- to six-year-olds) were excluded.
80 The final sample consisted of 864 children (24% of those invited) from 66 preschools. These preschools
81 operated from Monday to Friday. We excluded preschools operating 24 hours a day from the sample.

82 A parent or legal guardian of each participating child provided written informed consent. We
83 asked each family if we could contact them again for additional data collection. All procedures
84 involving human subjects were approved by the University of Helsinki Ethical Review Board in the
85 Humanities and Social and Behavioural Sciences on 24 February 2015 (Statement 6/2015).

86 2.3. Anthropometric and background data

87 Trained researchers measured weight and height at the preschool. The children removed their
88 shoes and heavy clothing. The clothes that the child was wearing during the weight measurement
89 were recorded and later deducted accordingly, creating a corrected weight variable. Body weight
90 was measured to the nearest 0.01 kg using CAS portable bench scales (CAS PB-100/200). Height was
91 measured to the nearest 0.1 cm using stadiometers (SECA 217). We used the extended international
92 body mass index cut-offs for thinness and overweight [19]. Other background data such as the parents'
93 level of education and the child's special diets were gathered via questionnaires.

94 2.4. Food record data

95 We sent each participating family a three-day food record including instructions. Exact dates (two
96 weekdays and one weekend day) for filling in the food record were assigned for each family. As the
97 aim was that all the days of the week would be well-represented in the data, these three days were not
98 always consecutive. In some cases, when the parents felt that the dates were unsuitable for keeping a
99 food record (for example due to illness in the family or a holiday trip), they contacted the study group
100 and renegotiated the dates. The three-day food records were kept between September 2015 and April
101 2016.

102 To capture seasonal variation in the diet, after about six months, the families who had agreed
103 to be contacted for additional data collection were sent an invitation to fill in a second food record
104 ($n=709$). This time it was a two-day food record and the families were assigned a week during which
105 they should choose two days for recording (with preferably at least one day being a weekday). When
106 necessary, parents also took the record and instructions to preschool. The two-day food records were
107 kept between June 2016 and September 2016. The time between the two food records ranged from 4 to
108 11 months.

109 The instruction page of the food records advised parents to record all foods and beverages that
110 their child consumed during the recording days, except for what they consumed at preschool. An
111 example page was also included. We provided the families with a validated [20] Children's Food
112 Picture Book [21], specifically designed for use in this project to assist in portion size estimation. The
113 parents were instructed to estimate the portion sizes eaten using the picture book, weighing, household
114 measures such as teaspoons or tablespoons, or package labels. The instruction was to list all the

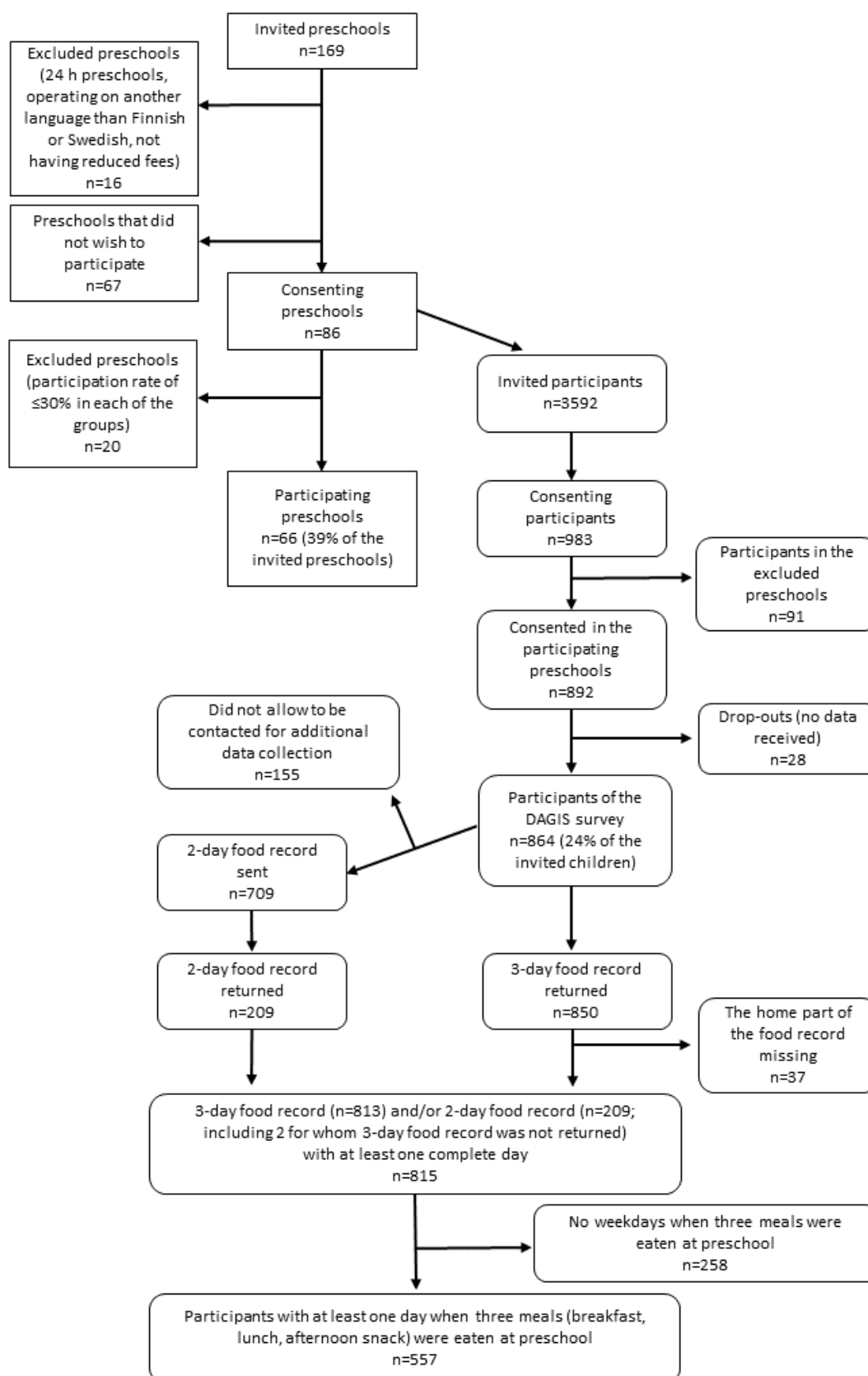


Figure 1. Participation of preschools and children in the DAGIS survey and the selection of participants for this paper.

115 ingredients of composite dishes. For packed food products, the exact brand and product name was
116 required. They were also asked to record the place and time of consumption.

117 The preschool personnel were given a separate pre-coded food record for recording food
118 consumption at the preschool on the dates matching the home food record. The researchers/research
119 assistants instructed the early educators orally, and the food record included written instructions.
120 Breakfast, lunch, afternoon snack and possible additional snacks each had predefined sections.
121 Different food groups, such as main courses, side dishes (potatoes, pasta, rice), and salad at lunch each
122 had predetermined rows. The early educators were given the Children's Food Picture Book [21] to help
123 them record the portion sizes eaten. They could also estimate the amounts in household measures.

124 The research assistants checked the returned food records and, if necessary, made follow-up
125 phone calls to complete missing details of foods consumed. Special attention was paid to vegetable,
126 fruit and sugary product consumption in the food record checking process. As an example, if the
127 parent had forgotten to record the type of yoghurt product, we asked if it had been natural yoghurt or
128 sugar-sweetened yoghurt; or if the portion size was missing, we asked for more details.

129 The food data were recorded using AivoDiet dietary software. This software included the Fineli
130 Food Composition Database Release 16 (2013) of the National Institute for Health and Welfare. New
131 food items were also added to the database when necessary. We checked that the vitamin D values of
132 foods fortified with vitamin D (fluid milk products, spreadable fats, and non-dairy milk substitutes)
133 corresponded with the products on the market at the time of study. The database includes recipes
134 for typical Finnish mixed dishes. For each individual meal, the research assistant used a suitable
135 recipe from the database, modified an existing recipe, or created a new recipe according to the parents'
136 reports. The salt content of home dishes was also based on the recipes in the database and unless the
137 parents stated otherwise in the record, main dishes, porridges, rice, pasta and potatoes were assumed
138 to have been cooked using salt. We asked the preschool food services if they were willing to give
139 their recipes to the study group to enable more precise calculation of the children's dietary intake at
140 preschool. Out of the eight municipalities, five gave their recipes, two gave a part of their recipes
141 and one municipality declined the request. In cases in which the recipe was not available, we made
142 estimations based on the recipes used in the other municipalities.

143 During the data entry, the research assistants coded each meal with a tag that specified the name
144 of the meal and the place at which it was eaten. These nametags were: breakfast, lunch, dinner, snack,
145 evening snack, and other. The research assistants decided on these on the basis of the recorded time
146 of day, the content of the meal, and general knowledge of Finnish food habits. The place tags were:
147 home, preschool, restaurant, and other.

148 After the data were entered, we checked for outlying values of food consumption in grams and
149 outlying energy and nutrient intakes. After extracting the data from the software, each food code (food
150 item or mixed dish) appearing in the data set was assigned to a food group and nutrient retention
151 factors [22] were applied using a single factor per nutrient per food group. The food composition
152 database did not include values for added sugar. As previously described [23], we estimated added
153 sugar intake by first assigning each food item to a food group and then giving each food group that
154 contained significant amounts of sugar a formula that represented the foods in that group. To estimate
155 the relative amounts of naturally occurring and added sugar in a certain food, we used the information
156 from package labels, the national food composition database and commonly used recipes.

157 The home and/or preschool food records of 850 (98% of the DAGIS survey sample) and 206 (29%
158 of those invited) children were returned in the first and second round of food record data collection,
159 respectively. However, the home part of the 3-day food record was missing for 37 children. Individual
160 days of data were also excluded due to unrealistically long pauses between consecutive meals (>8
161 hours). After data checking and entry, 815 children (94% of the DAGIS sample) had at least one day of
162 food record data available for analysis.

163 2.5. Data processing and analysis

164 In order to assess the dietary contribution of preschool meals among children attending full-time
165 care, we defined a 'full preschool day' and selected a sub-sample of the participants as follows. We
166 selected each singular food recording day when a child had eaten all three preschool meals (breakfast,
167 lunch and afternoon snack). We defined this as >0 grams of consumption of any food or beverage
168 during all these three meals. Using this criterion, we, in effect, discarded data for all weekend days
169 and those weekdays when: 1) the child was home-cared (it is common in Finland for a child to only
170 attend preschool four days per week) 2) the child came to preschool after preschool breakfast serving
171 time 3) the child was away from preschool for the whole day or part of the day for other reasons, such
172 as being ill or on vacation. The three meals were provided daily in all of the participating preschools.
173 Sometimes, when an additional snack was served during excursions or special events, we collapsed
174 these with the regular afternoon snack in the data analysis. This approach yielded a sample of 557
175 children (64% of the DAGIS sample). Each of these children contributed to the data with one to four
176 full preschool days; the total number of days in the data for this paper was 966. These children were
177 from 489 families (423 families had one child in the sample, 64 had two, and 2 had three children in
178 the sample). For analysis, we divided the data into two age groups. We used age at recruitment for
179 this categorization (even though the children grew older between the first and second food recording
180 period).

181 We rearranged all the meals in the data to fall under one of the seven possible meal categories
182 1) breakfast outside preschool, 2) breakfast at preschool, 3) lunch at preschool, 4) afternoon snack at
183 preschool, 5) dinner outside preschool, 6) evening snack outside preschool, and 7) other snack outside
184 preschool. We did not consider a glass of water or a chewing gum alone to be a meal and collapsed
185 these with another meal. We first calculated the percentage of individual days in the data that included
186 each meal. After that, we calculated an average day for each child and used these to calculate the
187 mean intakes and population proportions [24] of energy and nutrients during each meal, during the
188 preschool day in total, and during the whole day. We also calculated the mean amounts of foods
189 consumed and the food group sources of energy and nutrients. This was also done after calculating an
190 average day for each child. Finally, since not all the days included all the seven meals, we calculated
191 the mean intake of energy and nutrients for each meal during the days when the meal was consumed
192 after selecting these days and calculating an average day for each child. We used R version 3.5.2 for all
193 analyses.

194 3. Results

195 The analyses included 557 children from 66 preschools, 264 (47%) of whom were girls. The
196 majority (98%) of these children were in the target age group of three to six years. However, nine
197 children were two years old and one was seven years old; for analysis, we included them in the closest
198 age group. Of all the participants, 81% were categorized as being of normal weight. The participating
199 children attended preschool on four and a half days per week on average (Table 1).

200 3.1. Food consumption

201 We found that the majority ($\geq 60\%$) of skimmed milk, potatoes and potato dishes, fish dishes,
202 poultry dishes, sausage dishes, margarine and fat spread¹, porridge, fruit and berry soups, dairy-based
203 desserts, rye crispbread, and multi-grain bread were consumed at preschool (Tables 2 and 3). The
204 majority ($\geq 60\%$) of fruit, berries, sweet and savoury bakery products, biscuits and muesli bars, blended
205 spreads, yogurt and Finnish cultured milk, and cheese were consumed at home (and elsewhere

¹ In this paper, we use the European Union's definitions [25] for the following spreadable fats: butter, margarine, fat spread, and blended spread. In short, fat spreads and margarines are similar, but the total fat content differs. Blended spreads are obtained from a mixture of vegetable and animal fats and the milk-fat content is between 10% and 80%.

206 outside preschool). Furthermore, over 75% of the total amount of the 'sweets and sugar' group and
207 sugar-sweetened juice and all soda were consumed outside preschool. Fresh vegetables and vegetable
208 salads were consumed in roughly equal amounts at preschool and outside preschool.

209 At preschool, skimmed milk was the most commonly used milk. None of the preschools offered
210 whole milk. Of the 66 preschools, 64 (97%) offered milk with and 2 (3%) without vitamin D fortification
211 during the food recording days. The mean daily bread consumption was 65 g and 71 g among the
212 three- to four-year-olds and five- to six-year-olds, respectively, and about two thirds of the bread
213 consumption was at preschool (Tables 2 and 3). Preschools offered margarine or fat spread with bread
214 and their consumption was relatively high (mean 16 and 18 g/day, among the three- to four-year-olds
215 and five- to six-year-olds, respectively), which is in line with their bread consumption pattern. The
216 most common spreadable fat offered at preschool was margarine with a fat content of 60 g/100 g (data
217 not shown).

218 3.2. Energy and macronutrients

219 The mean energy intake for Monday to Friday was 5.6 MJ among the three- to four-year-olds
220 (Table 4) and 6.4 MJ among the five- to six-year-olds (Table 5). All preschool meals together accounted
221 for 54% of the total energy intake in both age groups. Lunch and dinner were the two main meals
222 with regard to energy intake. Breakfast at preschool, afternoon snack at preschool, and evening snack
223 at home were all of similar importance with regard to energy intake. Most children did not have a
224 home breakfast before going to preschool, and thus, on average, home breakfast was only 2–3% of
225 the energy intake (Tables 4 and 5). Among those who did have a home breakfast, it contributed on
226 average 0.50–0.57 MJ of energy (Supplementary Tables S1 and S2).

227 The mean proportions of energy from protein and saturated fatty acids in preschool meals were
228 above those recommended for ECEC food services (Table 6). The different food groups are presented
229 as sources of energy and nutrients in Supplementary Tables S3–S58. The main sources of energy were
230 cereals and bakery products, milk and dairy products, and meat and meat dishes in both age groups,
231 both at and outside preschool (Supplementary Tables S3 and S4). Lunch and dinner accounted for
232 the majority of protein and fat in the children's diet (Tables 4 and 5). Milk and dairy products, meat
233 and meat dishes, and cereals and bakery products were the greatest sources of protein both at home
234 and at preschool (Supplementary Tables S5 and S6). The 'margarine and fat spread' sub-group was
235 the most important source of mono- and polyunsaturated fatty acids, but also of saturated fatty acids
236 during preschool hours (Supplementary Tables S17 to S22). The proportion of saturated fat from milk
237 and dairy products was lower at preschool than outside preschool (Supplementary Tables S17 to S18).
238 On average, dinner and lunch were the meals that contributed the highest amounts of saturated fatty
239 acids.

240 The mean daily intake of fibre was 15.3 g and 16.7 g among the three- to four-year-olds and
241 five- to six-year-olds, respectively. Of this, more than a third was contributed by cereals and bakery
242 products consumed at preschool (Supplementary Tables S13 and S14). The mean percentage of energy
243 from added sugar on Monday to Friday was 6.2 E% in the younger and 7.0 E% in the older age group
244 (Table 6). Most of the sucrose and added sugar intake was outside preschool (Tables 4 and 5). The
245 meals accounting for the most added sugar intake on weekdays were the afternoon snack at preschool,
246 evening snack, and other snacks outside preschool. The main source of added sugar at preschool was
247 fruit and berry soups (Supplementary tables S11 and S12), which were eaten at the afternoon snack
248 and breakfast. However, the mean percentage of energy from added sugar at preschool was only 4–5
249 E% (Table 6).

250 3.3. Micronutrients

251 Preschool food was an important source of vitamins D and E ($\geq 60\%$ of total intake in both age
252 groups; Tables 4 and 5). Vitamin D fortified milk and margarine and fat spread were the main sources
253 of vitamin D (Supplementary Tables S25 and S26). The sub-group 'margarine and fat spread' was the

254 main source of vitamins A and E in preschool (Supplementary Tables S23, S24, S27 and S28). Calcium
 255 intake was distributed evenly between the five main meals of the day (Tables 4 and 5) and milk
 256 was its main source (Supplementary Tables S49 and S50). Milk was also the most important source
 257 of riboflavin (Supplementary tables S31 and S32) and iodine (Supplementary Tables S57 and S58).
 258 Folate came from a large variety of food groups in the diet, but at preschool, breads other than white
 259 bread were important sources (Supplementary Tables S37 and S38). Fresh fruit was a more important
 260 source of vitamin C at home than at preschool (Supplementary Tables S41 and S42). Preschool food
 261 contributed 60% to the total salt intake in both age groups; the mean salt intake at preschool was 3.2
 262 and 3.6 g/day in the younger and older age groups, respectively (Tables 4 and 5). Meat and meat
 263 dishes, and cereals and bakery products were especially significant sources of salt (Supplementary
 264 Tables S43 and S44).

Table 1. Characteristics of sample (total n=557).

Characteristics	3- to 4-year-olds (n=324)		5- to 6-year-olds (n=233)	
	data available, n	% or mean (SD)	data available, n	% or mean (SD)
Child				
Gender	324		233	
Girls		47.2		47.6
Boys		52.8		52.4
Age, years	324	4.1 (0.6)	233	5.6 (0.5)
Weight status [19]	301		224	
Underweight		8.0		5.8
Normal weight		83.1		78.6
Overweight or obese		9.0		15.7
Days in preschool/week	312	4.5 (0.8)	219	4.5 (0.8)
Hours in preschool/day	305	8.2 (0.8)	211	8.1 (0.8)
Special diets	322		226	
Food allergy or intolerance		8.4		7.5
Low lactose/lactose free		7.6		5.7
Gluten-free		0.9		1.3
Vegetarian or pescovegetarian		0.3		0.4
Family				
Highest educational level in family	315		221	
High school level or lower		19.1		18.0
Bachelor degree or equivalent		43.5		42.1
Master degree or higher		37.3		39.9
Number of < 18-year-old children living in the household, including participating child	315		221	
1		11.7		11.8
2		58.7		55.7
3 or more		29.5		32.6
Preschool				
Number of children in day care group	278	20 (6.8)	200	21 (7.0)

265 4. Discussion

266 We investigated the contribution of preschool meals to the weekdays' total energy and nutrient
 267 intake among Finnish preschoolers who eat three meals at preschool. We also examined the amounts
 268 of the foods consumed and the food sources of nutrients during preschool and outside preschool
 269 hours. We found that preschool meals contributed significant shares of some of the food groups that
 270 are considered part of a health-promoting diet [16] (fish, fat-free dairy, whole-grain products, and
 271 vegetable-oil based spreadable fats). Preschool meals were also low in sugary foods. Preschool food
 272 provided on average 54% of the total energy on a weekday, and $\geq 60\%$ of the total fibre, polyunsaturated

Table 2. Mean food consumption on preschool days (Monday to Friday) of 3- to 4-year-old Finnish children who eat three meals at preschool (n=324). Main food groups (bold) and selected sub-groups are presented.

	Outside preschool		Preschool		Total
	g/day	%	g/day	%	g/day
Vegetables, vegetable dishes	50	50	50	50	100
fresh vegetables and vegetable salads	35	53	32	47	67
vegetarian dishes	9	37	15	63	24
side dish vegetables	5	60	3	40	8
Potatoes, potato dishes	20	32	42	68	62
Fruit, berries, fruit and berry products	93	52	85	48	179
fresh fruit	66	71	27	29	93
berries	4	91	0.4	9	5
fruit and berry soups	6	15	33	85	39
100% juice	9	56	7	44	16
Cereals, bakery products	93	34	180	66	273
rye bread	6	37	11	63	17
rye crispbread	1	12	11	88	12
multi-grain bread	9	31	21	69	30
white bread	3	52	3	48	6
porridge	33	22	115	78	147
rice, pasta, etc.	20	67	10	33	30
buns, sweet bakery products	4	90	0.5	10	5
biscuits and muesli bars	3	84	1	16	4
savoury bakery products, hamburgers, pizza	7	76	2	24	10
pancakes, crêpes	3	34	5	66	8
Fats, oils, gravy	7	24	21	76	28
margarine and fat spread	2	12	16	88	18
blended spread	2	100	0	0	2
butter	0.2	100	0	0	0.2
Fish, fish dishes	11	30	25	70	35
Eggs, egg dishes	2	51	2	49	5
Meat, meat dishes	74	46	87	54	161
cold cuts	3	51	2	49	5
red meat dishes	51	51	48	49	99
poultry dishes	15	39	24	61	39
sausage dishes	5	29	12	71	17
Milk, dairy products	236	40	352	60	589
skimmed milk	79	23	265	77	344
milk with 1-1.5% fat content	84	63	50	37	134
whole milk	5	100	0	0	5
sour milk	3	37	5	63	8
milk with cocoa	10	77	3	23	14
yoghurt and Finnish cultured milk	37	78	10	22	47
cheese	7	64	4	36	11
dairy-based desserts	7	35	14	65	21
ice-cream	3	84	1	16	4
Sugar, sweets	4	81	1	19	5
Drinks	100	68	47	32	147
water	55	66	29	34	83
sugar-sweetened juice	23	82	5	18	28
sugar-sweetened soda	4	100	0	0	4
non-dairy milk substitutes	10	47	12	53	22
Miscellaneous	7	74	2	26	9

Table 3. Mean food consumption on preschool days (Monday to Friday) of 5- to 6-year-old Finnish children who eat three meals at preschool (n=233). Main food groups (bold) and selected sub-groups are presented.

	Outside preschool		Preschool		Total
	g/day	%	g/day	%	g/day
Vegetables, vegetable dishes	53	46	62	54	115
fresh vegetables and vegetable salads	38	49	39	51	77
vegetarian dishes	11	37	19	63	29
side dish vegetables	4	49	4	51	8
Potatoes, potato dishes	22	30	51	70	73
Fruit, berries, fruit and berry products	113	57	86	43	199
fresh fruit	64	68	30	32	93
berries	8	94	1	6	9
fruit and berry soups	12	31	28	69	40
100% juice	17	67	9	33	26
Cereals, bakery products	102	32	212	68	314
rye bread	7	43	10	57	17
rye crispbread	1	8	12	92	13
multi-grain bread	11	34	22	66	33
white bread	4	42	5	58	9
porridge	33	19	139	81	172
rice, pasta, etc.	22	66	11	33	34
buns, sweet bakery products	3	83	1	17	4
biscuits and muesli bars	3	70	1	30	4
savoury bakery products, hamburgers, pizza	10	72	4	28	14
pancakes, crêpes	2	27	6	73	8
Fats, oils, gravy	7	22	24	78	31
margarine and fat spread	2	11	18	89	20
blended spread	2	99	0	1	2
butter	0.2	100	0	0	0.2
Fish, fish dishes	16	37	27	63	42
Eggs, egg dishes	3	57	2	42	5
Meat, meat dishes	82	44	103	56	185
cold cuts	3	47	3	53	6
red meat dishes	58	50	57	50	115
poultry dishes	15	32	31	68	46
sausage dishes	6	35	11	65	16
Milk, dairy products	258	40	391	60	649
skimmed milk	100	26	284	74	384
milk with 1-1.5% fat content	67	52	63	48	130
whole milk	6	100	0	0	6
sour milk	8	55	6	45	14
milk with cocoa	11	62	7	38	18
yoghurt and Finnish cultured milk	44	83	9	17	53
cheese	8	65	4	35	12
dairy-based desserts	10	39	16	61	26
ice-cream	4	77	1	23	5
Sugar, sweets	8	83	2	17	10
Drinks	95	64	53	36	148
water	44	54	37	46	82
sugar-sweetened juice	29	77	9	23	38
sugar-sweetened soda	9	100	0	0	9
non-dairy milk substitutes	7	56	5	44	12
Miscellaneous	7	75	2	25	10

Table 4. Mean (SD) intake and population proportion [24] of energy and nutrients on weekdays among 3 to 4-year-old children who eat three meals at preschool (n=324). Each child had data for 1 to 4 days; the total number of days was 561.

	Breakfast, outside preschool	Breakfast, preschool	Lunch, preschool	Afternoon snack, preschool	Dinner, outside preschool	Evening snack, outside preschool	Other snack, outside preschool	Preschool food, total	Total, per day
% of days that included the meal	24	100	100	100	95	91	50		
Energy, MJ	0.13 (0.27)	0.77 (0.29)	1.37 (0.51)	0.90 (0.36)	1.15 (0.51)	0.89 (0.49)	0.37 (0.5)	3.04 (0.83)	5.59 (1.1)
Protein, g	1 (2)	7 (3)	15 (7)	8 (3)	15 (7)	8 (5)	2 (4)	31 (10)	56 (13)
Carbohydrate, g	4 (9)	24 (10)	35 (13)	29 (13)	26 (13)	28 (15)	13 (17)	88 (25)	159 (34)
Sucrose, g	1 (3)	2 (3)	2 (2)	7 (6)	3 (4)	7 (6)	5 (8)	11 (8)	27 (14)
Added sugar, g	1 (3)	1 (3)	1 (2)	6 (6)	2 (4)	6 (6)	5 (8)	8 (7)	21 (13)
Fibre, g	0.4 (0.9)	2.8 (1.5)	3.7 (1.5)	2.6 (1.5)	2.1 (1.4)	2.7 (2)	0.9 (1.5)	9.1 (3.1)	15.3 (4.6)
Fat, g	1 (2)	6 (4)	13 (6)	7 (4)	12 (6)	7 (6)	3 (5)	25 (9)	47 (13)
SAFA, g	0.4 (1.1)	1.8 (1.2)	4.1 (2.3)	2.5 (1.7)	4.3 (2.9)	2.9 (2.5)	1.3 (2.3)	8.4 (3.5)	17.3 (5.3)
MUFA, g	0.3 (0.8)	2 (1.5)	4.8 (2.6)	2.3 (1.4)	4.1 (2.5)	2.1 (2.1)	0.9 (1.8)	9.1 (3.7)	16.5 (5.1)
PUFA, g	0.1 (0.4)	1.2 (0.9)	2.5 (1.4)	1.3 (0.9)	1.6 (1.2)	0.9 (1.1)	0.4 (0.7)	4.9 (2.1)	8 (2.9)
Vitamin A, µg RAE	12 (52)	71 (56)	144 (126)	96 (104)	191 (517)	73 (104)	26 (79)	311 (185)	613 (568)
Vitamin D, µg	0.2 (0.6)	2.4 (1.2)	2.8 (1.5)	2.2 (1.1)	1.6 (1.5)	1.4 (1.2)	0.3 (0.7)	7.4 (2.8)	10.9 (3.7)
Vitamin E, mg	0.1 (0.4)	1.0 (0.6)	1.8 (1.0)	1.1 (0.7)	1.3 (0.8)	0.9 (0.9)	0.3 (0.6)	3.9 (1.5)	6.5 (2.1)
Thiamine, mg	0.02 (0.04)	0.10 (0.05)	0.27 (0.14)	0.11 (0.05)	0.20 (0.12)	0.12 (0.08)	0.03 (0.06)	0.47 (0.17)	0.84 (0.22)
Riboflavin, mg	0.04 (0.1)	0.29 (0.13)	0.39 (0.15)	0.3 (0.14)	0.37 (0.22)	0.28 (0.19)	0.07 (0.13)	0.98 (0.33)	1.74 (0.51)
Niacin eq., mg	0.4 (0.9)	2.5 (1.1)	5.5 (2.8)	2.4 (1)	5.6 (2.9)	2.5 (1.6)	0.7 (1.2)	10.4 (3.6)	19.5 (4.8)
Vitamin B6, mg	0.0 (0.1)	0.1 (0.1)	0.3 (0.2)	0.2 (0.1)	0.3 (0.1)	0.2 (0.2)	0.1 (0.1)	0.6 (0.2)	1.2 (0.3)
Folate, µg	4 (9)	21 (11)	42 (19)	24 (11)	34 (37)	23 (17)	7 (12)	87 (29)	154 (55)
Vitamin B12, µg	0.1 (0.2)	0.6 (0.3)	1.1 (0.7)	0.6 (0.3)	1.5 (2.5)	0.6 (0.9)	0.1 (0.3)	2.3 (1)	4.5 (2.9)
Vitamin C, mg	2 (6)	8 (9)	14 (9)	12 (18)	14 (15)	11 (14)	5 (11)	33 (23)	65 (35)
Salt, g	0.1 (0.2)	1.0 (0.5)	1.6 (0.7)	0.6 (0.3)	1.3 (0.7)	0.6 (0.4)	0.2 (0.3)	3.2 (1.1)	5.3 (1.4)
Potassium, mg	62 (130)	338 (126)	813 (332)	371 (152)	583 (303)	373 (211)	117 (177)	1521 (462)	2656 (610)
Phosphorous, g	26 (62)	198 (79)	291 (103)	194 (84)	250 (124)	181 (114)	46 (79)	684 (197)	1187 (281)
Calcium, mg	26 (67)	178 (80)	206 (90)	190 (94)	186 (116)	179 (129)	44 (87)	573 (197)	1007 (306)
Magnesium, mg	6 (14)	42 (17)	65 (22)	39 (17)	47 (23)	38 (23)	12 (18)	147 (41)	250 (54)
Iron, mg	0.2 (0.5)	1.2 (0.6)	1.9 (0.8)	0.9 (0.5)	1.7 (1.1)	1.1 (0.8)	0.3 (0.5)	4.1 (1.4)	7.3 (2)
Zinc, mg	0.2 (0.5)	1.2 (0.6)	2.1 (0.9)	1.2 (0.6)	2.0 (1)	1.2 (0.8)	0.3 (0.5)	4.5 (1.5)	8.1 (2)
Iodine, µg	3 (10)	40 (19)	47 (27)	27 (14)	46 (25)	26 (18)	6 (12)	114 (43)	195 (57)
Energy, %	2	14	24	16	21	16	7	54	100
Protein, %	2	13	27	14	27	13	4	54	100
Carbohydrates, %	3	15	22	18	16	18	8	55	100
Sucrose, %	4	8	8	25	10	26	19	41	100
Added sugar, %	4	7	4	28	9	27	22	39	100
Fibre, %	3	19	25	17	14	18	6	60	100
Fat, %	2	12	27	14	24	15	6	53	100
SAFA, %	2	11	24	14	25	17	8	49	100
MUFA, %	2	12	29	14	25	13	6	55	100
PUFA, %	2	15	30	16	20	12	5	61	100
Vitamin A, %	2	12	23	16	31	12	4	51	100
Vitamin D, %	2	22	25	20	15	13	3	68	100
Vitamin E, %	2	15	28	17	20	13	5	60	100
Thiamine, %	2	12	32	13	24	14	4	56	100
Riboflavin, %	2	17	22	17	21	16	4	56	100
Niacin eq., %	2	13	28	12	29	13	3	53	100
Vitamin B6, %	3	12	28	13	23	16	5	52	100
Folate, %	2	14	27	15	22	15	4	56	100
Vitamin B12, %	2	13	25	13	33	13	3	50	100
Vitamin C, %	3	12	21	18	21	18	7	50	100
Salt, %	1	20	29	11	24	11	3	60	100
Potassium, %	2	13	31	14	22	14	4	57	100
Phosphorous, %	2	17	25	16	21	15	4	58	100
Calcium, %	3	18	20	19	18	18	4	57	100
Magnesium, %	2	17	26	16	19	15	5	59	100
Iron, %	2	16	27	13	23	15	4	56	100
Zinc, %	2	15	26	14	24	14	4	56	100
Iodine, %	2	21	24	14	23	13	3	58	100

eq., equivalents; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; RAE, retinol activity equivalents; SAFA, saturated fatty acids.

Table 5. Mean (SD) intake and population proportion [24] of energy and nutrients on weekdays among 5 to 6-year-old children who eat three meals at preschool (n=233). Each child had data for 1 to 4 days; the total number of days was 405.

	Breakfast, outside preschool	Breakfast, preschool	Lunch, preschool	Afternoon snack, preschool	Dinner, outside preschool	Evening snack, outside preschool	Other snack, outside preschool	Preschool food, total	Total, per day
% of days that included the meal	27	100	100	100	95	88	50		
Energy, MJ	0.17 (0.35)	0.85 (0.28)	1.58 (0.61)	1.03 (0.42)	1.34 (0.65)	0.93 (0.54)	0.47 (0.58)	3.46 (0.94)	6.37 (1.25)
Protein, g	1 (3)	8 (3)	18 (8)	9 (4)	17 (9)	8 (5)	2 (4)	35 (11)	64 (16)
Carbohydrate, g	6 (10)	27 (10)	40 (14)	33 (15)	31 (17)	29 (18)	17 (22)	99 (27)	182 (42)
Sucrose, g	2 (4)	2 (3)	3 (3)	8 (7)	3 (5)	7 (6)	7 (11)	13 (9)	32 (17)
Added sugar, g	1 (4)	1 (3)	2 (3)	7 (7)	3 (6)	5 (6)	7 (13)	10 (9)	27 (19)
Fibre, g	0.5 (0.9)	3.2 (1.7)	4.2 (1.7)	2.7 (1.4)	2.3 (1.5)	2.9 (2.3)	1 (1.5)	10.1 (3.4)	16.7 (4.7)
Fat, g	1 (4)	6 (3)	15 (7)	8 (4)	13 (8)	7 (6)	3 (6)	29 (10)	54 (14)
SAFA, g	0.5 (1.7)	1.9 (1.3)	4.8 (2.5)	3 (2)	4.8 (3.4)	3 (2.6)	1.4 (2.4)	9.8 (4)	19.5 (6.2)
MUFA, g	0.4 (1.2)	2.1 (1.3)	5.6 (2.9)	2.8 (1.7)	4.8 (3.1)	2 (1.9)	1.1 (2)	10.5 (4)	18.8 (5.3)
PUFA, g	0.2 (0.6)	1.2 (0.8)	3 (1.8)	1.5 (0.9)	2 (1.6)	1 (1.1)	0.5 (1)	5.7 (2.4)	9.4 (3.1)
Vitamin A, µg RAE	9 (26)	73 (54)	212 (289)	105 (87)	167 (584)	73 (123)	20 (44)	389 (315)	659 (654)
Vitamin D, µg	0.2 (0.7)	2.5 (1.2)	3.1 (2.4)	2.6 (1.3)	1.9 (1.9)	1.5 (1.3)	0.3 (0.7)	8.2 (3.7)	12.1 (4.7)
Vitamin E, mg	0.2 (0.5)	1.0 (0.6)	2.2 (1.4)	1.3 (0.6)	1.5 (1.2)	0.9 (0.9)	0.4 (0.6)	4.5 (1.8)	7.5 (2.4)
Thiamine, mg	0.02 (0.06)	0.11 (0.06)	0.3 (0.17)	0.12 (0.05)	0.23 (0.14)	0.13 (0.10)	0.04 (0.06)	0.53 (0.21)	0.95 (0.28)
Riboflavin, mg	0.05 (0.11)	0.31 (0.14)	0.45 (0.19)	0.34 (0.15)	0.4 (0.27)	0.3 (0.21)	0.08 (0.13)	1.1 (0.37)	1.93 (0.59)
Niacin eq., mg	0.5 (1.3)	2.8 (1.1)	6.2 (3.5)	2.7 (1.2)	6.2 (3.2)	2.8 (1.9)	0.8 (1.3)	11.7 (4.3)	22 (6.3)
Vitamin B6, mg	0.0 (0.1)	0.2 (0.1)	0.4 (0.2)	0.2 (0.1)	0.3 (0.2)	0.2 (0.2)	0.1 (0.2)	0.7 (0.3)	1.3 (0.4)
Folate, µg	5 (10)	24 (14)	51 (39)	25 (11)	35 (43)	26 (18)	8 (11)	100 (48)	174 (67)
Vitamin B12, µg	0.1 (0.3)	0.6 (0.4)	1.3 (1.1)	0.7 (0.3)	1.5 (2.9)	0.6 (0.4)	0.1 (0.3)	2.5 (1.3)	4.8 (3.4)
Vitamin C, mg	3 (10)	9 (11)	16 (9)	11 (9)	14 (13)	15 (20)	7 (14)	35 (19)	74 (38)
Salt, g	0.1 (0.4)	1.2 (0.5)	1.8 (0.8)	0.7 (0.3)	1.4 (0.7)	0.7 (0.5)	0.2 (0.3)	3.6 (1.2)	6.0 (1.6)
Potassium, mg	74 (155)	381 (148)	935 (399)	410 (167)	661 (345)	403 (264)	136 (188)	1726 (557)	2999 (797)
Phosphorous, g	32 (78)	217 (80)	333 (135)	217 (95)	280 (148)	196 (130)	50 (78)	767 (231)	1326 (347)
Calcium, mg	29 (74)	189 (89)	232 (100)	211 (114)	210 (142)	192 (141)	49 (85)	632 (228)	1113 (358)
Magnesium, mg	7 (14)	47 (17)	74 (28)	43 (18)	52 (26)	40 (28)	14 (19)	164 (46)	278 (65)
Iron, mg	0.2 (0.4)	1.3 (0.7)	2.2 (1.1)	1.0 (0.5)	1.9 (1.5)	1.1 (0.8)	0.4 (0.6)	4.6 (1.6)	8.2 (2.4)
Zinc, mg	0.2 (0.5)	1.4 (0.6)	2.4 (1.2)	1.3 (0.6)	2.3 (1.3)	1.3 (0.8)	0.3 (0.5)	5.0 (1.8)	9.1 (2.5)
Iodine, µg	5 (12)	45 (19)	53 (34)	31 (14)	52 (31)	28 (21)	7 (12)	128 (48)	220 (69)
Energy, %	3	13	25	16	21	15	7	54	100
Protein, %	2	13	28	14	27	13	4	55	100
Carbohydrates, %	3	15	22	18	17	16	9	54	100
Sucrose, %	5	7	9	24	11	22	22	39	100
Added sugar, %	5	6	6	26	10	21	27	37	100
Fibre, %	3	19	25	16	13	17	6	61	100
Fat, %	2	11	28	15	25	13	6	54	100
SAFA, %	3	10	25	15	25	15	7	50	100
MUFA, %	2	11	30	15	26	11	6	56	100
PUFA, %	2	13	32	16	21	10	5	61	100
Vitamin A, %	1	11	32	16	25	11	3	59	100
Vitamin D, %	2	20	26	21	16	12	2	68	100
Vitamin E, %	2	14	29	17	20	12	5	60	100
Thiamine, %	2	12	31	12	24	14	4	56	100
Riboflavin, %	3	16	23	17	21	16	4	57	100
Niacin eq., %	2	13	28	12	28	13	4	53	100
Vitamin B6, %	3	12	28	13	23	14	7	53	100
Folate, %	3	14	29	14	20	15	5	58	100
Vitamin B12, %	2	13	26	14	31	12	2	53	100
Vitamin C, %	5	12	21	14	19	20	9	48	100
Salt, %	2	19	29	12	23	11	3	60	100
Potassium, %	2	13	31	14	22	13	5	58	100
Phosphorous, %	2	16	25	16	21	15	4	58	100
Calcium, %	3	17	21	19	19	17	4	57	100
Magnesium, %	3	17	27	15	19	15	5	59	100
Iron, %	2	16	27	13	23	13	5	56	100
Zinc, %	2	15	26	14	25	14	4	55	100
Iodine, %	2	20	24	14	24	13	3	58	100

eq., equivalents; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; RAE, retinol activity equivalents; SAFA, saturated fatty acids.

Table 6. Energy-yielding nutrient intakes [mean, (SD)] during preschool hours and the whole day (Monday to Friday) of children who eat three meals at preschool.

	Finnish recommendation for served preschool meals	3- to 4-year-olds (n=324)		5- to 6-year-olds (n=233)	
		Preschool	Total	Preschool	Total
Carbohydrates, E%	45–60	49 (6)	49 (5)	49 (5)	49 (5)
Sucrose, E%		6.1 (4)	8.1 (3.8)	6.2 (3.9)	8.5 (4.1)
Added sugar, E%	<10	4.5 (3.6)	6.2 (3.5)	4.8 (3.8)	7.0 (4.6)
Protein, E%	10–15	17 (3)	17 (2)	17 (3)	17 (3)
Fat, E%	30–40	30 (7)	31 (5)	31 (6)	31 (5)
Saturated fatty acids, E%	<10	10.1 (2.8)	11.4 (2.4)	10.3 (2.6)	11.3 (2.6)
Monounsaturated fatty acids, E%		11.0 (2.8)	10.9 (2.1)	11.1 (2.5)	10.9 (2.1)
Polyunsaturated fatty acids, E%		6.0 (1.8)	5.3 (1.3)	6.1 (1.7)	5.4 (1.4)
Fibre g/MJ		3.0 (0.8)	2.7 (0.7)	3.0 (0.7)	2.7 (0.7)

E%, percentage of the total energy.

273 fatty acids, and vitamins D and E. Salt intake was too high overall, and 60% of salt came from preschool
274 food.

275 The results show that the most typical meal pattern of a Finnish preschool child consists of five
276 meals per day: breakfast, lunch, afternoon snack, dinner, and evening snack. Small snacking also
277 occurred outside these meals. Although lunch and dinner were the main meals, more than half of
278 the total daily energy was consumed during the other meals. In a study of Dutch children, lunch and
279 dinner together had a higher share of total energy than that in our study and other meals accounted for
280 about 44% of the daily energy [8]. In our study, each of the three smaller meals (breakfast at preschool,
281 afternoon snack at preschool and evening snack outside preschool) provided a similar share of energy.
282 Common anecdotes on the importance of breakfast should not obscure the fact that, based on energy
283 intake, afternoon and evening snacks are as important as breakfast in the diet of Finnish preschoolers.
284 Thus, breakfast, afternoon snack, and evening snack deserve equal attention with regard to healthy
285 food choices.

286 In our study, the total daily energy intake on weekdays for three- to four-year-olds was 5.6 MJ,
287 which is comparable with the results of Goldbohm et. al. [26] in the Netherlands, in which the mean
288 daily total energy intake for three-year-old children attending day care was 5.8 MJ. We found that
289 preschool meals did not cover two thirds of the daily energy, which is the target level set in the Finnish
290 recommendation for ECEC food services [15]. The distribution of energy between day care and home
291 among three-year-old children in the Netherlands was similar to that in our findings; their energy
292 intake in day care was about 3.0 MJ/d and the daily total 5.9 MJ [8].

293 The distribution of the consumption of fish between home and ECEC has seldom been reported.
294 Lehtisalo et al. [10] found more consumers of fish among Finnish children who attended ECEC than
295 among children taken care of at home. In our study, the consumption of fish dishes at preschool was
296 over twice that consumed at home. Our results concerning fresh fruit consumption contradict those of
297 previous studies in the Netherlands [8] and Oklahoma, USA [9], which found higher consumption in
298 ECEC than at home. Overall, there is room to increase fruit intake at Finnish preschools.

299 Our study supports previous findings that more low-fat dairy products [9,10] and more vegetable
300 oil-based spreadable fats [10] are consumed in ECEC than at home. Despite this positive finding,
301 the mean proportion of energy from saturated fatty acids exceeded the recommendation for ECEC
302 food services (<10 E%). Meat and meat dishes, along with spreadable fats, were important sources of
303 saturated fatty acids. An increased amount of vegetarian main courses, if well accepted by the children
304 and if prepared without ingredients high in saturated fatty acids such as cheese, might be one strategy
305 to improve the fatty acid profile as well as to increase vegetable consumption at preschools. However,
306 it should be noted that about half of the saturated fatty acid intake (but less than half of the energy
307 intake) occurred outside preschool.

308 Bread consumption (largely as whole grain-bread) and along with it, also margarine/fat spread
309 consumption, were relatively high at preschool. This combination provided large shares of nutrients

310 such as fibre; folate; unsaturated fatty acids; and vitamins A, D, and E. On the other hand, bread with
311 margarine/fat spread also contributed significantly to the saturated fatty acid and salt intakes, both
312 of which should be reduced. Margarines with 60% fat content generally contain 16–18 g of saturated
313 fatty acids/100g [27] and the development of products with an even lower saturated fatty acid content
314 could be useful in reducing the saturated fatty acid intake. Since flour is not fortified in Finland, white
315 bread was not a relevant source of total folate (including folic acid).

316 We found that protein intake was higher at preschool than recommended, and milk and dairy
317 products and meat and meat dishes were important sources of protein. Finnish food-based dietary
318 guidelines state that, over the day, 4 dl of fluid milk products (e.g. milk, sourmilk, yogurt, Finnish
319 cultured milk) and one slice of cheese is enough for preschool-aged children [16]. Our results show
320 that on average, this is exceeded on weekdays. It might be possible to adjust the protein content and
321 type (animal vs. plant protein) of preschool meals by reducing the amount of milk and adding more
322 vegetarian dishes to the menu.

323 In our study, the percentage of energy from added sugar at preschool was well within the limits
324 of the recommendation (<10 E%) [15]. Strategies to limit the use of added sugar in the food services at
325 the participating preschools included, for example, sweetening plain yogurt with only fruit and berry
326 purees. The main sources of added sugar outside preschool were sugar-sweetened dairy products,
327 beverages, bakery products, and sweets and chocolate. At preschool, a considerably smaller amount
328 of added sugar came from these food groups. In contrast to our results, some previous studies have
329 found that sweet snacks are more often consumed in ECEC than at home [8,11]. When interpreting the
330 results of our study, it is important to note that we did not include weekend days, which are likely to
331 include more sugary products, in the analysis. We found that the mean density of fibre was 3 g/MJ at
332 preschool in both age groups. In the Netherlands, three-year-olds on average ate a total of 13 g of fibre
333 per day, of which 7.2 g was at day care [8], which is slightly lower than in our sample.

334 The total daily salt intake of two- to ten-year-old children should not exceed 3 to 4 g/day [16]
335 and the intake at preschool should not exceed 2 to 2.6 g/day [15]. We found that the mean salt intake
336 on weekdays far exceeded these recommendations. In Belgium, the total sodium intake of preschool
337 children also greatly exceeded the acceptable range [28]. In Portugal, children eating preschool meals
338 had a total intake of salt of about 6.3 g/day [29]. In our study, cereals and bakery products were the
339 main source of salt at preschool. Meat and meat dishes were also an important source of salt both at
340 and outside preschool. Preschool food services should reduce the sodium content in their porridge
341 and main course recipes, and offer low-sodium bread.

342 A limitation of the study was the low participation rate in the DAGIS cross-sectional survey (24%)
343 and the fact that the strict inclusion criteria further limited the sample used in the analyses for this
344 paper. The data also includes siblings, meaning that when means were calculated, some families had
345 a larger representation than others. The estimate of salt intake at home may be more prone to bias
346 than that at preschool due to the fact that in the home dishes, salt content estimates were based on
347 typical Finnish recipes in the database, whereas at preschool, the salt content of the dishes was, for
348 most municipalities, based on recipes provided by the food services. A strength of this study was its
349 comparatively large sample. Its methodological strengths included the use of a picture book that was
350 specifically designed for use in children's portion size estimation. This has been used with similar
351 accuracy by parents and ECEC personnel in a validity study [20]. Detailed information on the recipes
352 and products used at preschools further aided the careful analysis of the diet.

353 Meal planning in ECEC food services may have an important influence on the formation of dietary
354 habits and long-term effects on the health of children. Only a few previous studies have examined
355 how different meals at ECEC and at home contribute to the diets of children. Although our study was
356 a single-time cross-sectional study, the results are useful for the purposes of nutritional education,
357 communication and policy target setting for further developing the dietary quality of preschool meals.
358 A long-term monitoring system of the actual dietary intake at preschools in Finland would be even
359 more effective. As Lucas et al. [30] point out, such monitoring would allow the evaluation of how

360 changes in policy and guidance actually affect children's intakes. As an example, possible changes in
361 milk consumption should be accompanied by an analysis of their effects on the overall diet, as milk is
362 an important source of a variety of nutrients in Finnish children's diets.

363 5. Conclusions

364 Finland provides preschool meals free of charge and the law requires the served food to be healthy.
365 We found that Finnish children who attend full-time care eat preschool meals that contribute significant
366 shares of favourable food groups and nutrients to their total weekday diet. Salt intake, however, was
367 high at preschool and exceeded the recommendation. Thus, tackling salt intake is an important goal
368 for guidance. In addition, fruit consumption and vegetarian food consumption at preschool could be
369 increased. The intake of protein and saturated fatty acids also needs to be monitored.

370 **Supplementary Materials:** The following are available online at <http://www.mdpi.com/2072-6643/xx/1/5/s1>:
371 Tables S1 and S2: Mean (SD) intake and population proportion of energy and nutrients on weekdays among 3- to
372 4-year-old/5- to 6-year-old children who eat three meals at preschool. Results for days when the child
373 ate the meal. Tables S3-S58: Sources of energy and nutrients (mean and population proportion) in the diet on
374 weekdays among Finnish 3- to 4-year-old/5- to 6-year-old preschool children who eat three meals at preschool.
375 Main food groups and selected food groups are presented.

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