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Short Communication

A comparison of the nutritional quality of organic and conventional ready-to-eat breakfast cereals based on NuVal scores

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Abstract

Objective: To identify whether there were differences in nutritional quality between organic and conventional ready-to-eat breakfast cereals of similar types, based on NuVal scores.
Design: The current descriptive study analysed NuVal scores for 829 ready-to-eat breakfast cereals and eighteen different cereal types. ANOVA was used to compare the mean NuVal scores of 723 conventional cereals with those of 106 organic cereals.
Setting: Ready-to-eat breakfast cereals (*n* 829) with NuVal scores.
Subjects: Not applicable.
Results: There was no significant difference in NuVal scores between conventional (mean 28·4 (SD 13·4)) and organic (mean 30·6 (SD 13·2)) cereal types.
Conclusions: Consumers who choose the organic version of a ready-to-eat breakfast cereal believing that nutritional quality is superior may not be making a valid assumption. Public health nutrition educators must help consumers understand that organic cereals are not necessarily more nutritious and their consumption could result in excessive intake of undesirable nutrients, such as fat, sugar and sodium.

Keywords
Organic
NuVal score
Ready-to-eat cereals
Nutritional quality

In the USA, there is an abundance of choice in the grocery store; every year, approximately 20 000 new food and beverage products appear on grocery shelves[1]. The public is now exposed to a greater variety of foods, fresh and processed, organic as well as conventional. According to recent data from the Organic Trade Association's 2012 Organic Industry Survey, health and environmental concerns boosted sales in the organic food and beverage industry by 9·5 % in 2011. Since 2000, organic food sales in the USA have more than tripled to comprise 4·2 % of total food sales[2]. Sustained growth of the organic food market leading to increased consumption of organic foods has the potential to impact the health of many people. However, exactly how is uncertain.

For one thing, it is not known what consumers understand about the nutritional value of organic *v.* conventional foods. According to the US Department of Agriculture, organic foods have been defined as being produced without chemical fertilisers, synthetic pesticides, hormones, antibiotics or GM organisms[3]. Although organic foods often receive a health halo, conventional choices may actually be as or more nutritious[4–9]. In addition, organic products may also contain added sugars, fats and sodium, which may make them less nutritious than their conventional counterparts.

An issue at hand is how consumers can determine the nutritional value of the foods they purchase other than by identifying certain macro- and micronutrients from the food label. Front-of-package labels, as well as nutrient scoring systems, and health claims, often conflicting, have been associated with all processed food products. Currently, three types of front-of-package rating systems, scores or symbols are used to indicate nutritional quality. First, nutrient-specific systems are based on selected nutrients, such as fat or fibre. Kellogg's Nutrition at a Glance is one example. Second, food group symbols, such as the Whole Grain Council's Whole Grain Stamp, may reflect the presence of healthy nutrients[10]. Third, summary indicators provide a single score or symbol to represent the nutrient content of a food based on algorithms that account for various nutrients (i.e. NuVal, Guiding Stars and the Nutrient Rich Foods Index)[10].

Cereals, both organic and conventional, are used as an important source of nutrients for many populations in as

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well as outside the USA[11]. A study of breakfast consumption patterns using National Health and Nutrition Examination Survey (NHANES) 1999–2000 data revealed that ~22 % of adults aged ≥19 years consumed cereal for breakfast[12]. Cereals are sold and distributed throughout the world, and it has been estimated that there is a $US 30 billion global cereal market[13]. In Brazil, China and India, consumer demand has increased tremendously for breakfast cereals made popular in the USA, creating a high-growth market in these countries[13]. Therefore, having further information on the nutritional value of ready-to-eat breakfast cereals is important globally.

As there is limited research regarding the relationship between nutritional quality scores and organic foods, the present study aimed to identify whether there were differences in NuVal scores between organic and conventional ready-to-eat breakfast cereals of similar types. We hypothesized that there would not be a difference in NuVal scores between organic cereals and conventional cereals in all category types of cereals.

Experimental methods

Study design

The current descriptive study was designed to analyse NuVal scores for similar types of conventional and organic ready-to-eat breakfast cereals to determine whether or not there was a difference in nutritional quality between the cereals based on their NuVal score. The Florida International University Office of Research Integrity reviewed the study and determined it was exempt from Institutional Review Board approval.

NuVal scoring

NuVal is a science-based, nutrient profiling system that is independent of the food industry. The NuVal score measures the nutritional quality of thousands of foods on a scale from 1 to 100, with 100 being the most nutritious. It was developed by a panel of twelve scientific experts in various disciplines, including nutritional biochemistry, cardiovascular and cancer epidemiology, weight management, behaviour modification and dietary counselling[14].

Moreover, a scientific advisory board convenes biannually to reauthorize or to update the algorithm to reflect changes in nutrition science and epidemiology. The ONQI (overall nutritional quality index) algorithm considers both nutrients that promote health, as well as nutrients that are less nutritious. In addition, the ONQI algorithm considers how nutrients in foods contribute to meeting recommended daily nutrient intakes by including a trajectory score. It is computed by dividing the nutrient quantity per total kilojoules per food serving by the recommended nutrient quantity per total kilojoule intake per day[14].

Healthy nutrients, such as fibre, folate, vitamins A, C, D, E, B_{12} and B_6, potassium, calcium, zinc, *n*-3 fatty acids, total bioflavonoids, total carotenoids, magnesium and iron, are placed in the numerator, where higher values will raise the NuVal score. Less nutritious nutrients, such as saturated fat, *trans*-fat, sodium, sugar and cholesterol, are placed in the denominator, thus lowering the NuVal score. Other factors such as fat and protein quality, energy density and glycaemic load are included in the algorithm[14,15].

Data collection

The researchers sent an email request to a representative of NuVal, a US Limited Liability Company, in order to obtain a list of NuVal scores for ready-to-eat breakfast cereals. The NuVal scores for 829 cereals were provided by email in the format of an Excel file. The different cereal types were assigned the following codes: 1 = raisin bran, 2 = all bran, 3 = shredded wheat, 4 = corn flakes, 5 = wheat bran flakes, 6 = granola, 7 = muesli, 8 = puffed rice, 9 = puffed corn, 10 = sweetened corn, wheat and oat blend (e.g. Froot Loops), 11 = multi grain, 12 = chocolate, 13 = toasted oat, 14 = squares (e.g. Chex), 15 = puffed wheat, 16 = oat bran flakes, 17 = toasted rice (e.g. Rice Krispies) and 18 = hot cereal. The status of the cereals (organic *v.* conventional) was confirmed based on information on the shelf product or, when necessary, from the website of the cereal brand or grocery store.

Statistical analysis

The data were analysed using the statistical software package SPSS for Windows version 20·0. Frequencies were generated for the cereal brands and cereal types for both organic and conventional versions. Ranges, means and standard deviations of NuVal scores for all cereals were also produced. ANOVA was performed to compare the mean NuVal scores of the 723 conventional cereals with those of the 106 organic cereals ($P < 0{\cdot}05$ was taken to indicate significance). In addition, ANOVA compared the means of conventional and organic cereals of cereal types with at least six in each group. Eta squared (η^2), the degree of variance accounted for by the organic or conventional status, was computed as a measure of effect size, with a small effect defined as 0·01[16].

Results

The mean NuVal score for all ready-to-eat breakfast cereals (*n* 829) was 28·7 (SD 13·4) and the range was 3–91. NuVal scores were generated for conventional cereals (*n* 723), mean 28·4 (SD 13·4), and organic cereals (*n* 106), mean 30·6 (SD 13·2), and there was no significant difference between the two: $F(1,827) = 2{\cdot}35$, $P = 0{\cdot}13$, $\eta^2 = 0{\cdot}003$.

Cereal type NuVal scores

Table 1 describes the eighteen cereal types evaluated by their status (conventional or organic). The highest percentages of cereal type in the organic category were

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Table 1 Number of ready-to-eat breakfast cereal types evaluated, conventional and organic

	Conventional (*n* 723)		Organic (*n* 106)		Total (*n* 829)	
Cereal type	*n*	%	*n*	%	*n*	%
Raisin bran	24	3	2	2	26	3
All bran	6	1	1	1	7	1
Shredded wheat	51	7	3	3	54	7
Corn flakes	37	5	9	9	46	6
Wheat bran flakes	20	3	3	3	23	3
Granola	109	15	16	15	125	15
Muesli	20	3	3	3	23	3
Puffed rice	5	1	2	2	7	1
Puffed corn	44	6	6	6	50	6
Coloured blend	88	12	1	1	89	11
Multi grain	98	14	37	35	135	16
Chocolate	38	5	3	3	41	5
Toasted oat	67	9	8	8	75	9
Squares	61	8	4	4	65	8
Puffed wheat	11	2	0	0	11	1
Oat bran flakes	3	0	1	1	4	1
Toasted rice	39	5	5	5	44	5
Hot cereal	2	0	2	2	4	1

Table 2 NuVal scores for five types of conventional *v.* organic ready-to-eat breakfast cereals

	Conventional			Organic			
Cereal type	*n*	Mean	SD	*n*	Mean	SD	*P* value
Corn flakes	37	23·3	2·2	9	22·6	5·7	0·52
Granola	109	30·3	11·0	16	29·6	7·4	0·83
Puffed corn	44	25·5	11·4	6	24·7	1·5	0·86
Multi grain	98	29·4	11·1	37	33·8	15·2	0·07
Toasted oat	67	27·9	5·6	8	28·6	2·4	0·71

multi grain (35 %) and granola (15 %). The highest percentage (15 %) in the conventional cereal type was granola, followed by multi grain (14 %).

Table 2 compares the conventional and organic mean NuVal scores overall and within five cereal types based on sufficient sample sizes. There were no significant differences in mean NuVal scores for conventional and organic cereals within any of the cereal types.

Discussion

The present study examined the nutritional quality of eighteen different types of ready-to-eat breakfast cereals to see whether there was a significant difference between these organic and conventional cereals based on the NuVal nutritional scoring system. We found no significant difference in the mean scores; this supported our hypothesis.

To the authors' knowledge, no other studies have specifically reported on the nutritional quality of organic and conventional ready-to-eat breakfast cereals using the NuVal system. Dangour *et al.* reviewed 162 studies comparing nutrients in organic and conventional foods. Chemical analysis was used to determine the nutrient composition of the foods. Their systematic review found no difference in nutrient content between the organic and conventional foods to justify the purchase of organic foods[7]. In a subsequent study, Dangour *et al.* reviewed twelve studies in search of evidence linking organic food consumption to health benefits. That study addressed only the health effects of the nutrients, and not the health impact of pesticides or contaminants. Their review yielded no difference in health benefits between the nutrients in organic and conventional foods[8].

A recent systematic review of 240 studies, from 1966 to 2011, conducted by Stanford University researchers, compared the safety and health impact of conventional and organic foods[9]. Included in the review were seventeen studies on health outcomes in humans, and 223 studies on various types of produce, grains, dairy, meat, poultry and eggs. However, studies on processed foods, such as ready-to-eat breakfast cereals, were excluded. Although some of the studies showed that consumption of organic foods reduced exposure to pesticides, the risk of food contamination from pathogens was equal for conventional and organic foods[9].

In addition, the Stanford University review revealed no statistically significant difference in nutritional quality or health outcomes between conventional and organic foods. These findings support the results of our study. The results of our study suggest that consumers who choose the organic version of a ready-to-eat breakfast cereal based on the assumption that they will have superior nutritional quality may not be making a valid selection.

In a study by Katz *et al.*, the researchers found that NuVal scores were positively correlated with the Healthy Eating Index-2005, as well as with differences between a typical diet reflected by the NHANES 2003–2006 data and the healthier Dietary Approaches to Stop Hypertension diet[17]. A Harvard School of Public Health study by Chiuve *et al.* applied the NuVal algorithm to 20 years of data from

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two large cohort studies of more than 100 000 health professionals in the Nurses' Health Study and the Health Professionals Follow-Up Study. The data analysis showed that consumption of a diet comprised of foods with higher NuVal scores was associated with a reduced risk of chronic disease and total mortality[18].

The ONQI scientific advisory board identified nine criteria for an 'optimal nutrient profiling system'. One criterion is that the system be sophisticated enough to analyse a complex food supply comprised of foods with fortified nutrients, as well as those with intrinsic nutrients. To prevent NuVal score inflation, fortified foods receive limited credit for certain nutrients up to a capped amount. Other foods, which must be fortified with vitamins A and D, such as milk, are not capped. Neither are nutrients such as fibre and *n*-3 fatty acids, which decrease palatability in large quantities. After all of the nutrients are entered into the ONQI algorithm, the ONQI scores may range from 1 to more than 8000. The ONQI score is then compressed to a NuVal score ranging from 1 to 100 for consumer use at the supermarket[14].

Finally, the NuVal scoring system was tested with consumer focus groups to learn about their preference for shopping at supermarkets using the scores from 1 to 100, with nutrition education provided to explain the scores. Overall, consumers were interested in the NuVal system and found it appealing, believable and unique. A separate consumer test compared the NuVal system with another nutrient profiling system that used one to three stars, and 75 % of consumers preferred NuVal[14].

The application of the ONQI algorithm and NuVal scores to breakfast cereals should be of interest to researchers around the world who may be developing nutritional quality scoring systems. Dietary guidance materials from the WHO were used to achieve consensus regarding inclusion of specific nutrients and other factors during development of the first ONQI algorithm[14]. Also, international experts convened to create a WHO manual, currently in press, to guide researchers in the development of nutrient profile models for disease prevention[19].

Researchers from outside the USA have shown interest in the area of nutritional quality scoring systems and their application to public health issues. At the Rudd Center for Food Policy and Obesity at Yale University, the Nutrient Profiling Model developed at Oxford University was used to analyse the nutritional quality of breakfast cereals marketed to children. These studies found that none of the children's cereals met the nutrition standards required by the UK Office of Communications for television advertising to children[20]. Researchers at the University of Sydney used the UK Traffic Light System to study the nutritional quality of Australian breakfast cereals[21]. International interest in the area of nutritional quality scoring systems indicates that more and more consumers globally can benefit from information to help them compare foods to help create an optimally nutritious diet.

The 2010 Dietary Guidelines' Call to Action suggests using the Social-Ecological Model which explains the importance of changing the environment to support individuals in making healthy choices. Environmental strategies include partnerships with retailers to expand access to healthy foods to eliminate health disparities[22]. Although the development of nutritional scoring systems to help consumers make healthier choices at the supermarket has progressed, further research is needed to evaluate specifically how NuVal scores influence nutrition knowledge, perceptions of nutrition quality and intent to purchase food products. It is important that public health nutrition educators, including Registered Dietitians, understand how to use the NuVal score to improve the quality of nutrition information available to consumers at the point of purchase so that the public can successfully navigate the aisles of the supermarket and make healthier food choices.

Both literacy and numeracy impact consumers' ability to read, understand and use nutrition labels[23], so low-literacy populations may benefit from the simplicity of the NuVal score. Nutrition education interventions may help to increase the public's confidence in using NuVal scores as a tool to increase their dietary intake of nutrient-dense foods both organic and conventional. Future research studies might examine usage and preference for the NuVal system in association with diverse demographics, socio-economic status and literacy, as well as health outcomes associated with chronic diseases.

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