

## Convenience food in the diet of children and adolescents: consumption and composition

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Despite an increasing trend towards the use of convenience food, there is to date little debate on it in the nutritional sciences. In the present study, we present and evaluate data on consumption frequencies and composition of savoury convenience food in German families using data from the Dortmund Nutritional and Anthropometric Longitudinally Designed (DONALD) Study. The DONALD Study is an ongoing, longitudinal (open cohort) study (started 1985), collecting detailed data on diet, development, and metabolism in infants, children and adolescents. Dietary intake was measured by yearly repeated 3 d weighed dietary records ( $n$  1558) in 554 subjects (278 boys; 276 girls), 3–18 years old, between 2003 and 2006. A total of 1345 (86%) 3 d dietary records mentioned consumption of at least one convenience food. Convenience food consumption (percentage of total food intake, g/d) increased with age from approximately 3% in the 3–8 year olds to 7% in 14–18-year-old boys and 5% in 14–18-year-old girls ( $P < 0.0001$ ) but remained constant during the study period. Convenience foods contributed more to total fat (g/d) ( $P < 0.001$ ) and less to total carbohydrate ( $P < 0.0001$ ) than to total energy (kJ/d) intake. The 700 convenience-food products recorded by our sample had on average fourteen ingredients; 4% were flavourings and 16% were food additives. In conclusion, convenience foods were widely consumed by our sample of German children and adolescents and their consumption increased with age. The composition of convenience food was characterised by a high fat content and a high number of flavourings and food additives.

**Convenience food: Energy: Macronutrients: Children: Adolescents: Dietary records**

Consumer researchers have reported an increasing trend towards the use of convenience food (CF) products in Germany during the last few decades. For instance, the per capita consumption of frozen CF increased from 0.4 kg in 1960 to 29 kg in 2000<sup>1</sup>. This development is attributed to several social changes, for example, the increasing number of single or small family households, the increasing number of women in employment, a social trend towards more leisure time, or the break-up of traditional family mealtimes, and an altogether increase in the demand for easily prepared and just-in-time meals<sup>1,2</sup>. Simultaneously, the technical equipment of household kitchens (freezer, microwave) has increased, and food preparation skills have decreased<sup>3</sup>.

Up to the present, the scientific literature on CF has concentrated mainly on the microbiological properties or consumer attitudes<sup>4,5</sup>. Usually, dietary surveys do not distinguish between homemade and industrially pre-prepared food. To our knowledge, no systematic evaluation of the consumption patterns and composition of CF in families exists. Therefore, the objectives of the present dietary analysis were (1) to quantify the consumption of CF in children and adolescents, (2) to describe the age and time trends of CF consumption and the contribution of CF to daily energy and macronutrient intake, and (3) to evaluate the ingredients, the energy, and

macronutrient composition of the CF products, using data from the Dortmund Nutritional and Anthropometric Longitudinally Designed (DONALD) Study.

### Methods

#### Study design

The DONALD Study is an ongoing, longitudinal (open cohort) study collecting detailed data on diet, growth, development and metabolism between infancy and adulthood since 1985. Details have been published elsewhere<sup>6</sup>.

In short, the starting study sample included infants, children and adolescents recruited from cross-sectional studies conducted in schools and kindergartens ( $n$  about 470). Since 1989, infants are recruited and followed up longitudinally at least until the age of 18 years.

The regular DONALD assessments include records of dietary intake and behaviour, anthropometry, urine sampling, interviews on lifestyle and health-related issues, and medical examination, once per year per study participant  $\geq 2$  years<sup>6</sup>. All examinations and assessments are performed with parental and/or the subject's consent.

The DONALD Study, which is exclusively observational and non-invasive, has been approved by the International

**Abbreviations:** CF, convenience food; DONALD, Dortmund Nutritional and Anthropometric Longitudinally Designed.

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Scientific Committee of the Research Institute of Child Nutrition and the Ethics Commission of the University of Bonn.

#### Study sample

For the present evaluation, we analysed 3 d dietary records of subjects aged 3–18 years in the study period of 2003 to 2006. This selection resulted in 1558 records from 554 subjects (278 boys, 276 girls). Per participant, one ( $n$  101; 18% of the total sample), two ( $n$  96; 17%), three ( $n$  163; 29%) or four ( $n$  194; 35%) 3 d records were available and analysed, with one record per year and subject. Per study year, 423 dietary records were available for 2003, 413 for 2004, 404 for 2005, and 318 for 2006.

#### Dietary survey

Parents of younger subjects and older subjects themselves weighed and recorded all foods and beverages consumed using electronic food scales ( $\pm$  1 g) on three consecutive days. In addition, the medicines and supplements taken on these days were recorded as well. Semi-quantitative recording (for example, number of spoons, scoops) was allowed when weighing was not possible. The complete food collection details have been described elsewhere<sup>7</sup>.

Energy and nutrient intakes were calculated using our nutrient database, LEBTAB, which undergoes continuous update for all new food items. LEBTAB is based on standard nutrient tables, predominantly the German (48% of items) and the USA (18% of items) tables<sup>8</sup>.

In the case of composite foods, in particular commercial food products (for example, CF products), the nutrient contents were estimated by recipe simulation using labelled nutrient contents and ingredients. To facilitate this, our dietitians collect the food ingredients labels and, if available, nutrient labels either when they visit the family to gather the records or complementing this by getting labels from the stores.

Energy and nutrient contents of the food products are calculated from such simulated recipes and entered into the LEBTAB database. The ingredients of the simulated recipes are also included in the database. For longitudinal analysis in the DONALD Study, LEBTAB is updated continuously for new foods recorded by the participants, if their composition is different from existent labels. A new food or a commercial food product that already exists in the database but has undergone a change in composition (i.e. new ingredients, fortification) leads to a new entry<sup>8</sup>.

At present, LEBTAB contains about 6000 food items (15% staple foods, 77% composites and commercial products including commercial infant food, and 8% special preparations, i.e. medicines, supplements). For the present evaluation, dietary supplements and pharmaceuticals were excluded.

#### Definition of convenience food

For the present evaluation, CF was defined as all prepared savoury products. Sweet CF were excluded, because of the heterogeneity of this food group (sweetened dairy products, cakes, biscuits, instant dessert powders, ice cream etc), which demands a separate evaluation. CF eaten at communal feeding, for example, in day-care centres, school, etc., and

frozen or canned pure vegetables, meat or fish without any other ingredients, for example, spices, cream or crumb, were excluded as well.

The CF were assigned to the following categories:

- (a) salad (including cold dishes with meat, fish, potatoes, rice, pasta);
- (b) fish dishes (including fish fingers, overlaid or coated fish);
- (c) potato dishes (including instant mashed potatoes, French fries);
- (d) vegetable dishes (including vegetables with spices, cream or fat additives or vegetarian dishes);
- (e) cold sauces (including mayonnaise, ketchup, salad dressings);
- (f) warm sauces (including tomato, curry or gravy sauces);
- (g) soups (including stews);
- (h) pasta and rice (including pasta with sauces, lasagne or paella);
- (i) pizza;
- (j) meat (including escalopes, meat balls, spiced meat);
- (k) miscellaneous (including wraps, burgers, hotdogs, spring rolls, baguettes au gratin).

CF products were classified by the kind of preservation, i.e. canned, deep-frozen or chilled, instant, and others. Instant CF were defined as products that are ready to eat after the addition of fluids only, for example, water or milk. Food packages, such as pasta with instant sauces, were also classified as instant CF.

#### Statistical analysis

SAS<sup>®</sup> procedures (version 8.2; SAS Institute, Inc., Cary, NC, USA) were used for data analysis. Food and nutrient intakes were calculated as individual means of the three recorded days.

To analyse the influence of effects (age, time trends) on the outcome variables (consumption of CF (g/d), contribution of CF to total energy (% kJ/d) and macronutrient intake (% g/d)) a mixed linear model was used, in which the means of the data and the covariance structure (children of the family, repeated measurements) were modelled (PROC MIXED). An exponential spatial structure of covariance was specified to consider correlation of repeated measurements dependent on the absolute time interval of repeated measurements within the same subject.

For the comparison of the contribution of CF to daily energy intake (% of total daily intake) and to daily macronutrient intakes (% of total daily intake), the individual differences between two variables (for example, % fat from CF out of total fat (g/d) – % energy from CF out of total energy intake (kJ/d)) were calculated. To test if these difference are significantly different from zero, a paired *t* test was used. A *P* value < 0.05 would show, that CF had a significant higher impact on fat intake, for example, than on energy intake.

## Results

### Consumption

In 1345 3 d dietary records (86% of all records) at least one CF was recorded. In 463 (30%) records, CF was recorded on one

single day of the three days, in 554 (36%) on two days, and in 328 (21%) on all the three recorded days.

Overall, 125 843 food items were recorded, i.e. 4314 different food items (for example, about 350 dairy products, 670 grain products and 450 beverages, i.e. mineral waters, fruit juice drinks, sodas). Of these items, 4056 (3%) were CF, representing 700 different product items (Table 1).

Regarding the type of food conservation, chilled or frozen CF products were the most popular (384 products), which were altogether consumed 1626 times (40% of all CF eating occasions). We found that 122 different instant CF products were consumed 569 times (14%) and 187 different canned CF products were consumed 1847 times (46%).

The amount of CF consumed (g/d) and energy (kJ/d) and macronutrient intake (g/d) from CF increased with age (Table 2). Consumption amounts when calculated as % of total intake (g/d, without beverages) also increased from approximately 3% in the 3–8 year olds to 7% in 14–18-year-old boys and 5% in 14–18-year-old girls. The percentage of subjects who ate  $\geq 20\%$  CF (g/d) also increased with age (3–8 years 1% ( $n$  8), 9–13 years 5% ( $n$  23), 14–18 years 9% ( $n$  40)). Simultaneously, energy (kJ/d) and macronutrient intakes (g/d) from CF, calculated as % of total intake, increased with age (Fig. 1). This positive age trend was significant for % consumption ( $\beta = +0.3\%$  per study year), % energy ( $\beta = +0.3\%$ ), % protein ( $\beta = +0.2\%$ ), % carbohydrates ( $\beta = +0.3\%$ ) and % fat ( $\beta = +0.4\%$ ) (results of PROC MIXED;  $P < 0.0001$  for all variables). Neither time trends during the study period nor sex differences of these variables were statistically significant.

As Fig. 1 shows, % protein from CF was near the values for % energy over the total age period, % fat from CF was higher and % carbohydrates from CF was lower than % energy. Table 3 shows the mean individual differences between % contribution of CF to energy (% energy) and the % contribution of CF to fat (% fat), protein (% protein) or carbohydrates (% carbohydrates) in the total sample.

**Table 1.** Consumption frequency and product diversity of convenience food in the diet of 554 3–18-year-old children and adolescents from the Dortmund Nutritional and Anthropometric Longitudinally Designed Study, 2003–6 (1558 3 d records)

(Frequencies and percentages)

	Consumption frequency*		Product diversity†	
	<i>n</i>	(%)	<i>n</i>	(%)
Cold sauces	1536	38	79	11
Warm sauces	516	13	107	15
Vegetable dishes	416	10	69	10
Potato dishes	360	9	48	7
Fish dishes	306	8	55	8
Meat dishes	238	6	80	11
Pizza	198	5	70	10
Soups	154	4	73	10
Salads	167	4	27	4
Pasta/ and rice dishes	114	3	61	9
Miscellaneous	51	1	31	4

\* Number of eating occasions of convenience food respective categories, and percentage of all convenience food eating occasions ( $n$  4056).

† Number of different convenience food items in all records, and percentage of all recorded convenience food items ( $n$  700).

The paired  $t$  test showed that all these differences were statistically significantly different from zero.

#### Composition of convenience food: ingredients

The 700 different CF products consumed by the study sample consisted of 10 025 ingredients, an average fourteen ingredients per CF product. Of these, 203 CF (29%) had up to ten ingredients, 388 (55%) between eleven and twenty-one ingredients and 109 (16%) between twenty-two and thirty-six ingredients.

The median number of ingredients per product was similar by kind of preservation, with thirteen (range three to twenty-seven) ingredients in canned CF, fourteen (range three to thirty-six) in chilled or frozen CF, and fifteen (range two to thirty) in instant CF.

Very high ranges in the number of ingredients within the same type of dish were observed: for example, for pizza between five and thirty-six ingredients (median nineteen); for pasta and rice dishes between nine and thirty-three ingredients (median seventeen); for cold sauces between three and twenty-three ingredients (median thirteen).

Of the CF ingredients, 390 (4%) were flavourings and 1605 (16%) were food additives. From the latter, 264 (16% of all additives) were acidifiers, 261 (16%) modified starch, 258 (16%) thickening agents, 237 (15%) flavour enhancers, 154 (10%) colouring, 134 (8%) emulsifiers, 103 (6%) antioxidants, and ninety-one (6%) preserving agents. Of the products, 378 (54%) contained either flavourings and/or flavour enhancers.

Table 4 shows the most frequent ingredients in non-instant CF (chilled, frozen, canned). Only up to five different ingredients per food group make up at least 50% of all listed ingredients in the various groups. In approximately one-third of all listed fat or oil ingredients of non-instant CF the type of oil used was not specified on the label but only listed as 'vegetable oil'. Coconut oil with a high proportion of SFA was a popular ingredient in non-instant CF. Only five types of vegetables were found among the 50% of the most frequently listed vegetables. Only 206 products (36%) contained iodised salt.

#### Composition of convenience food: energy and macronutrient content

Table 5 shows the energy and nutrient content of non-instant CF products. Soups and vegetable dishes had the lowest median energy density (kJ/100 g), while the median energy density of cold sauces and pizzas was 2–3-fold higher. The median percentage energy from fat was above 35% energy in all categories and the highest in cold sauces and salads. The carbohydrate content (% energy) was highest in pasta and rice, and potato dishes, and lowest in meat dishes, cold sauces, and salads.

#### Discussion

The present study reports the widespread use of CF in the present-day diet of families in the DONALD Study. The high consumption frequencies (at least one use of CF in approximately four of five 3 d records) in the DONALD Study are in accordance with a recent report in Germany. In a questionnaire of 2200 families, only 3% declared never to use frozen

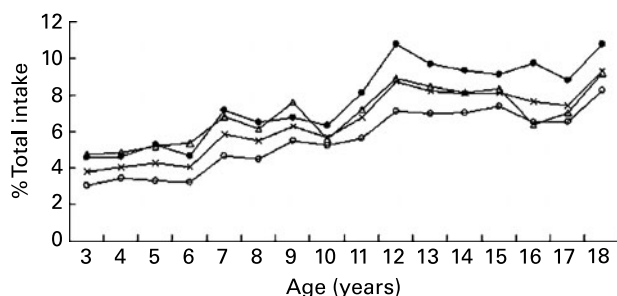
**Table 2.** Consumption amount and contribution of convenience food (CF) to energy and macronutrient intakes in the diet of 554 3–18-year-old children and adolescents of the Dortmund Nutritional and Anthropometric Longitudinally Designed Study, 2003–6 (Medians and interquartile ranges)

Age group...	Boys						Girls					
	3–8 years		9–13 years		14–18 years		3–8 years		9–13 years		14–18 years	
	Median	Q1, Q3	Median	Q1, Q3	Median	Q1, Q3	Median	Q1, Q3	Median	Q1, Q3	Median	Q1, Q3
3 d Dietary records (n)		341		214		221		342		233		207
Consumption (g/d)												
Total*	865	728, 1055	1099	912, 1328	1363	1096, 1682	804	694, 936	1020	863, 1205	1083	886, 1266
CF	26	4, 55	50	20, 114	88	32, 181	27	4, 62	51	13, 108	57	9, 110
Energy (kJ/d)												
Total	5243	4360, 6121	6937	6167, 8008	8690	7418, 10376	4803	4105, 5661	6280	5648, 7243	6745	5778, 7745
From CF	146	21, 364	360	100, 695	556	180, 1318	142	21, 360	322	79, 678	293	50, 774
Protein (g/d)												
Total	42	36, 51	59	52, 66	80	67, 99	39	33, 46	53	47, 62	56	48, 66
From CF	1	0, 4	3	0, 7	4	1, 12	1	0, 4	2	0, 7	2	0, 7
Fat (g/d)												
Total	52	42, 63	71	61, 82	87	74, 11	48	38, 59	64	52, 73	66	53, 79
From CF	2	0, 4	4	1, 9	7	2, 16	2	0, 4	4	1, 8	3	0, 8
Carbohydrates (g/d)												
Total	150	124, 181	199	170, 230	245	201, 289	140	116, 164	181	156, 211	192	161, 232
From CF	3	1, 8	8	2, 16	11	3, 30	2	0, 8	7	1, 17	7	1, 19

Q, quartile

\* Total food intake; beverages (for example, juice, water, tea, soda) were excluded.

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**Fig. 1.** Mean intakes (% total intake) of energy (kJ/d; ×), protein (g/d; Δ), carbohydrates (g/d; o) and fat (g/d; ●) from convenience food by age in the diet of 554 3–18-year-old children and adolescents from the Dortmund Nutritional and Anthropometric Longitudinally Designed (DONALD) Study, 2003–6 (1558 dietary records).

CF, 16% never used ready-to-eat meals and 14% ready-to-eat soups. On the other extreme, frozen CF were used in 22% of families several times per week, and ready-to-eat meals and soups in 9%.<sup>2</sup> In comparison with other European countries, the annual German per capita consumption of frozen CF (33 kg/year), which reflects a substantial part of CF, was lower than in Great Britain (48 kg), Sweden (45 kg) and Norway (42 kg), but higher than in France (30 kg), Spain (22 kg) or Italy (12 kg).<sup>1</sup>

During the study period of 2003–6, the intake of CF (as % total intake) remained stable. Either, the 4-year study period was too short to find a statistically significant trend, or the consumption of CF has reached a steady state. But with age, the consumption amount of CF (% total food intake) increased. To date, there has been no other evaluation of CF consumption in relation to age.

There is a lack of consensus about the definition of CF.<sup>2</sup> Berghofer<sup>3</sup> cited the *New Oxford Dictionary of English* that stated: ‘A convenience food is typically a complete meal, that has been pre-prepared commercially and so requires minimum further preparation by the consumer.’ This definition’s limitation on complete meals does not reflect modern dietary habits and the actual food market. Our analysis showed that also CF meal components, especially CF sauces, are very popular in families. These CF meal components might also affect the nutritional value of a meal and/or the total diet and therefore were included

**Table 3.** Differences in the contribution of convenience food to energy intake and intake of macronutrients in the diet of 554 3–18-year-old children and adolescents of the Dortmund Nutritional and Anthropometric Longitudinally Designed Study, 2003–6 (1558 3 d records) (Mean values and standard deviations)

Variable*	Difference in contribution		t	Pt
	Mean	SD		
% Fat – % energy	1.13	3.48	12.85	<0.0001
% Protein – % energy	0.44	3.98	4.38	<0.0001
% Carbohydrates – % energy	–0.95	2.60	–14.42	<0.0001

\* % Intake from convenience food of total intake.

† Paired t test.

**Table 4.** Most-frequently-contained ingredients of the canned, chilled or frozen convenience food products (n 571) consumed by 554 children and adolescents of the Dortmund Nutritional and Anthropometric Longitudinally Designed Study, 2003–6 (1558 3 d records) stratified by selected ingredient food groups (Numbers and percentages)

Ingredient subgroups*	Frequency	
	n	%†
Dairy products (n 586)		
Cheese (≥ 45% fat)‡	159	27
Cream, sour cream, crème fraiche	104	18
Mozzarella (16% fat)‡	58	10
Meat and sausage (n 275)		
Chicken meat	55	20
Minced meat (pork, beef)	38	14
Ham (raw, cooked)	39	14
Salami, saveloy	23	8
Fish (n 94)		
Saithe or coalfish	43	46
Tuna	8	9
Fats and oils (n 634)		
Vegetable oil	229	36
Coconut oil	111	18
Bread, cereal and meal (n 664)		
Wheat flour	325	49
Starch (maize, wheat, potato)	145	22
Vegetables and fruits (n 1387)		
Onions (fresh, dry)	223	16
Tomatoes (fresh, dry, canned)	256	18
Carrots (fresh, dry)	94	7
Paprika (fresh, dry)	65	5
Leek (fresh, dry)	49	4
Sweetening agents (n 719)§		
Sugar (saccharose)	350	49

\* Only those ingredients were listed that grouped together to at least 50% of the number of all ingredients in this food group. In some products, more than one ingredient of the subgroups is contained.

† Of all ingredients in the respective subgroup.

‡ In dry mass.

§ Exclusively artificial sweeteners.

in our present analysis. Additionally, a clear classification of the various CF into ‘complete meals’ v. ‘meal components’ was not always possible, since a CF pizza (a complete meal) could be combined with a fresh salad, and a CF salad (a meal component) could be eaten as a complete meal.

A more comprehensive definition of CF is available, which defines it as products that transfer time and activities of preparation from the household manager to the food processor<sup>9</sup>. This definition would also include bread, sausage or raw pasta. Thus, definitions of CF vary considerably in the available literature.

In spite of the widespread use of CF across Europe, published literature on CF is basically restricted to studies of CF marketing organisations. There is a lack of research data on CF from the fields of nutritional sciences and public health. A probable cause could be the lack of adequate food and nutrient databases including a representative proportion of CF products with the required information on their ingredients. In our sample, 700 different products were recorded in approximately 4500 record days. Energy and macronutrient content of different products varied remarkably, even within the same group of dishes.

The DONALD Study gives importance to obtaining information on the composition of commercial food products,



**Table 5.** Energy density and macronutrient proportion in 547 non-instant convenience food (CF) products recorded by 554 children and adolescents of the Dortmund Nutritional and Anthropometric Longitudinally Designed Study, 2003–6 (1558 3 d records)\*

(Medians and interquartile ranges)

CF category	CF foods (n)†	Energy (kJ/100 g)		Protein (% energy)		Fat (% energy)		Carbohydrates (% energy)	
		Median	Q1, Q3	Median	Q1, Q3	Median	Q1, Q3	Median	Q1, Q3
Meat dishes	77	808	565, 1008	28	22, 42	52	30, 62	19	11, 30
Cold sauces	76	954	619, 1443	2	1, 3	80	61, 86	18	12, 35
Pizza	70	920	870, 992	16	14, 18	39	34, 46	45	40, 49
Vegetable dishes	67	335	264, 410	14	11, 20	55	34, 62	31	24, 51
Warm sauces	62	464	280, 954	7	3, 11	51	33, 86	34	9, 60
Fish dishes	55	724	527, 858	31	24, 41	44	34, 52	26	12, 32
Pasta and rice dishes	49	602	494, 682	14	13, 17	35	29, 45	50	41, 58
Soups	34	289	209, 356	24	19, 27	36	26, 46	38	34, 49
Potato dishes	30	695	602, 791	7	6, 10	37	19, 43	56	50, 70
Salad	27	820	611, 1184	7	5, 11	72	51, 84	17	7, 37

Q, quartile.

\*Energy density and macronutrient proportion estimated using the labelled ingredient lists.

†Number of CF items in this category (the category 'miscellaneous' (n 24) is not shown).

including CF. For example, the DONALD nutrient database simulated recipes of CF products using labelled ingredients in order to estimate the product energy and nutrient contents<sup>8</sup>. This procedure allows only a rough estimate of energy and nutrient contents. However, this is the only present available option since the nutritional data of the different CF products are not available.

A few studies have analysed some components of CF, such as an analysis of seventy-six CF in Austria; the mean energy content per portion ranged between 515 kJ (soups) and 4004 kJ (sweet dishes). Another study published some data either on the Mg content or the vitamin profile of selected ready-to-eat meals<sup>10,11</sup>.

In our evaluation, CF had a higher impact on fat intake than on energy intake. The median % of energy from fat in all product groups was at least 35% energy. In an Australian survey with 18 year olds, CF was the major food group contributing to fat intake (32 and 28% in males and females, respectively)<sup>12</sup>.

Flavourings and/or flavour enhancers were found in about half of the CF products consumed in our sample. This was not surprising, since the sensory quality of CF could be impaired by the warmed-over flavour and aroma losses from storage<sup>3</sup>. The use of high and standardised spicing in industrial food production results in a taste standardisation and a loss of the specific taste of 'mothers' cuisine'. In addition, the lower diversity in ingredient use can also contribute to taste standardisation. Studies demonstrating that sensory experiences in early childhood may have long-lasting effects are increasing<sup>13,14</sup>. Additionally, Berghofer<sup>3</sup> complained of the agricultural disadvantage of the loss of biodiversity, if the number of plants used for human nutrition were to further decrease.

However, not only composition of CF determines the diet quality, but also menu planning by the consumer. Model calculations on the diet of children and adolescents in Germany showed that daily menus including commercial CF in families and day-care centres reach the dietary reference intakes<sup>15,16</sup>. Since the present evaluation is confined to the composition of CF products as sold, potential modifications by the

consumer at home, for example, adding vegetables to a ready-to-eat-meal, were not included in the analysis.

In conclusion, the consumption of CF increased with age using current data on diets of children and adolescents from the DONALD Study. From the side of the food industry, the composition of CF could be improved regarding their nutritional and sensory properties, in particular by a reduction of the fat content and food additives and flavourings. From the side of public dietary information, parents could be better informed and be encouraged to read the CF ingredients labels to get an idea of the composition. Current political efforts to enforce the defining of nutrient profiles of foods could be a significant step to simplify the choice of healthy CF products by the consumers. Vice versa, improved consumer demand could encourage the food industry to offer improved products.

Further studies on the impact of present-day CF consumption on nutrition and health are required, for example, the influence of CF consumption on overall diet quality, or on body weight, or on the development of flavour sensation in children.

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