Children's and non-children's breakfast cereals on the German market

Differences in energy and nutrient content and Nutri-Score

Anna Dittmann, David Wolff, Hanna Haidar, Benedikt Merz, Silvia Roser, Corinna Gréa, Stefan Storcksdieck genannt Bonsmann

Abstract

In 2022, breakfast cereals were surveyed for the third time as part of the German product monitoring of packaged food which is in the scope of the National Reduction and Innovation Strategy for sugar, fats, and salt in processed foods. The declared energy and nutrient contents were compared for children's and non-children's breakfast cereals at the overall level and for mueslis, flakes, and other breakfast cereals. Additionally, the Nutri-Score was calculated for all products. Non-children's breakfast cereals (85%) were predominantly mueslis, while children's breakfast cereals were mainly other cereal products in addition to mueslis. By proportion, more products among children's breakfast cereals had a Nutri-Score of C–E than among non-children's breakfast cereals. At the same time, children's breakfast cereals had a significantly higher mean sugar content (17.1 g/100 g vs. 14.3 g/100 g), but a lower fat content (7.2 g/100 g vs. 11.4 g/100 g). The results suggest that there is further potential for reformulation, especially for children's breakfast cereals.

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Introduction

A balanced breakfast makes an important contribution to daily nutrient intake [1]. Breakfast cereals are popular among consumers in Germany; the customer reach[1] for this product group is around 61% [2]. The variety of breakfast cereals is large and covers mueslis, cornflakes, and other cereal products [3]. By comparison, many of the products are targeted at children and adolescents (children's breakfast cereals). In addition to the German monitoring of packaged foods of the *Max Rubner-Institut* (MRI), several other surveys for the German market between 2013 and 2023 [4–7] show that these products, in particular, are high in sugar. According to the 2023 Nutrient Profile Model of the World Health Organization (WHO), which provides guidance for decision-makers to assess whether products are suitable to be marketed towards children, breakfast cereals should not contain more than 12.5 g of sugar per 100 g [8].

As part of the National Reduction and Innovation Strategy (NRI) adopted by the German government in 2018, a voluntary commitment for the reduction of the sugar content of children's breakfast cereals was agreed upon by the trade association of the Cereal Processing, Milling, and Starch Industry (VGMS). The commitment is to reduce mean sugar content in these products by at least 20% by 2025 [9]. To accompany the NRI, the MRI carries out an annual product monitoring to examine the energy and nutrient contents of selected product groups. The survey from 2022 provides current data on breakfast cereals [2]. Its focus lay on the contents of energy, fat, saturated fat, and sugar at the level of the overall product group and also for subgroups, including subgroups for children's breakfast cereals, as

[1] The customer reach describes the share of households that bought products from a specific product group at least once within a year.

well as their changes over time. In addition to these analyses, the present study compares children's and non-children's breakfast cereals from the subcategories muesli, flakes as well as other cereal products for the year 2022. For this purpose, significant differences in the energy and nutrient contents are examined and the nutrient composition is assessed using the Nutri-Score.

Method

Data base

The 2022 survey of the German monitoring of packaged foods provides the data [2]. The procedure for the surveys has already been published elsewhere [10] and can also be found in the annual reports [2]. In the survey, that was carried out between August and December 2022, unprepared breakfast cereals available in the food retail sector were recorded. To cover the market as broadly as possible, data was predominantly collected online via the manufacturer's websites. The online research was complemented by enquiries with manufacturers and visits to grocery stores in order to fill data gaps.

Plain rolled grains without any other ingredients as well as savory porridges (e.g. tomato-broccoli porridge) were excluded. Furthermore, products consisting mainly of nuts and seeds rather than cereals which were monitored within the subgroup "muesli with nuts/seeds" were not considered in the present study as no comparable group of children's breakfast cereals existed. In addition, products for which the declared nutrient contents applied for the prepared product (e.g. porridge with milk) were excluded.

Definition of product categories

The analysis was carried out at the level of three categories into which the included products were categorized:

- **Muesli**: labelled as muesli or porridge; may contain (pseudo) cereals or soya flakes (e.g. crunchy chocolate muesli, berry muesli)
- **Flakes**: labelled as flakes; without additives, except for in the coating (e.g. cornflakes, honey & nut flakes, frosted flakes)
- **Other cereal products:** all further breakfast cereals that cannot be assigned to mueslis or flakes; usually contain additives (e.g. nougat bits, cinnamon chips)

Definition of products classified as "children's"

Within the three categories a distinction was made into children's and non-children's breakfast cereals. Four criteria defined by the MRI were used for categorization, of which at least one had to be fulfilled [10]:

- product name includes 'child(ren)' or 'kids' or appeals directly to children such as 'Chocolate Bears' and/or
- packaging is attractively designed for children (e.g. pictures of smiling animals, cartoon characters) and/or
- food product itself or its components is/are designed for children (e.g. cereals in the shape of bears or letters) and/or
- packaging includes information aimed at children or parents (e.g. "for your little ones", reference to e.g. children's games, learning effects or free collectible picture cards)

Calculation of the Nutri-Score

In addition to the documentation of the energy and nutrient contents, the Nutri-Score was calculated. The computation of the Nutri-Score is based on the declared nutritional values per 100 g and on the allocation of points reflecting the contents of energy, saturated fat, sugar, and salt (unfavorable points) and of protein, fiber, and the percentage of fruits, vegetables and legumes (favorable points; henceforth referred to as F&V component). For the overall score, the favorable points were subtracted from the unfavorable points. Products with a more favorable nutritional composition therefore have a lower score than products with a less favorable nutrient composition. The overall score was then translated into color-coded letters from dark green A (0 points and less) to a dark orange E (+ 19 points and more) [11, 12]. The percentage of the F&V component was determined based on the ingredient list using the Nutri-Score FAQ document [11]. The product was excluded if the ingredient list was not available or if fiber content was not declared. For the computation of the Nutri-Score, the algorithm as revised in 2023 and applicable in Germany since 2024 [11, 12] was used.

Statistical analysis

The energy and nutrient contents of the overall sample (henceforth referred to as breakfast cereals) and of the three categories are displayed using the arithmetic mean with standard deviation, median, and ranges. Also, the shares of the Nutri-Score classification were calculated. For the analyses a differentiation was made between children's and non-children's breakfast cereals.

The normality of the data distribution was tested and rejected using the Shapiro-Wilk test. Accordingly, the non-parametric Mann-Whitney test for two independent samples was used to compare the energy and nutrient contents between children's and non-children's breakfast cereals within the respective categories of muesli, flakes, and other cereal products. For all results, p-values <0.05 were considered statistically significant.

All statistical analyses were carried out using the software R, version 4.3.2.

Results

Study sample

For the present study 1473 breakfast cereals were analyzed, of which 15% (n=225) were classified as children's breakfast cereals. The category muesli accounted for the largest share by far with 1201 products. In the category of other cereal products more than half of the products were children's breakfast cereals (◆ Figure 1).

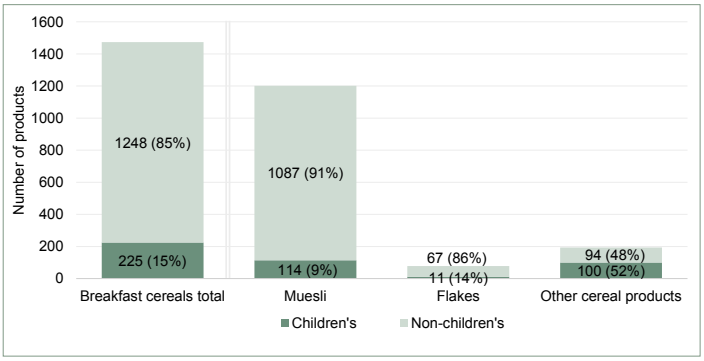

Fig. 1: **Number of included breakfast cereals (total) as well as of the categories muesli, flakes, and other cereal products on the German market in the survey year 2022;** differentiated into children's and non-children's breakfast cereals

In general, the composition of the subsamples of children's and non-children's breakfast cereals differed from each other: Among children's breakfast cereals, in addition to mueslis, there were also products from the category of other cereal products, whereas the subsample of non-children's breakfast cereals mainly comprised mueslis (◆ Figure 2).

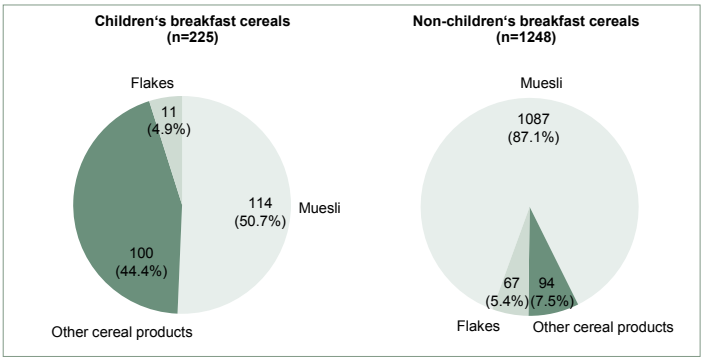

Fig. 2: **Overview of the composition of the subsamples of children's and non-children's breakfast cereals on the German market in the survey year 2022**

Energy and nutrient contents

The arithmetic means for all *children's* breakfast cereals were 17.1 g for sugar, 7.2 g for fat, and 0.24 g for salt per 100 g of product. In contrast, the means for *non-children's* breakfast cereals were 14.3 g for sugar, 11.4 g for fat and 0.21 g for salt per 100 g of product (◆ Table 1).

At subcategory level, among *children's* breakfast cereals, sugar content was highest at 21.9 g/100 g for other cereal products. The product with the highest sugar content (37.0 g/100 g) belonged to the subcategory of flakes. Among *non-children's* breakfast cereals, the product with the highest sugar content (54.0 g/100 g) belonged to the subcategory of other cereal products, which was also the subcategory with the highest mean sugar content (20.2 g/100 g) among the *non-children's* subcategories.

The ranges for energy and nutrient contents were large in all categories. Regarding the mean fat and salt contents, the muesli categories showed comparatively high fat contents, but lower salt contents; whereas the opposite was true for flakes.

Statistical comparison of energy and nutrient contents

At the level of the overall sample, *children's* breakfast cereals showed a statistically significantly higher mean carbohydrate and sugar content, but significantly lower contents of energy ($p=0.002$), fat ($p<0.001$), saturated fat ($p<0.001$), and protein ($p<0.001$) than *non-children's* breakfast cereals (◆ Table 1).

Within categories, especially for mueslis statistically significant differences between *children's* and *non-children's* breakfast cereals were shown. *Children's* mueslis had lower mean contents of energy ($p=0.048$), fat ($p<0.001$), saturated fat ($p=0.032$), sugar ($p=0.020$), and salt ($p=0.013$) than *non-children's* mueslis, while carbohydrate content was higher ($p<0.001$). A higher carbohydrate content ($p<0.001$) was also found for *children's* other cereal products, which also had a lower mean protein content ($p=0.011$) than *non-children's* breakfast cereals. For children's flakes, no statistically significant differences to *non-children's* breakfast cereals were found (◆ Table 1, ◆ Figure 3).

Nutri-Score classification

Based on the available information, the Nutri-Score could be calculated for 203 of 225 *children's* breakfast cereals (ca. 90%), and for 1092 of 1248 *non-children's* breakfast cereals (ca. 88%), respectively. The share of products with a green Nutri-Score (A or B) was lower among *children's* breakfast cereals than among *non-children's* breakfast cereals (37% vs. 46%).

	Category	Breakfast cereals total		Muesli		Flakes		Other cereal products	
	Sub-category	mKO	oKO	mKO	oKO	mKO	oKO	mKO	oKO
	number (n)	225	1248	114	1087	11	67	100	94
Energy [kcal/100 g]	Mean ± SD	391 ± 29**	401±40	395 ± 32*	403 ± 41	378 ± 15	380 ± 21	388 ± 27	395 ± 34
	Median	386	395	393	400	378	375	384	386
	Min/Max	329/489	254/556	339/489	254/556	348/404	339/459	329/480	334/482
Fat [g/100 g]	Mean ± SD	7.2 ± 5.2***	11.4 ± 6.2	9.7 ± 4.7***	12.3 ± 5.8	1.8 ± 1.4	3.2 ± 4.2	4.9 ± 4.4	6.7 ± 5.9
	Median	5.6	11.0	9.6	11.9	1.0	2.0	3.5	4.5
	Min/Max	0.6/25.6	0.6/41.0	2.0/25.6	1.6/41.0	0.6/4.4	0.6/18.7	0.9/22.0	0.6/23.9
Saturated Fat [g/100 g]	Mean ± SD	2.2 ± 2.1***	3.1 ± 2.7	2.8 ± 2.4*	3.3 ± 2.6	0.4 ± 0.4	1.2 ± 2.7	1.6 ± 1.7	2.2 ± 2.5
	Median	1.3	2.1	2.5	2.4	0.2	0.3	0.9	1.0
	Min/Max	0.0/18.4	0.0/20.8	0.2/18.4	0.2/20.8	0.1/1.3	0.0/11.3	0.0/6.5	0.0/14.4
Carbo-hydrate [g/100 g]	Mean ± SD	68.2 ± 8.7###	58.4 ± 11.3	61.5 ± 4.8###	56.3 ± 10.0	81.0 ± 5.1	75.9 ± 8.0	74.5 ± 5.7###	70.3 ± 7.8
	Median	66.5	59.9	61.5	58.9	82.0	79.0	75.0	70.0
	Min/Max	43.7/87.0	3.6/85.3	43.7/81.7	3.6/72.8	69.0/87.0	59.4/85.3	61.0/86.0	30.5/85.0
Sugar [g/100 g]	Mean ± SD	17.1 ± 7.8###	14.3 ± 7.5	13.2 ± 5.5*	14.3 ± 6.9	12.7 ± 11.6	6.3 ± 7.9	21.9 ± 6.7	20.2 ± 8.9
	Median	16.6	14.9	12.9	14.7	9.2	3.0	23.0	21.7
	Min/Max	0.0/37.0	0.3/54.0	0.7/31.0	0.6/34.0	0.0/37.0	0.3/35.0	4.2/34.0	0.4/54.0
Protein [g/100 g]	Mean ± SD	9.6 ± 2.1***	11.9 ± 5.6	11.0 ± 1.6	12.3 ± 5.7	7.5 ± 1.9	8.9 ± 3.0	8.3 ± 1.6*	9.8 ± 4.5
	Median	9.9	10.9	10.9	11.0	7.4	8.0	8.5	9.2
	Min/Max	1.0/22.8	1.1/51.0	7.5/22.8	1.2/51.0	4.5/12.0	5.5/16.8	1.0/12.0	1.1/40.0
Salt [g/100 g]	Mean ± SD	0.24 ± 0.29	0.21 ± 0.32	0.09 ± 0.10*	0.15 ± 0.21	0.68 ± 0.45	0.81 ± 0.65	0.36 ± 0.30	0.48 ± 0.42
	Median	0.08	0.08	0.05	0.07	0.73	0.80	0.33	0.47
	Min/Max	0.0/1.40	0.0/2.50	0.0/0.42	0.0/1.60	0.03/1.40	0.0/2.50	0.0/1.10	0.0/1.50

Tab. 1: **Energy and nutrient contents of breakfast cereals** (total) **as well as of the categories muesli, flakes, and other cereal products on the German market in the survey year 2022;** differentiated into children's and non-children's breakfast cereals
* corresponds to mean content being statistically significantly lower than for corresponding non-children's subcategory (* p<0.05; ** p<0.01; *** p<0.001)
# corresponds to mean content being statistically significantly higher than for corresponding non-children's subcategory (# p<0.05; ## p<0.01; ### p<0.001)
SD: Standard Deviation

For both, *children's* as well as *non-children's* breakfast cereals, more than half of the products had a rather unfavorable nutrient composition (Nutri-Score C, D or E) (≙ Figure 4).

At the category level, the highest share of products with a green Nutri-Score was found for mueslis (children's and non-children's) as well as for *non-children's* flakes. For *children's* mueslis this applied to 54% of all products. By contrast, for children's other cereal products the share was only 17%. For both mueslis and other cereal products, the differences in the Nutri-Score classification between *children's* and *non-children's* breakfast cereals were less pronounced than in the category of flakes. Among flakes, about 30% of *children's* breakfast cereals reached a green Nutri-Score, while this applied to 49% of *non-children's* breakfast cereals. At

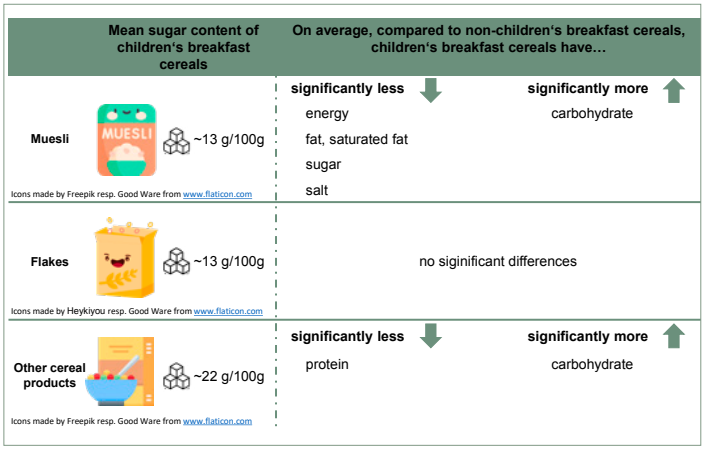

Fig. 3: **Mean sugar content of the surveyed subcategories of children's breakfast cereals on the German market in the survey year 2022, as well as statistically significant differences in mean energy and nutrient contents to non-children's breakfast cereals** (p<0.05) (own visualization)

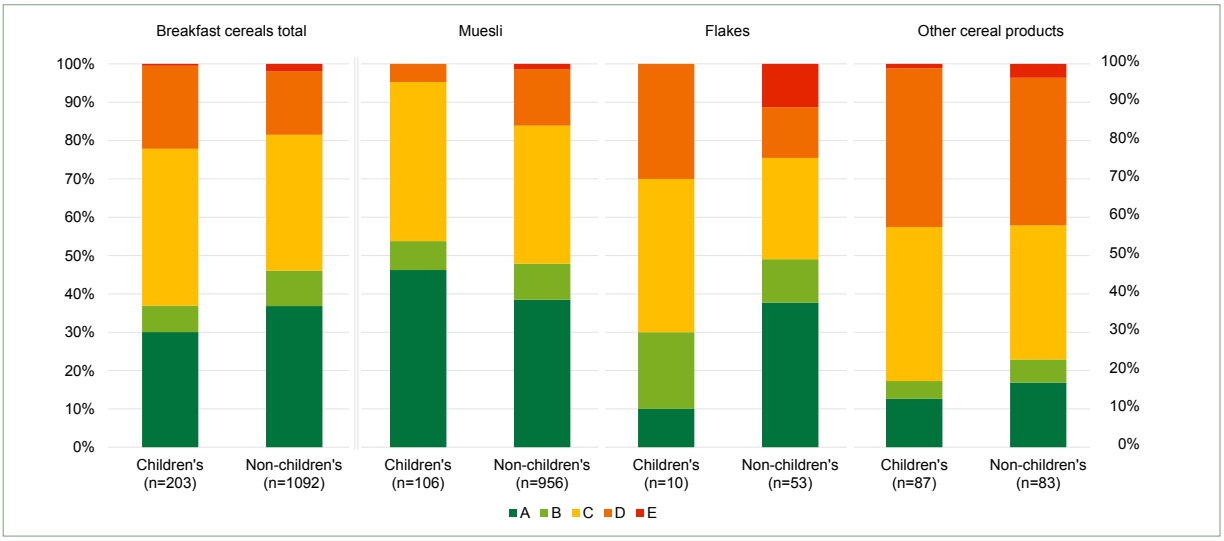

Fig. 4: **Shares of Nutri-Score classification of breakfast cereals (total) as well as of the categories muesli, flakes, and other cereal products on the German market in the survey year 2022;** differentiated into children's and non-children's breakfast cereals

the same time, the sample size was considerably smaller than in the other categories. For *non-children's* flakes the share of products with a Nutri-Score E was the highest across all subcategories. For other cereal products the share of products with a rather unfavorable classification was highest, as more than three quarters of the products were assigned a Nutri-Score C or worse.

Discussion

The present study provides a detailed insight into the German market for breakfast cereals in 2022, differentiated into children's and non-children's breakfast cereals. For the overall market, it was observed that on average children's breakfast cereals contained more sugar than non-children's breakfast cereals. These results are in line with observations from market checks by the non-profit organization Foodwatch (2019) [6], the German health insurance company AOK (2019) [4] and most recently by the German consumer organization and foundation Stiftung Warentest (2023) [7]. Internationally, a higher sugar content in breakfast cereals targeted at children has also been reported multiple times [13–16]. Several studies [14–16] found the sugar content to be up to 10 g/100 g higher in children's breakfast cereals compared to non-children's breakfast cereals, while in the present study, children's breakfast cereals on average contained 3 g/100 g more sugar.

The mean sugar content of children's breakfast cereals on the German market was 17.1 g/100 g, which is markedly higher than the 12.5 g/100 g threshold set by the WHO Nutrient Profile Model 2023 for marketing products towards children [8]. However, in international comparison, it was considerably lower than the contents found in other countries. Surveys in Canada [15], New Zealand [14, 17], and Australia [13] found that children's breakfast cereals had mean sugar contents between 23 g and 30 g/100 g. Studies in Europe reported sugar contents of 22 g/100 g and 27 g/100 g for such products in Sweden [16] and the United Kingdom [18], respectively. In addition to country-specific variations of the products, these differences may partly be due to methodological reasons. These include different approaches to data collection, categorization of products and/or the definition of children's products [10]. For example, for those studies reporting markedly higher mean sugar contents, it is unclear what the exact composition of the sample of children's breakfast cereals was. It is possible that in other countries, breakfast cereals with child-appealing packaging are primarily those that in the present study belonged to the category of other cereal products. Thus, in other countries, fewer mueslis might be included in the samples (e.g. [18]). Furthermore, in the context of reformulation efforts and a dynamic market, the study results must be considered as a snapshot of the current situation. The time span between the survey years (2013 [New Zealand] and 2022 [Germany]) may reflect the progress and changes that have been achieved through reformulation initiatives over the years. For example, the mean sugar content in children's breakfast cereals in New Zealand was 3.6 g/100 g lower in 2017 compared to 2013 [17]. For the German market, a statistically significant sugar reduction by 5.8 g/100 g was monitored since 2019 [2].

Despite the sugar reductions already achieved in Germany, high sugar contents were still observed, in particular, for the category of other cereal products. In 2022, these products dominated the market of children's breakfast cereals, together with mueslis. In addition, especially high-sugar products had a particularly high sales volume. A study by the AOK Federal Association from 2019 found that the top 10 children's breakfast cereals had sugar contents between 24 g/100 g and 35 g/100 g and accounted for 39% of the total volume of children's breakfast cereals sold [4]. Since sugar in cereals is often used for coating or in the form of sweet fillings [3], it typically consists of free sugars according to the WHO definition [19]. For portion sizes of 30–60 g, as frequently indicated on breakfast cereal packaging in Germany [20], a serving of the AOK list's most popular cereals (without the addition of milk, plant-based drinks, etc.) would account for 17 to 50% of the recommended upper limit for free sugar intake (<10% of energy intake[2] [19]) for children aged 7 to 10 years. Thus, with just one such cereal meal, a significant proportion of the recommended maximum intake would already have been consumed.

The subsample of non-children's breakfast cereals was dominated by the category of muesli, accounting for more than 85% of the sample. Alongside chocolate and crunchy mueslis, this subsample included primarily fruit and nut mueslis as well as porridges [2], so that for this subsample a correspondingly larger selection of products with a nutritionally more favorable composition is available. At the same time, the present study clearly demonstrates the diversity of products within a category, indicated by the wide spread of nutrient contents. To make it easier to identify nutritionally favorable products within a comparable product category, the widespread use of a front-of-pack label, such as the Nutri-Score, is advocated [22]. At the time of data collection, only about 15% of the products were labelled with the Nutri-Score. For the present comparison, the Nutri-Score was therefore calculated specifically for all products using the algorithm, revised in 2023. Among other things, the goal of the revision was to incorporate stricter requirements for sugar and salt content into the evaluation, thereby improving the differentiation of various sugar contents across different product groups. This was of particular importance given the varying sugar contents in breakfast cereals [12].

For breakfast cereals on the German market, the share of children's products was 15%, which is high compared to other product groups surveyed in the German monitoring of packaged food. According to the AOK, 75% of the total quantity of cereals purchased consisted of children's products [4]. At the same time, the analysis by the AOK, based on the GfK[3] Household Panel comprising 30000 households, showed that individuals with a lower social status (low income + lower formal education) tend to purchase sugar-rich children's breakfast cereals more frequently [4]. Here, the widespread use of the Nutri-Score could facilitate the selection of a product that is comparatively more favorable from a nutritional point of view.

Marketing strategies can negatively influence children's food preferences and choices [23], which is why the marketing of foods and beverages with poor nutritional profiles is considered a risk factor for overweight, obesity, and nutrition-related diseases [23, 24]. Various studies have shown that, in addition to sweets and fast food, in particular, sugar-rich breakfast cereals are marketed to children [24, 25]. According to an analysis of children's products, based on the WHO Nutrient Profile Model [8], 77% of children's breakfast cereals may not be marketed towards children [26]. This was particularly true for children's other cereal products (90%) (internal analysis). It can already be observed that in some cases manufacturers are at least changing the design of packaging so that children are no longer directly targeted [27]. Whether more companies will follow this example voluntarily, leading to a decreased proportion of children's breakfast cereals, will become evident in the 2025 product monitoring survey, which will again examine breakfast cereals. Developments on other marketing channels, such as social media, cannot be tracked within the scope of the product monitoring.

Conclusion

The market for breakfast cereals in Germany is characterized by a wide variety of products, which is also reflected in large ranges for energy and nutrient contents. A relatively large proportion of the products are specifically targeted at the vulnerable group of children and adolescents through their packaging and may suggest to parents that these products are particularly suitable for children and adolescents. At the same time, the mean sugar content remains high, even when compared to non-children's breakfast cereals. Therefore, there is still a lot of potential for reformulation, in particular to help parents or legal guardians make more balanced choices and to contribute to an improvement in the food

[2] approximately 42 g/day for an energy intake of 1700 kcal (based on a physical activity level of 1.4 [low physical activity] for boys aged 7 to 10 years) [21]

[3] *Gesellschaft für Konsumforschung* (GfK), 2024 takeover by YouGov plc

environment. Furthermore, a greater adoption of the Nutri-Score by manufacturers could help consumers to compare within categories and thus facilitate more favorable nutritional choices.

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Disclosures on Conflicts of Interest and the use of AI
The authors declare that there is no conflict of interest. No AI has been used in the preparation of this manuscript.

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