

Assessment of the nutritional composition of breakfast cereal and the nutritional benefits of two serving portions for young children

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Summary. *Background:* Breakfast cereal is a widely popular morning breakfast meal and it is a source of nutrients and fibers for both children and adults. *Purpose:* this study was conducted to assess the nutritional composition of selected breakfast cereals in Omani market and the nutritional benefits of two serving portions; 30g and 45g. *Methods:* The nutritional information was extracted from the nutrition panel of each 26 products collected from hypermarket outlets and statistically analysed. *Results:* The salt content was found to be significantly high ($P = 0.015$) with original/plain and other flavours cereals when compared with the other two groups; honey/sugar coated and chocolate flavour cereals. For the 26 breakfast cereals products, the serving portion of 45g has significant amounts of nutrients, except for total fat, when compared with that of 30g portion. The assessment of nutritional benefits of 30g and 45g portions in terms of total carbohydrates for two age groups 4–8 years and 9–13 years old children respectively is found to be within the range of recommended breakfast intake of carbohydrates per day. On the other hand, the energy intake provided by both portions for both age groups is low and inadequate when compared to the recommended breakfast intake of energy per day. *Conclusion:* For some breakfast cereal products the consumption by young children should be monitored due to the high salt content. In the studied sample, energy intake from 30g and 45g portions is considered low and should be compensated by the consumption of energy-rich food sources such as biscuits and nuts.

Key words: Breakfast cereal, nutritional composition, serving portion, carbohydrates, energy

Introduction

Morning breakfast meal or breakfast is the first meal of the day that breaks the fast after a long period of sleep and is consumed within 2 to 3 hours of waking up (1). It has been described as the most important meal of the day, contributing substantially to the individual's daily nutrient intake and energy needs, hence it has an immediate effect on cognitive performance and feelings of wellbeing, as well as extended benefits related to diet quality and weight management (1, 2). As children of young age require optimal nutrient intake to meet the basic demands of growth and development, it has been reported that children who eat

breakfast are more likely to meet daily nutrient intake requirements as compared to children who eat breakfast infrequently or skip breakfast (3). Furthermore, breakfast consumption has been associated with better learning and school performance (4).

Breakfast consumption, as with other meals, provides fuel for preferential oxidation of glucose. In children aged between 3 and 11 years, the brain has been shown to account for more than 50% of body oxygen consumption (5). Moreover, children exert greater demands on glycogen stores overnight fasting period during sleep which are often longer than in adults. The child's relatively small muscle mass, in turn, limits the availability of glucogenic amino acids for hepatic glu-

coneogenesis (5). Consequently, the higher metabolic turnover of children, their rapid growth rates and the importance of their cognitive function for academic achievement underlie the need for optimal nutrition when they start the day in the morning (4).

The quality and composition of a breakfast meal is essential for a maximum nutritional benefit. Therefore, establishing criteria for a quality breakfast; such as types and amounts of foods, nutrients, and energy, deemed important by researchers and can help understand the role of breakfast composition in relation to positive health outcomes (1). A breakfast cereal can be considered as one of the main components of a breakfast meal in many households owing to the fact that it is a convenient and an easy-to-prepare breakfast option. It has been the focus of several studies partly due to its popularity as a breakfast meal and substantial evidence have shown the positive association between breakfast cereal consumption, nutrient intake and well being (2, 6, 7). Breakfast cereal is a source of many macro- and micronutrients for both children and adults such as carbohydrates, proteins, fibers, vitamins (vitamin A,C,D and B complex) and minerals (iron and calcium).

There is a huge variety of ready-to-eat breakfast cereals available in the market. The nutritional composition (macro- and micronutrients) of any breakfast cereal product is printed in the nutrition panel (also known as nutrition facts label) which facilitates quick and informed food choices (breakfast cereal in this case) within dietary patterns to achieve a healthy diet. In addition, many of these products' labels suggest two serving options; 30g portion of cereal with 125ml of semi-skimmed milk or 45g portion of cereal with 125ml of semi-skimmed milk. It is true however that the information presented in the nutrition panel could make the selection of the breakfast cereal type and the appropriate serving options for kids a challenging task for the parents. This also involves identifying the nutritional composition and benefits offered by the breakfast cereal product in terms of adequate supply of nutrients for a good start of the day (8). Therefore, the assessment of the nutritional information of a selected breakfast cereal products in Omani market and the nutritional benefits of two serving portions; 30g and 45g of breakfast cereal for two children age groups; 4-8 years old and 9-13 years old can be considered as a

valid quest. The outcome of this research can provide preliminary information to establish an appropriate practice on consumption of breakfast cereals for children to enjoy a quality breakfast.

Methods

A number of 26 breakfast cereal products were collected from hypermarkets in Muscat city in October 2015. The product selection was based on the manufacturer; Kellogg's (16 products) and Nestle (10 products) and the popularity of the products, which are consumed mainly by young children and commonly seen on TV commercials; such as Kellogg's Corn flakes and Nestle Nesquik. These 26 products were classified into three main groups according to the young children's taste preference; chocolate flavour cereal (8 products), honey/sugar coated cereal (7 products) and original/plain and other flavours cereal (flavours include: cinnamon, fruits and mango) (11 products). The information about the nutritional composition of each of these products; protein (g), total carbohydrates (g), total fat (g), fibers (g), salt (mg) and energy (kilo calorie; kcal) was extracted from the nutrition panel printed on the back or side of the product pack. The nutrients and energy values displayed in each of the products' nutrition panel are per 100g in addition to a serving portion of 45g or 30g with 125ml semi-skimmed milk. Therefore, values per 100g, 45g and 30g portions were recorded for further data comparison and statistical analysis. The Recommended Daily Intake (RDI) of carbohydrates and energy for two age groups of children; 4-8 and 9-13 years old that is published by the Institute of Medicine of the National Academies of the US (9) were used to assess the nutritional benefits of two serving portions of 45g and 30g of the selected breakfast cereals.

Statistical analysis

The data of the study were evaluated using SPSS 19.0 package program. The nutritional information (protein, total carbohydrate, total fat, salt, fibers and energy) of three breakfast cereal groups; chocolate flavour cereal, honey/sugar coated cereal and original/plain and other flavours cereal, and of the 30g portion and 45g portion were analyzed and compared using

student's *t*-test and ANOVA. A criterion for *p* level of <0.05 was used to determine statistical significance.

Results

The mean values of the nutritional information per 100g for protein (g), total carbohydrates (g), total fat (g), fibers (g), salt (mg) and energy (kcal) recorded from the 26 breakfast cereal products selected in this study are as follows; $7.2\text{g}\pm 1.5$, $79.7\text{g}\pm 4.8$, $3.1\text{g}\pm 2.2$, $4.8\text{g}\pm 2.7$, $843.7\text{mg}\pm 357.5$, $385.2\text{ kcal}\pm 11.5$ respectively. A preliminary analysis showed that Kellogg's cereal products contain significantly higher amounts of total carbohydrates when compared to their counterpart Nestle cereal products. On the other hand, protein and fiber contents of Nestle cereal products were found to be significantly higher than in Kellogg's cereal products (data not shown). When classifying these products into three main groups: chocolate flavour (group 1; 8 products), honey/sugar coated (group 2; 7 products) and original/plain and other flavours (group 3; 11 products) and comparing the nutritional information between these groups, the statistical analysis revealed that all groups

have a comparable amounts of nutrients and energy except for salt content which was significantly high ($P = 0.015$) in group 3 as shown in Table 1 (see appendix A - available online www.progressinnutrition.it).

For all the 26 products, the nutrients and energy values recorded for the serving portion of 45g showed to be significantly higher than the amounts provided by the serving portion of 30g except for total fat with $P = 0.057$ (Table 2). The nutritional benefit of these two serving portions, which are recommended to be served with 125ml of semi-skimmed milk, for young children of two age groups; 4 – 8 years old and 9 – 13 years old was investigated and summarised in Table 3. The total carbohydrates and energy were calculated for each serving portion of cereal with milk and further calculation was carried out to obtain the percentages of total carbohydrates and energy per day for each age group (see appendix B - available online on www.progressinnutrition.it). These percentages were compared with the recommended daily percentages of total carbohydrates and energy that should be obtained by consuming a breakfast meal in order to assess the nutritional benefit and suitability of these two serving portions with regard to the age group (Tab 3).

Table 1. Comparison between the nutritional components of 100g portion of three breakfast cereals groups; Chocolate flavor (group 1), Honey/sugar coated cereal (group 2), Original/plain and other flavours cereal (group 3).

Mean values						
Breakfast cereal type	Proteins (g)	Total Carbohydrates (g)	Total Fat (g)	Fibers (g)	Salt (mg) (g)	Energy (kcal)
Chocolate flavour cereal	7.5 ± 1.2	77.6 ± 3.5	3.9 ± 1.9	5.6 ± 2.2	677.5 ± 136.5	387 ± 10.4
Honey/sugar coated cereal	6.4 ± 1.6	82.2 ± 4.7	2.5 ± 1.88	4 ± 2.9	677.9 ± 344.1	384.7 ± 12.4
Original/plain and other flavours cereal	7.5 ± 1.5	79.8 ± 5.3	2.8 ± 2.7	4.8 ± 2.98	1070 ± 371.2	384.2 ± 12.7
<i>P</i> -value	0.211	0.185	0.451	0.525	0.015	0.873

Table 2. Comparison between the nutritional components of 30g and 45g portions for the studied sample of breakfast cereals ($n = 26$).

Mean values						
Breakfast cereal portion	Proteins (g)	Total Carbohydrates (g)	Total Fat (g)	Fibers (g)	Salt (mg)	Energy (kcal)
30g portion	2.2 ± 0.5	23.9 ± 1.5	0.9 ± 0.7	1.5 ± 0.8	253.1 ± 107.3	115.6 ± 3.5
45g portion	3.3 ± 0.7	35.9 ± 2.2	1.4 ± 1.1	2.2 ± 1.2	379.6 ± 160.9	173.3 ± 5.2
<i>P</i> -value	0.000	0.000	0.057	0.015	0.002	0.000

Table 3. Mean values and percentages of total carbohydrate and energy obtained from 30g and 45g portions of cereal + 125ml semi-skimmed milk for 4 – 8 and 9 – 13 years old children. These percentages were compared with the recommended breakfast intake of total carbohydrates and energy.

Mean values		
Breakfast cereal portion + 125ml semi-skimmed milk [†] Vs age group	Total Carbohydrates (g)	Energy (kcal)
	4 – 8 years old RDI [‡] = 192.5g/day 9 – 13 years old RDI = 268.1g/day	4 – 8 years old RDI = 1400kcal / day 9 – 13 years old RDI = 1950 kcal / day
30g portion	29.9g ± 1.5	169.4 kcal±3.5
45g portion	41.9g ± 2.2	227.1 kcal±5.2
4 – 8 years old	30g portion = 15.5%	30g portion = 12.1%
	45g portion = 21.8%	45g portion = 16.2%
	*60g portion = 27.9%	*60g portion = 20.4%
9 – 13 years old	30g portion = 11.2%	30g portion = 8.7%
	45g portion = 15.6%	45g portion = 11.7%
	*60g portion = 20.1%	*60g portion = 13.5%
Remarks	15 – 20% of the total carbohydrates per day is the recommended amount to be consumed in a breakfast meal (1).	20 – 35% of the total energy per day is the recommended to be obtained in a breakfast meal (9).

[†] In 125mls semi-skimmed milk (n=5), the mean values of proteins = 3.9g, total carbohydrates = 6g, total fat = 1.6g and energy = 53.8kcal.

[‡] The Recommended Daily Intake (9).

* Refer to the discussion section.

Discussion

Breakfast cereals can be considered as an attractive healthy choice for children. Research showed that children who consume cereal, relative to eating other breakfast foods, had lower percentages of fat in their diet, lower cholesterol levels, lower BMI and in overall they have improved nutrient status and health benefits (6, 10). This type of food can be classified as carbohydrate-rich food with low fat content and low energy value as indicated from the results presented in this research work as well as in the literature (6, 11). High salt content is evident in one of the breakfast cereals groups; group 3, with a mean value of 1070mg±371 per 100g. As a rule of thumb, if a child had four eating occasions a day then the aim for < 25% of daily value of salt (< 3g for 4 – 8 years old and < 5g for 9 – 13 years old children (12)) is recommended in the breakfast meal. Accordingly the consumed amount of salt from 30g portion of group 3 cereals would be 10.7% for 4 – 8 years old and 6.4% for 9 – 13 years old, meanwhile for 45g portion it would be 16.1% for 4 – 8 years old and 9.6% for 9 – 13 years old children. This suggests

that the consumption of 45g portion of group 3 cereals by 4–8 years old children might contribute to high salt intake in the child's diet per day. Hence to reduce the health risk associated with high salt intake, this group of young children are better off with other groups of breakfast cereals; group 1 and group 2, which provide much less amounts of salt.

In any meal, the portion served should supply adequate amounts and types of nutrients within the energy needs as well as provide the feel of fullness and satisfaction, i.e. satiety (13). A breakfast cereal meal of serving sizes of 30g and 45g with milk can be considered appropriate in terms of satiety for young children of age 4 to 13 years old due to the fact that breakfast cereals are a good source of dietary fibers (14, 15). However, there is no information in the literature assessing the nutritional benefit of these two serving portions for young children. Data presented in Table 2 show that the 45g portion provides significant amounts of protein, total carbohydrates, salt, fibers and energy when compared with the 30g portion. The percentages of total carbohydrates and energy obtained from these serving portions with milk for 4 – 8 years old (group A) and 9 – 13 years old (group

B) children was calculated and compared with that of the recommended percentages of intake in breakfast as presented in Table 3. In respect to group A, 30g and 45g portions provide 15.5% and 21.8% of total carbohydrates; which are within and slightly higher than the recommended intake range of 15 – 20% respectively. Meanwhile, for group B, it is 11.2% and 15.6% which are lower than and within the recommended intake range respectively. The energy intake from 30g and 45g portions by both age groups is lower than the recommended intake range of 20 – 35%. In connection to the above discussion, research has reported the effect of food carbohydrates and energy intake from a breakfast meal on children's attention and cognitive performance in school (7). A breakfast cereal meal which provides low sugar/glucose amounts (referred to as low glycemic index (GI) cereal meal) may prevent children performance from declining throughout the morning on certain measures of attention and memory when compared with the consumption of a breakfast meal which provides high sugar/glucose amounts (referred to as high glycemic index (GI) cereal meal) (16). This can be explained by that the consumption of a low GI cereal meal will maintain a more sustained release of glucose into the bloodstream and to the brain compared with the sharper rise and fall in blood glucose associated with high GI cereal meal (16, 17). As a result, carbohydrate intake from the 30g portion would be appropriate for group A and the 45g portion would be appropriate for group B.

The energy intake provided by both portions for both age groups is inadequate. This is due to the fact that breakfast cereals are generally rich in carbohydrates and poor in fat content. This low energy intake in breakfast can affect creativity and physical endurance of children of school going age (18, 19) and controverse the usual claim on TV commercials that breakfast cereals provide an energetic start for a child's day. To compensate this low total fat and energy, a portion of biscuits, which can vary from 15 – 25g depending on the age group, can be separately consumed along with the breakfast cereal meal. Biscuits, when compared to breakfast cereals, have a significant high total fat content and high energy value as well as low total carbohydrate content where in 100g biscuits the mean values of total carbohydrates = 65g, total fat =

22.5g and energy = 480.1 kcal (20). Furthermore, nuts such as almonds and peanuts which are rich in fat and energy can also be considered as a good choice. The option of having a larger portion size such as 60g will not be feasible as this amount would be large to consume and the required balance of total carbohydrate and energy per meal for both age groups is difficult to achieve as illustrated in Table 3.

In conclusion, for some breakfast cereal products the consumption by young children should be monitored due to the high salt content. In the studied sample, the 30g and 45g serving portions provide a sufficient daily intake of carbohydrate for a breakfast meal; 30g portion for 4 – 8 years old and 45g portion for 9 – 13 years old children. However, energy intake from these portions is low and should be compensated by the consumption of energy-rich food sources such as biscuits and nuts.

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Appendix A: Breakfast cereal groups and their nutritional information per 100g portion.

per 100g portion						
Breakfast cereal groups	Nutritional information					
	Proteins(g)	CHO(g)	Fat(g)	fibers (g)	Sodium (mg)	Kcal
Group 1						
A	5.7	84	2.5	2	730	385
B	7	75	8	5	750	410
C	9	78	2.5	5	780	381
D	8	75	4.5	7	800	387
E	6	82	3	3.5	730	386
F	8.8	75.2	2.2	9	620	374
G	8.1	75.8	4.5	6.2	380	389
H	7.7	75.4	4	7.4	630	384
Group 2						
I	6	84	1.5	4	80	382
J	4.5	87	0.6	2	375	375
K	6	82	5	2.5	880	402
L	6	82	5	2.5	880	402
M	8.7	76.1	1.7	8.9	630	372
N	8.3	76.1	2.8	7.1	1070	377
O	5	88	1	1	830	383
Group 3						
P	7	85	1.5	1	1130	384
Q	8	77	2.5	8	380	379
R	8	80	3.5	3.5	1130	391
S	7	84	0.9	3	1250	378
T	4.7	88	0.5	1.7	1650	379
U	8	79	3.5	5	1000	390
V	5.7	73.4	10.1	5.2	1080	418
W	7.3	84	1.2	2	1620	380
X	10.4	72.4	2.1	10.4	750	370
Y	7.6	81.5	1.5	4.6	730	379
Z	9	73	3.8	8	1050	378

Appendix B: Percentages of total carbohydrates and energy provided by 45g and 30g + 125ml semi-skimmed milk portions for each age group; 4-8 and 9-13 years old in respect to each breakfast cereal product (n = 26). The percentages were calculated using the RDI of carbohydrates and energy for these age groups.

Breakfast cereal	Amounts of carbohydrates (g) in 45g portion + 125ml semi-skimmed milk			Amounts of carbohydrates (g) in 30g portion + 125ml semi-skimmed milk		
	45g	% of carbohydrates for 4 – 8 years	% of carbohydrates for 9 – 13 years	30g	% of carbohydrates for 4 – 8 years	% of carbohydrates for 9 – 13 years
A	43.77	22.73766	16.32417	31.17	16.19221	11.62496
B	39.72	20.63377	14.81371	28.47	14.78961	10.61798
C	41.07	21.33506	15.3172	29.37	15.25714	10.95364
D	39.72	20.63377	14.81371	28.47	14.78961	10.61798
E	42.87	22.27013	15.98851	30.57	15.88052	11.40119
F	43.77	22.73766	16.32417	31.17	16.19221	11.62496
G	45.12	23.43896	16.82766	32.07	16.65974	11.96062
H	44.22	22.97143	16.492	31.47	16.34805	11.73684
I	45.57	23.67273	16.99549	32.37	16.81558	12.0725
J	40.62	21.1013	15.14937	29.07	15.1013	10.84176
K	41.97	21.8026	15.65285	29.97	15.56883	11.17741
L	43.77	22.73766	16.32417	31.17	16.19221	11.62496
M	42.87	22.27013	15.98851	30.57	15.88052	11.40119
N	45.57	23.67273	16.99549	32.37	16.81558	12.0725
O	42.87	22.27013	15.98851	30.57	15.88052	11.40119
P	41.52	21.56883	15.48503	29.67	15.41299	11.06553
Q	39	20.25974	14.54518	27.99	14.54026	10.43897
R	43.77	22.73766	16.32417	31.17	16.19221	11.62496
S	38.55	20.02597	14.37735	27.69	14.38442	10.32708
T	39.81	20.68052	14.84728	28.53	14.82078	10.64036
U	40.215	20.89091	14.99832	28.8	14.96104	10.74106
V	42.645	22.15325	15.9046	30.42	15.8026	11.34524
W	40.08	20.82078	14.94797	28.71	14.91429	10.70749
X	40.215	20.89091	14.99832	28.8	14.96104	10.74106
Y	38.82	20.16623	14.47805	27.87	14.47792	10.39421
Z	39.9	20.72727	14.88084	28.59	14.85195	10.66274

(Continued...)

Appendix B: Percentages of total carbohydrates and energy provided by 45g and 30g + 125ml semi-skimmed milk portions for each age group; 4-8 and 9-13 years old in respect to each breakfast cereal product (n = 26). The percentages were calculated using the RDI of carbohydrates and energy for these age groups. (Continued...)

A	Amounts of energy (kcal) in 45 g portion + 125ml semi-skimmed milk			Amounts of energy (kcal) in 30 g portion + 125ml semi-skimmed milk		
	45g	% of energy for 4 – 8 years	% of energy for 9 – 13 years	30g	% of energy for 4 – 8 years	% of energy for 9 – 13 years
B	227	16.21429	11.64103	169.25	12.08929	8.679487
C	238.25	17.01786	12.21795	176.75	12.625	9.064103
D	225.2	16.08571	11.54872	168.05	12.00357	8.617949
E	227.9	16.27857	11.68718	169.85	12.13214	8.710256
F	227.45	16.24643	11.6641	169.55	12.11071	8.694872
G	225.65	16.11786	11.57179	168.35	12.025	8.633333
H	222.5	15.89286	11.41026	166.25	11.875	8.525641
I	226.55	16.18214	11.61795	168.95	12.06786	8.664103
J	226.1	16.15	11.59487	168.65	12.04643	8.648718
K	224.3	16.02143	11.50256	167.45	11.96071	8.587179
L	229.7	16.40714	11.77949	171.05	12.21786	8.771795
M	223.85	15.98929	11.47949	167.15	11.93929	8.571795
N	234.65	16.76071	12.03333	174.35	12.45357	8.941026
O	224.3	16.02143	11.50256	167.45	11.96071	8.587179
P	234.65	16.76071	12.03333	174.35	12.45357	8.941026
Q	229.25	16.375	11.75641	170.75	12.19643	8.75641
R	241.85	17.275	12.40256	179.15	12.79643	9.187179
S	224.75	16.05357	11.52564	167.75	11.98214	8.602564
T	220.25	15.73214	11.29487	164.75	11.76786	8.448718
U	222.05	15.86071	11.38718	165.95	11.85357	8.510256
V	221.15	15.79643	11.34103	165.35	11.81071	8.479487
W	224.3	16.02143	11.50256	167.45	11.96071	8.587179
X	228.8	16.34286	11.73333	170.45	12.175	8.741026
Y	223.4	15.95714	11.45641	166.85	11.91786	8.55641
Z	223.85	15.98929	11.47949	167.15	11.93929	8.571795
A	226.55	16.18214	11.61795	168.95	12.06786	8.664103