Use of Added Sugars Instead of Total Sugars May Improve the Capacity of the Health Star Rating System to Discriminate between Core and Discretionary Foods

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ABSTRACT

Background The Australian Government has introduced a voluntary front-of-package labeling system that includes total sugar in the calculation.

Objective Our aim was to determine the effect of substituting added sugars for total sugars when calculating Health Star Ratings (HSR) and identify whether use of added sugars improves the capacity to distinguish between core and discretionary food products.

Design This study included packaged food and beverage products available in Australian supermarkets (n=3,610). The product categories included in the analyses were breakfast cereals (n=513), fruit (n=571), milk (n=309), non-alcoholic beverages (n=1,040), vegetables (n=787), and yogurt (n=390). Added sugar values were estimated for each product using a validated method. HSRs were then estimated for every product according to the established method using total sugar, and then by substituting added sugar for total sugar. The scoring system was not modified when added sugar was used in place of total sugar in the HSR calculation. Products were classified as core or discretionary based on the Australian Dietary Guidelines. To investigate whether use of added sugar in the HSR algorithm improved the distinction between core and discretionary products as defined by the Australian Dietary Guidelines, the proportion of core products that received an HSR of $\geq$3.5 stars and the proportion of discretionary products that received an HSR of <3.5 stars, for algorithms based upon total vs added sugars were determined.

Results There were 2,263 core and 1,347 discretionary foods; 1,684 of 3,610 (47%) products contained added sugar (median 8.4 g/100 g, interquartile range=5.0 to 12.2 g). When the HSR was calculated with added sugar instead of total sugar, an additional 166 (7.3%) core products received an HSR of $\geq$3.5 stars and 103 (7.6%) discretionary products received a rating of $\geq$3.5 stars. The odds of correctly identifying a product as core vs discretionary were increased by 61% (odds ratio 1.61, 95% CI 1.26 to 2.06; $P<0.001$) when the algorithm was based on added compared to total sugars.

Conclusions In the six product categories examined, substitution of added sugars for total sugars better aligned the HSR with the Australian Dietary Guidelines. Future work is required to investigate the impact in other product categories.
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GLOBALLY, NONCOMMUNICABLE DISEASES ARE THE leading cause of death.[1] Currently, 62.8% of Australians are overweight or obese,[2] and poor diet quality and high body mass index are significant contributors to global disease burden.[3] High added sugar intake is a target for intervention due to associations with nutritionally poor diets, weight gain, dental caries, and consequently, risk of developing non-communicable diseases.[4,5]

The term *added sugars* is defined as the sugars added during food production, including sugars, syrups, honey, and fruit

juice concentrates.[6,7] Despite chemical synonymy with intrinsic sugars naturally present in dairy, fruits, and vegetables, a growing body of evidence has linked added sugars with adverse health outcomes, including dental caries,[8] weight gain,[9] type 2 diabetes,[10] and cardiovascular disease.[11-13] For these reasons, the World Health Organization strongly recommends adults and children consume <10% of total dietary energy from "free sugars."[5] A conditional recommendation was made to further restrict free sugars to <5% of energy to reduce dental caries.[5,8] Free sugars are defined in the same way as added sugar, although free sugars include fruit juice. The 2011-2012 National Nutrition and Physical Activity Survey showed that Australians consume, on average, 10.9% of their daily energy intake from free sugars, with an estimated 52% exceeding the World Health Organization's recommendations for free sugars to contribute <10% total energy, and nearly all (98%) consumed >5% of energy from free sugars.[14]

In 2014, the Australian Government introduced a front-of-package labeling system, the Health Star Rating (HSR), which is currently implemented by the food industry on a voluntary basis.[15] The HSR system rates packaged food products from half a star to five stars, where a greater number of stars represents a healthier food choice.[16] To calculate the HSR, products receive a score based on the amount of energy, saturated fat, sodium, and total sugar per 100 g or 100 mL. In addition, "positive" components, such as fruit and vegetable content, and in some food categories fiber and protein, are also included in the score. This front-of-package labeling system was introduced to make it easier for consumers to compare similar products and choose healthier products. The HSR is designed to be used in conjunction with the Australian Dietary Guidelines. Previous research suggests the HSR is reasonably aligned with the Australian Dietary Guidelines.[17,18] However, the HSR is calculated using total sugar content and, therefore, includes both naturally occurring, intrinsic sugars, and added sugars. As a result, products with naturally occurring sugars from dairy, fruit, and vegetable sources, are penalized by the current labeling system. Consequently, there is a need to investigate the use of added sugars in the calculation of the HSR. This research applied a systematic validated methodology[6] to estimate the added sugar content of packaged food products available in Australia in 2015. The aim was to determine the effect of substituting added sugars for total sugars when calculating the HSR, and identify whether use of added sugars in the algorithm improved the capacity to distinguish between core and discretionary food products.

METHODS

This project used The George Institute for Global Health's Branded Food Composition Database. Methods for the collection of food composition data have been described elsewhere.[19,20] Briefly, the database contains annually updated nutrition information for packaged food products available in Australian supermarkets (ALDI, Coles, IGA, and Woolworths) in Sydney, Australia. Sales from these four supermarkets make up 88.4% of total grocery expenditure in Australia.[21] The 2015 version of this database was used, which comprises data collected between October and December 2015 and contains 22,562 product listings. Products had their brand and product name, nutrient content from the Nutrition Information Panel, and ingredients list recorded following standardized procedures. Nutrient information was used to calculate the HSR and added sugar content. Calculated added sugar values were used to replace total sugars in the HSR algorithm. This study was exempt from Institutional Review Board review because the research did not involve human subjects.

RESEARCH SNAPSHOT

Research Question: Does using added sugar, instead of total sugar, to calculate the Health Star Rating improve its capacity to distinguish between core and discretionary food products?

Key Findings: These analyses included 3,610 packaged food and beverage products available in Australian supermarkets. Using added sugar, in place of total sugar, in the algorithm used to calculate the Health Star Rating increased the odds of correct identification of core vs discretionary products by 61%. Substitution of added sugar for total sugar in this front-of-pack labeling system improved the alignment with the Australian Dietary Guidelines.

Product Categories

These analyses include the following product categories: fruit, vegetables, milk, yogurt, breakfast cereals, and non-alcoholic beverages. Fruit, vegetables, milk, and yogurt categories were included because these products contain a high proportion of natural sugars, and so it was hypothesized that using added sugar in the HSR algorithm instead of total sugar would have the greatest effect in these categories. The nonalcoholic beverages category was included because they are the single greatest source of added sugars in Australian diets,[14] and many of these products are discretionary. We wanted to establish the effect of using added sugars in the HSR algorithm for both core and discretionary products. At present, breakfast cereal manufacturers represent the largest proportion of manufacturers adopting the HSR system[22] and, therefore, analysis of these products has the most relevant implication for suggested alterations to labeling policy. A detailed description of the included product categories is available in Figure 1 (available online at www.jandonline.org).

Estimating the Added Sugar Content of Food and Drink

A validated methodology developed by Louie and colleagues[6] was used to calculate the added sugar content of each included product. Two of the authors conducted these calculations (H.M, K.S.P.). This methodology was developed for use in the Australian food supply, with demonstrated accuracy and good repeatability in estimating added sugar values. In accordance with the methodology, added sugar was defined as refined sugars added during cooking or manufacturing, and includes sugars (sucrose), monosaccharides and disaccharides, syrups, honey, molasses, fruit juice concentrates, and maltodextrin. The definition excludes sugar alcohols, fruit juices, and diluted fruit juice

concentrates. The methodology utilizes a 10-step process whereby added sugar content is estimated using total sugar content as reported on the Nutrition Information Panel (per 100 g) in conjunction with product ingredients list, both of which are mandated on packaged food products for sale in Australia.[23,24]

The following 10-step process was used. The added sugar content of a product was calculated at the first step where calculation was possible.

- Step 1: Assign 0 g added sugar to foods with 0 g total sugars.
- Step 2: Assign 0 g added sugar to foods in food groups that are either unprocessed or minimally processed with no added sugar.
- Step 3: Assign 100% of total sugar as added sugar for foods in food groups that contain no naturally occurring sugars.
- Step 4: Calculation based on standard recipe used in an Australian or overseas food composition database, using the following formula (proportioning method). For each ingredient use the most appropriate step from 1 to 3 to determine the added sugar content.

$$\text{Added sugar (per 100 g)} = \frac{\sum_{i=1}^{j} Wi \; x \; ASi}{\left(\sum_{i=1}^{j} wi\right) x \; (100\% + \%W_{\Delta})}$$

Where W_i is the weight of the i^{th} ingredient in the recipe, AS_i is the added sugar content per 100 g of the i^{th} ingredient and $\%W_{\Delta}$ is the percentage change in weight during cooking.

- Step 5: Calculation based on comparison values from the unsweetened variety.
- Step 6: Decision based on analytical data, for example, all lactose in dairy foods was considered naturally occurring.
- Step 7: Use borrowed values from similar products where steps 1 to 6 were used to determine the added sugar content. The value can also be borrowed from an overseas database. The only overseas database used for these estimates was the US Department of Agriculture's Food Composition Database.
- Step 8: Subjective estimation on the basis of ingredients and/or common recipes. This step is guided by the ingredients list. If none of the ingredients contain added sugar, a value of 0 is assigned. If the ingredients contain added sugar, the proportion of the sugary ingredient(s) in the product is used to estimate the added sugar content.
- Step 9: Calculation based on the standard recipe that includes ingredients with values assigned at steps 5 to 8 using the proportion method (see step 4 for a description).
- Step 10: Assign 50% of total sugars as added sugars where estimation is not possible from steps 1 to 9. This step was only used for 30 products (<1%).

Calculating the HSR

The HSR was calculated in alignment with methods described in the *Guide for Industry to the Health Star Rating Calculator*[16] for all products regardless of whether an HSR rating was reported on pack or not. See Figure 2 (available online at www.jandonline.org) for an overview of the calculation. In accordance with these guidelines, product HSR was calculated via an algorithm including criteria for negative nutrients of energy, saturated fat, total sugars and sodium, as well as positive components of fiber, protein, and fruit, vegetable, nut, and legume (FVNL) content as a percentage of the total product, and calcium for dairy products. When not presented on the package, proxy values calculated by The George Institute were used for fiber and FVNL. These proxy values are based on the average level for the product category. To calculate the HSR using added sugar, these methods were modified such that nutrient criteria for total sugars were instead applied to the calculated added sugar values.

Statistical Analysis

Normality was assessed by inspection of histograms with non-normal distributions observed for all nutrients and the HSR. The difference in median HSR calculated with total sugar and added sugar for each product category was assessed using the Wilcoxon signed-rank test. To determine whether replacing total sugars with added sugars in the algorithm improved the distinction between core and discretionary products, food and drink products were first categorized as core or discretionary per Australian Dietary Guidelines[26] (see Figure 3, available online at www.jandonline.org). Briefly, core foods are those that are included in the five recommended food groups: vegetables and legumes; fruit; milk, yogurt, cheese, and alternatives; lean meats, fish, poultry, eggs, nuts, seeds, and legumes; and grains. Discretionary foods are those that should be consumed occasionally in small amounts because they are not required to meet nutritional requirements and do not fit in the recommended food groups. The proportion of products classified as core and discretionary by the Australian Dietary Guidelines receiving an HSR of <3.5 stars or ≥3.5 stars when the HSR was calculated with added sugar vs total sugar was tabulated. McNemar's test was performed to test for a difference in the proportion of core and discretionary products in each category scoring <3.5 stars or ≥3.5 stars when the HSR was calculated with added sugar vs total sugar. Based on previous work,[18] core products with an HSR of ≥3.5 stars and discretionary products with a rating of <3.5 stars were considered correctly classified. These cutoffs are used in local government healthy food policies.[27] Conditional logistic regression was used to determine the relative odds of correct alignment for algorithms based on total vs added sugars and expressed as odds ratios with 95% CI. Statistical significance was set at $P<0.05$. All values are presented as median and interquartile range (IQR), unless otherwise specified. Analyses were conducted using STATA software.[28]

RESULTS

A total of 3,610 unique packaged food and non-alcoholic beverage products were included in these analyses. Products were allocated into six categories of breakfast cereals (n=513), fruit (n=571), milk (n=309), non-alcoholic beverages (n=1,040), vegetables (n=787), and yogurt (n=390) categories.

Table 1. Comparison of median total and added sugar content of packaged food products available in Australian supermarkets

Category	n	Total Sugar (g/100 g or 100 mL)		Added Sugar (g/100 g or 100 mL)		*P* value[b]
		Median	IQR[a]	Median	IQR	
Breakfast cereals	513	16.5	7.9-22.3	10.1	2.0-17.7	<0.001
Brans	22	17.2	1.5-22.7	12.2	0.0-16.0	<0.001
Breakfast biscuits	26	6.0	2.2-21.1	5.7	2.2-19.5	0.002
Cookie/toaster pastry	26	22.1	17.7-27.9	18.8	14.4-26.4	<0.001
Flakes	82	16.7	10.0-21.3	12.3	9.3-16.2	<0.001
Flavored oats	39	23.0	11.0-24.5	19.7	6.4-23.9	<0.001
Fruit muesli	134	16.5	13.2-19.7	5.1	0.0-8.4	<0.001
Granola/cluster	51	19.4	17.6-22.4	17.4	15.5-19.7	<0.001
Plain muesli	18	6.6	2.1-12.9	6.6	2.1-12.9	0.05
Plain oats	53	1.0	0.6-1.3	0.0	0.0-0.0	<0.001
Puffed	24	3.7	0.9-10.3	3.7	0.9-10.3	>0.99
Sweet	38	28.6	25.0-34.0	28.6	23.8-34.0	0.03
Fruit	571	29.7	11.8-54.3	0.0	0.0-10.3	<0.001
Dried	176	56.5	35.0-67.7	0.0	0.0-8.4	<0.001
Dried with nuts/seeds	64	32.9	26.1-40.3	3.5	0.0-11.5	<0.001
Extruded snacks	87	50.9	40.2-62.7	9.2	0.0-30.2	<0.001
Fresh/frozen	54	8.0	6.5-10.3	0.0	0.0-0.0	<0.001
In juice/syrup	140	12.2	9.8-14.7	0.0	0.0-9.0	<0.001
Other sweetened	6	51.2	40.8-63.2	27.3	27.3-31.6	0.03
Purée	33	13.0	11.3-14.5	0.0	0.0-2.2	<0.001
Yogurt-coated	11	61.6	59.9-67.4	37.6	33.1-42.0	0.003
Milk	309	4.8	2.7-7.3	0.0	0.0-3.0	<0.001
Coconut cream/milk	37	1.5	1.0-2.0	0.0	0.0-0.0	<0.001
Condensed	7	55.9	53.5-56.4	41.2	38.8-41.7	0.02
Flavored dairy	73	8.8	7.9-9.7	3.8	2.9-4.8	<0.001
Flavored milk alternatives	10	5.9	4.6-6.0	4.6	3.0-6.0	0.08
Plain dairy	118	4.8	4.6-5.1	0.0	0.0-0.0	<0.001
Skim (<0.2% fat)	25	5.1	4.7-5.1	0.0	0.0-0.0	<0.001
Light (<2% fat)	46	4.9	4.7-5.1	0.0	0.0-0.0	<0.001
Full cream (>2% fat)	47	4.7	4.5-5.0	0.0	0.0-0.0	<0.001
Plain milk alternatives	57	2.1	1.4-2.8	1.7	0.0-2.3	<0.001
Probiotic drinks	7	12.3	10.5-15.0	10.9	8.7-13.3	0.02
Nonalcoholic beverages	1,040	4.9	0.8-8.5	0.0	0.0-7.7	<0.001
Coconut water	39	4.0	3.5-5.1	0.0	0.0-0.0	<0.001
Fruit drinks	165	9.8	6.9-10.9	7.9	4.0-9.2	<0.001
Fruit/vegetable juices	366	9.8	8.3-10.7	0.0	0.0-0.0	<0.001
Plain sparkling/still water	22	0.0	0.0-0.0	0.0	0.0-0.0	>0.99
Sugar-free	92	0.0	0.0-0.4	0.0	0.0-0.0	<0.001
Sugar-sweetened	356	7.7	5.2-10.9	7.6	5.1-10.9	<0.001

(*continued on next page*)

Table 1. Comparison of median total and added sugar content of packaged food products available in Australian supermarkets (*continued*)

Category	n	Total Sugar (g/100 g or 100 mL)		Added Sugar (g/100 g or 100 mL)		*P* value[b]
		Median	IQR[a]	Median	IQR	
Vegetables	787	2.5	1.0-4.4	0.0	0.0-0.0	<0.001
Canned	278	2.9	1.0-4.0	0.0	0.0-0.0	<0.001
Dried	13	2.4	1.0-6.0	0.0	0.0-0.0	0.001
Flavored fresh/frozen	34	2.8	1.2-5.3	0.0	0.0-0.8	<0.001
Fresh/frozen	180	2.7	1.6-3.9	0.0	0.0-0.0	<0.001
Frozen potato products	73	1.0	0.3-1.0	0.0	0.0-0.0	<0.001
Pickled/marinated	209	2.5	0.8-10.4	0.0	0.0-0.0	<0.001
Yogurt	390	11.8	8.6-13.6	7.2	3.1-9.4	<0.001
Drinking	5	12.0	11.8-13.2	3.2	3.2-3.5	0.04
Flavored	89	12.0	10.0-14.2	7.7	5.9-9.8	<0.001
Fruit	191	12.3	10.1-13.8	8.1	6.0-9.7	<0.001
Natural	67	6.4	4.8-7.2	0.0	0.0-0.0	<0.001
Nonfruit addition	23	15.0	11.0-19.2	8.1	7.1-9.8	<0.001
Yogurt alternative	15	7.4	3.0-13.5	1.2	0.0-13.5	0.006
Total	3,610	8.8	3.5-13.4	0.0	0.0-7.9	<0.001

[a]IQR=interquartile range.
[b]Wilcoxon signed-rank test used to determine the *P* value.

Added Sugar Content of Packaged Food Products

Across the six categories analyzed, 1,684 (47%) products contained added sugar. Overall, mean total sugar content was 12.2 g/100 g (median 8.8 g/100 g; interquartile range [IQR]=3.5 to 13.4 g/100 g) and the mean added sugar content was 5.2 g/100 g (median 0.0 g/100 g; IQR=0.0 to 7.9 g/100 g) (Table 1). Fruit products were found to be highest in total sugars (median 29.7 g/100 g, IQR=11.8 to 54.3 g/100 g), while breakfast cereals were highest in added sugars (median 10.1 g/100 g, IQR=2.0 to 17.7 g/100 g). On the other hand, vegetables were lowest in both total and added sugars (median 2.5 g/100 g, IQR=1.0 to 4.4 g/100 g; and 0.0 g/100 g, IQR=0.0 to 0.0 g/100 g). Average levels of other nutrients (including energy, protein, saturated fat and sodium) are provided in Table 2 (available online at www.jandonline.org).

Using Added Sugar to Calculate the HSR of Packaged Food Products

For all product categories, the median HSR calculated with total sugar and added sugar is included in Table 3 (available online at www.jandonline.org). In every product category, there was a difference in the HSR calculated with total sugar vs added sugar ($P<0.05$). When products were grouped as core or discretionary items as per the Australian Dietary Guidelines, using added sugar to calculate HSR elevated the HSR for all core products (Table 4). For discretionary products, in all categories except breakfast cereals, the median HSR calculated using added sugar was significantly different from the HSR calculated using total sugar ($P<0.05$).

Distinction between Core and Discretionary Packaged Food Products When the HSR Is Calculated with Added Sugar

When the HSR was calculated with added sugar instead of total sugar, the number of core products receiving a rating of ≥3.5 stars increased by 7.3% (Table 5). The number of discretionary products receiving a rating of ≥3.5 stars increased by a similar amount (7.6%). However, for breakfast cereals, milk, and yogurt there was an increase in the proportion of core products that received ≥3.5 stars when added sugar was used to calculate the HSR, but no increase in the star rating of the discretionary products. In the fruit category, there was an increase in the proportion of both core and discretionary products receiving ≥3.5 stars, although for nonalcoholic beverages there was no increase in the number of core or discretionary products receiving ≥3.5 stars when added sugar was used in the HSR algorithm. For vegetables, using added sugar to calculate the HSR resulted in an increase in the number of discretionary products receiving ≥3.5 stars, but no change in the number of core products.

Overall use of added sugar to calculate the HSR resulted in a net improvement in the classification of products as core or discretionary, see Table 6. The odds of correctly aligning core products with ratings ≥3.5 stars and discretionary products with ratings <3.5 stars was increased by 61% (OR 1.61, 95% CI

Table 4. Comparison of median Health Star Rating calculated with total sugars and added sugars of core and discretionary packaged food products available in Australian supermarkets

Category	Core/discretionary[a]	n	HSR[b] Calculated with Total Sugar (Stars)		HSR Calculated with Added Sugar (Stars)		*P* value[d]
			Median	IQR[c]	Median	IQR	
Breakfast cereals	Core	489	4.0	4.0-4.5	4.5	4.0-4.5	<0.001
	Discretionary	24	2.5	2.3-2.5	2.5	2.3-2.5	>0.99
Fruit	Core	282	3.5	3.5-4.5	4.5	4.0-5.0	<0.001
	Discretionary	289	3.0	2.5-3.5	3.5	3.0-4.0	<0.001
Milk	Core	225	4.0	3.5-4.5	4.5	4.0-5.0	<0.001
	Discretionary	84	2.0	1.5-2.5	2.0	1.5-2.5	0.002
Nonalcoholic beverages	Core	388	5.0	4.5-5.0	5.0	5.0-5.0	<0.001
	Discretionary	652	2.0	1.3-2.0	2.0	1.5-2.0	<0.001
Vegetables	Core	506	4.5	4.0-5.0	4.5	4.0-5.0	<0.001
	Discretionary	281	3.0	2.5-3.5	3.0	2.5-3.5	<0.001
Yogurt	Core	373	3.0	2.5-4.0	3.5	2.5-4.5	<0.001
	Discretionary	17	2.0	1.5-3.5	2.0	1.5-3.5	0.046
Total	Core	2,263	4.0	3.5-4.5	4.5	4.0-5.0	<0.001
	Discretionary	1,347	2.0	1.5-3.5	2.5	1.5-3.5	<0.001

[a]Core foods are part of the five recommended food groups: vegetables and legumes; fruit; milk, yogurt, cheese and alternatives; lean meats, fish, poultry, eggs, nuts and seeds, legumes; grains. Discretionary foods are those that should be consumed occasionally in small amounts because they are not required to meet nutritional requirements and do not fit in the recommended food groups.
[b]HSR=Health Star Rating.
[c]IQR=interquartile range.
[d]Wilcoxon signed-rank test used to determine the *P* value.

1.26 to 2.06; $P<0.001$) when compared to the use of total sugars. At a product category level, use of added sugar in the HSR calculation improved classification of breakfast cereals, fruit, milk, and yogurt (all $P<0.001$). There was no improvement for non-alcoholic beverages and a slight worsening in the classification for vegetables.

DISCUSSION

This research is the first to investigate the added sugar content of branded food products in Australia. Estimation of the added sugar content for breakfast cereals, fruit, milk, nonalcoholic beverages, vegetables, and yogurt showed large differences in the total sugar content reported on the package, and the fraction of this contributed by added sugars. Furthermore, while using added sugar in the HSR algorithm in place of total sugar increased the HSR, this tended to be limited to core products, with lesser increases in the HSR occurring in discretionary products. Overall, in these six categories, use of added sugar in the HSR algorithm improved the distinction between core and discretionary food products.

The current study explored the use of added sugar in the HSR algorithm; however, the lack of added sugar labeling in Australia is a significant barrier to adoption of this method. If added sugar was used in the HSR algorithm in place of total sugar, added sugar would likely need to be included on the Nutrition Information Panel to enable the HSR calculation. This would also assist consumers in determining the added sugar content of products, which is important because the dietary guidelines make recommendations for added sugars and not total sugars.[26] In Australia, under current food labeling practice, it is not possible for consumers to determine the quantity of added sugar in products. Presently, to discern added sugar content, consumers must consult the Nutrition Information Panel in conjunction with the ingredients list in a process requiring advanced food literacy skills. In May 2016, it was announced that added sugar will be included on the US Nutrition Facts label and the compliance date was set for July 2018; it was recently announced the compliance date would be extended.[7] Currently, there are no such plans in Australia, however, after a labeling review, Food Standards Australia New Zealand is planning further investigation into the labeling of sugars.[29]

Previous research has shown that the HSR system is able to discriminate between core and discretionary products.[17,18] The current analyses found that using added sugar to calculate the HSR may improve the alignment of the HSR with the Australian Dietary Guidelines in the six categories examined. In accordance with this finding, a recent publication, which used a different method to calculate added sugar, showed that using added sugar in the HSR algorithm improved discrimination between core and discretionary food in all food categories.[30] However, this is an imperfect solution because, in general, use of added sugar in the HSR algorithm tends to elevate the HSR because the added sugar content of a product is typically lower than the total sugar

Table 5. The number of core and discretionary packaged food products receiving <3.5 stars or ≥3.5 stars when the Health Star Ratings is calculated with total sugar and added sugar

Category	Core/discretionary[a]		HSR rating (stars)	Added Sugar		*P* value[c]
				HSR[b] <3.5 stars	HSR ≥3.5 stars	
				←——————n (%)——————→		
Breakfast cereals	Core	Total sugar	<3.5	50 (10.2)	22 (4.5)	<0.001
			≥3.5	0 (0)	417 (85.3)	
	Discretionary		<3.5	20 (83.3)	0 (0)	>0.99
			≥3.5	0 (0)	4 (16.7)	
Fruit	Core	Total sugar	<3.5	1 (0.4)	43 (15.2)	<0.001
			≥3.5	0 (0)	238 (84.4)	
	Discretionary		<3.5	97 (33.6)	95 (32.9)	<0.001
			≥3.5	0 (0)	97 (33.6)	
Milk	Core	Total sugar	<3.5	11 (4.9)	23 (10.2)	<0.001
			≥3.5	0 (0)	191 (84.9)	
	Discretionary		<3.5	82 (97.6)	0 (0)	>0.99
			≥3.5	0 (0)	2 (2.4)	
Nonalcoholic beverages	Core	Total sugar	<3.5	2 (0.5)	0 (0)	>0.99
			≥3.5	0 (0)	386 (99.5)	
	Discretionary		<3.5	506 (77.6)	0 (0)	>0.99
			≥3.5	0 (0)	146 (22.4)	
Vegetables	Core	Total sugar	<3.5	2 (0.4)	1 (0.2)	>0.99
			≥3.5	0 (0)	503 (99.4)	
	Discretionary		<3.5	157 (55.9)	8 (2.8)	0.009
			≥3.5	0 (0)	116 (41.3)	
Yogurt	Core	Total sugar	<3.5	137 (36.7)	77 (20.6)	<0.001
			≥3.5	0 (0)	159 (42.6)	
	Discretionary		<3.5	12 (70.6)	0 (0)	>0.99
			≥3.5	0 (0)	5 (29.4)	
Total	Core	Total sugar	<3.5	203 (9)	166 (7.3)	<0.001
			≥3.5	0 (0)	1,894 (83.7)	
	Discretionary		<3.5	874 (64.9)	103 (7.6)	<0.001
			≥3.5	0 (0)	370 (27.5)	

[a]Core foods are part of the five recommended food groups: vegetables and legumes; fruit; milk, yogurt, cheese and alternatives; lean meats, fish, poultry, eggs, nuts and seeds, legumes; grains. Discretionary foods are those that should be consumed occasionally in small amounts because they are not required to meet nutrition requirements and do not fit in the recommended food groups.

[b]HSR=Health Star Ratings.

[c]McNemar's test used to determine *P* values.

content and, therefore, fewer negative points are scored. Of particular concern is elevation in the HSR of discretionary products. In these analyses of six product categories, when added sugar was used in the HSR algorithm instead of total sugar, the number of discretionary products that received an HSR of ≥3.5 stars increased by 7.6%, this is in comparison to a 7.3% increase in core products receiving an HSR of ≥3.5 stars. The overall result was a 61% increase in the number of products that were correctly identified as core or discretionary when added sugar was used in the HSR algorithm. The number of discretionary products receiving a higher HSR when added sugar is used in the HSR algorithm may be reduced if the scoring system was recalibrated for added sugar. This issue should be investigated further in future work.

One of the HSR system's greatest criticisms is that fruits and vegetables do not score five stars, and this issue was one of the motivations for testing the inclusion of added sugar in the HSR algorithm. However, the present analyses demonstrated that even when the HSR is calculated with added sugars, fresh fruit and vegetables do not receive five stars; in fact, the HSR for these products are not elevated at all. This is because sugar is just one component of the HSR scoring system and, therefore, a relatively modest improvement in the sugar score does not elevate the overall HSR. The second issue is that the system was not originally designed for

Table 6. The proportion of products correctly and incorrectly classified when the Health Star Ratings is calculated with added sugar and total sugar

Category			Added Sugar		
			Incorrect[a]	Correct	*P* value[b]
			←——————*n (%)*——————→		
Breakfast cereals	Total sugar	Incorrect	54 (10.5)	22 (4.3)	<0.001
		Correct	0 (0)	437 (85.2)	
Fruit	Total sugar	Incorrect	98 (17.2)	43 (7.5)	<0.001
		Correct	95 (16.6)	335 (58.7)	
Milk	Total sugar	Incorrect	13 (4.2)	23 (7.4)	<0.001
		Correct	0 (0)	273 (88.4)	
Non-alcoholic beverages	Total sugar	Incorrect	148 (14.2)	0 (0)	>0.99
		Correct	0 (0)	892 (85.8)	
Vegetables	Total sugar	Incorrect	118 (15)	1 (0.1)	0.04
		Correct	8 (1)	660 (83.9)	
Yogurt	Total sugar	Incorrect	142 (36.4)	77 (19.7)	<0.001
		Correct	0 (0)	171 (43.9)	
Total	Total sugar	Incorrect	573 (15.9)	166 (4.6)	<0.001
		Correct	103 (2.9)	2,768 (76.7)	

[a]Incorrect: Core and Health Star Ratings (HSR) <3.5 or Discretionary and HSR ≥3.5; Correct: Core and HSR ≥3.5 or Discretionary and HSR <3.5. Core foods are part of the five recommended food groups: vegetables and legumes; fruit; milk, yoghurt, cheese and alternatives; lean meats, fish, poultry, eggs, nuts and seeds, legumes; grains. Discretionary foods are those that should be consumed occasionally in small amounts because they are not required to meet nutritional requirements and do not fit in the recommended food groups.
[b]McNemar's test used to determine the *P* value.

nonpackaged food products and therefore the nutrient composition of these foods was not taken into consideration. In order to fix this criticism of the HSR, additional solutions are required.

Although added sugars in the Australian food supply has previously been assessed for generic items in food composition databases,[6,31,32] this research is the first to estimate the added sugar content of branded packaged food products using the validated method developed by Louie and colleagues.[6] Another strength of these analyses is the use of The George Institute for Global Health's Branded Food Composition Database. This database contains nutrient data that has been collected by rigorous methods from four major Australian supermarket chains with a large market share.[19,20] In addition, the data used were collected in 2015, so is likely to reflect the current Australian food supply, and the products included in these analyses are likely to be purchased by a large number of urban consumers.

Despite a rigorous methodology, limitations should be considered. Primarily, as only six product categories were examined, results may not be representative of the wider Australian food supply. However, the six categories that were examined are product categories in which the foods contain a high proportion of intrinsic sugar relative to added sugar (fruits, vegetables, and dairy products), or are high in added sugar, in the case of breakfast cereals and non-alcoholic beverages. Therefore, these categories are representative of the two extremes of the spectrum and it was hypothesized that this is where the greatest impact of using added sugar in the HSR algorithm would have been observed. The algorithm for calculating the HSR is based on a nutrient profiling system that includes energy, total sugar, sodium, saturated fat, and, in some cases FVNL, fiber, and protein. Therefore, the system takes a nutrient-based approach and, increasingly, the importance of considering whole foods and dietary patterns is being recognized. Further, the methodology used for calculating added sugars has a number of limitations, which have been summarized by Louie and colleagues.[6] The limitations likely to impact the current analyses are the subjective nature of some parts of the methodology. In particular, in some cases it is not clear which is the most appropriate step to use for the added sugar calculation, in many cases steps 7 to 10 require assumptions to be made about product formulation. However, this was minimized by having two individuals estimate the added sugar content, and thus is likely to have limited effect on the calculated average added sugar content at the product category level. Another limitation is that for some products, calculation of added sugars is dependent on recipes used in the food composition databases (eg, AUSNUT, NUTTAB). These databases provide average nutrient levels for a typical product (eg, strawberry yogurt) rather than actual nutrient composition, which will vary for individual products due to manufacturer formulation. Using this approach may therefore underestimate the variability in added sugar content (and the resulting HSR calculations based on added sugar). Lastly, because fiber and FVNL values are not reported on package proxy values developed by The George Institute were used.

CONCLUSIONS

In the six product categories examined, the use of added sugar in the HSR algorithm improved the distinction between core

and discretionary foods. However, modification to the HSR algorithm may be required if added sugars are to be used in place of total sugars. Future research should confirm these results through analysis of a larger number of product categories.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

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Category	Description
Breakfast cereals	
Brans	Unprocessed brans, plain bran cereals, and bran cereals with additions such as fruit and/or nuts.
Breakfast biscuits	Wheat biscuit cereals (eg, Weet-Bix[a] and similar products) and small biscuit cereals (eg, Weet-Bix Bites[a] and similar products).
Cookie/toaster pastry	Fortified biscuit products for consumption as a breakfast alternative, rusks, and toaster pastries (eg, Pop Tarts[b] and similar products).
Flakes	Flake cereals from wheat, corn, rice and/or oat, and/or other grain. Including flake cereals with additions such as fruit and/or nuts.
Flavored oats	Oats and oat alternatives with the addition of flavorings, fruit, spices and/or sugar.
Fruit muesli	Mix of oats and other cereals with fruit. Product may contain nuts and/or seeds or other addition eg, chocolate chips, yogurt compound.
Granola/cluster	Granola or cluster-type cereal.
Plain muesli	Mix of oats and other cereals without the addition of fruit. Product may contain nuts and/seeds or other non-fruit addition, eg, chocolate chips, yogurt.
Plain oats	Instant or rolled oats, or plain oat alternative without the addition of flavorings, fruit, spices, sugar, or other non-grain addition.
Puffed	Toasted, puffed cereals of corn, rice, wheat, or other grain (eg, rice bubbles and similar products), excluding chocolate or other flavored varieties (eg, cocoa pops and similar products).
Sweet	Sweet style and flavored cereals, including cocoa-based cereals, fruit flavored cereals, and Nutri-Grain[b]—style cereals.
Fruit	
Dried	Plain dried fruits, including coconut, without the addition of nuts/seeds or yogurt compound.
Dried with nuts/seeds	Dried fruits with the addition of nuts/seeds, including those with contribution from compound yogurt or chocolate chips.
Extruded snacks	Snack products based on dried fruit, fruit juice, fruit purée or fruit pulp, either alone or in combination with other non-fruit ingredients, such as grains, nuts, or seeds.
Fresh/frozen	Packaged fresh or frozen fruits.
In juice/syrup	Fruit pieces in fruit juice and/or sugar-sweetened liquid. Includes fruit pieces in fruit purée/liquid mixes and coconut water.
Other sweetened	Sweetened fruit products, including fruit minces and firm, conserve-style dried fruit logs.
Purée	Blended/mashed fruit products.
Yogurt-coated	Dried fruit—based products coated with yogurt.
Milk	
Coconut cream/milk	Liquids derived from the grated flesh of coconuts for use in cooking, and excluding those intended for use as a beverage/milk alternative.
Condensed	Dairy-based condensed milk.
Flavored dairy	Dairy milk that has been flavored and/or sweetened.
Flavored milk alternatives	Non—dairy-derived, flavored alternatives to cow's milk, including almond, oat, rice, and soy, as well as other flavored milk alternatives formulated with use of grains, nuts, or seeds.

(continued on next page)

Figure 1. Detailed description of the products included in each of the categories examined. [a]Sanitarium. [b]Kellogg Company.

Category	Description
Plain dairy	Unflavored and unsweetened dairy milks, including evaporated milk.
Plain milk alternatives	Non−dairy-derived, unflavored alternatives to cow's milk, including almond, oat, rice, and soy, as well as other milk alternatives formulated with use of grains, nuts, or seeds.
Probiotic drink	Dairy milk−based beverage containing live bacteria to be consumed for intended gastrointestinal health benefits.
Nonalcoholic beverages	
Coconut water	Beverages derived from the clear liquid portion of young coconuts, includes plain/100% coconut water, as well as sweetened or otherwise flavored coconut waters.
Fruit drink	Fruit juice−based beverages containing <100% fruit juice.
Fruit/vegetable juice	100% fruit and/or vegetable juices, including juice-based smoothies (formulated without the addition of milk), as well as carbonated 100% juices.
Plain sparkling/still water	Unflavored, unsweetened carbonated or still water.
Sugar-free	Artificially sweetened cordials, electrolyte drinks, energy drinks, soft drinks, and waters.
Sugar-sweetened	Cordials, electrolyte drinks, energy drinks, soft drinks, and flavored or sweetened waters.
Vegetables	
Canned	All canned vegetables including legumes and baked beans.
Dried	All dehydrated vegetable products.
Flavored fresh/ frozen	Packaged fresh or frozen vegetables with the addition of flavorings, such as dressings, sauces, or seasonings, excluding frozen potato products.
Fresh/frozen	Packaged fresh or frozen vegetables without added flavoring.
Frozen potato products	Frozen potato-based products, including potato chips, wedges, hash browns, potato gems, and other potato-based frozen products.
Pickled/marinated	Vegetables preserved in vinegar or brine or marinated in oil, including those with the addition of herbs, spices, or other seasonings eg, capers, capsicum/peppers, dolmades, olives, pickles/gherkins, and sundried tomatoes.
Yogurt	
Drinking	Low viscosity, dairy milk yogurts intended to be consumed as a beverage.
Flavored	Dairy milk yogurts that been flavored and/or sweetened, including lactose-free varieties and those prepared from dry mixes. Excludes yogurts containing fruit.
Fruit	Dairy milk yogurts containing fruit, including lactose-free varieties and those prepared from dry mixes.
Natural	Unflavored, unsweetened plain dairy milk yogurts without additions.
Nonfruit addition	Dairy milk yogurts containing additions other than fruit, such as cereals, confectionary, and/or nuts/ seeds. Products in this category may also contain fruit in their ingredients.
Yogurt alternatives	All varieties of non−dairy-derived alternatives to yogurt formulated from coconut or soy.

Figure 1. *(continued)* Detailed description of the products included in each of the categories examined. [a]Sanitarium. [b]Kellogg Company.

Step 1: Determine the HSR Category of the Food
Each food item is assigned to one of six categories:

Category 1: Beverages other than dairy beverages
Category 1D: Dairy beverages
Category 2: All foods other than those included in Category 1, 1D, 2D, 3, or 3D
Category 2D: Dairy foods other than those included in Category 1D or 3D
Category 3: Oils and spreads
Category 3D: Cheese and processed cheese (with calcium content >320 mg/100 g)

Category 1D. Milk and dairy beverage alternatives derived from legumes, cereals, nuts, or seeds may be considered in the dairy beverages category (1D).
Step 2: Determine the Form of the Food for the HSR
The HSR was derived based on the nutrient values presented in the Nutrition Information Panel of the product. As a general rule, nutrient values are entered into the database as follows:

- If nutrient values for both "as sold" and "as prepared" are provided, the nutrient values for "as sold" are entered and the product is flagged as "Unprepared" in the database. "Unprepared" foods were not included in these analyses.
- If nutrient values are only provided "as prepared" or "as consumed" then these values are entered and are flagged as "Prepared" in the database. "Prepared" foods were not included in these analyses.

Step 3: Calculate HSR Baseline Points
HSR baseline points are calculated for the average quantity of energy, saturated fat, total sugars, and sodium in 100 g or 100 mL of the food (based on the units used in the Nutrition Information Panel). HSR baseline points are given in Tables A and B for determining the HSR of a food, with a maximum of 30 points assigned to some components.
Step 4: Calculate HSR Modifying Points.
Modifying points were given for the amount of fruits, nuts, vegetables, and legumes (FVNL) in a food product (Table C) and, in some cases, the amount of protein and dietary fiber (Table D). Because FVNL and fiber are not mandatory on Nutrition Information Panels, proxy values are based on mean food category levels.
Step 5: Calculate the Final HSR Score
Final HSR score=baseline points−(fruit and vegetable [V] points)−(protein points)−(dietary fiber points).
Step 6: Assignment of a Rating to Food Based on the Final HSR Score
The HSR score was assigned a rating based on Table E, depending on which of the six categories of food in the HSR calculator it was classified.

Figure 2. Overview of the procedure used to calculate the Health Star Rating. This overview is adapted from Wu and colleagues[25] and the Health Star Rating Guidelines for Industry.[16]

Table A. Health Star Rating baseline points for category 1, 1D, 2, or 2D foods

Baseline points	Energy content (kJ) per 100 g or 100 mL	Saturated fatty acids (g) per 100 g or 100 mL	Total sugars (g) per 100 g or 100 mL	Sodium (mg) per 100 g or 100 mL
0	≤335	≤1.0	≤5.0	≤90
1	>335	>1.0	>5.0	>90
2	>670	>2.0	>9.0	>180
3	>1,005	>3.0	>13.5	>270
4	>1,340	>4.0	>18.0	>360
5	>1,675	>5.0	>22.5	>450
6	>2,010	>6.0	>27.0	>540
7	>2,345	>7.0	>31.0	>630

(*continued on next page*)

Table A. Health Star Rating baseline points for category 1, 1D, 2, or 2D foods (*continued*)

Baseline points	Energy content (kJ) per 100 g or 100 mL	Saturated fatty acids (g) per 100 g or 100 mL	Total sugars (g) per 100 g or 100 mL	Sodium (mg) per 100 g or 100 mL
8	>2,680	>8.0	>36.0	>720
9	>3,015	>9.0	>40.0	>810
10	>3,350	>10.0	>45.0	>900
11	>3,686	>11.2	>49.0	>1,005
12	—	>12.5	>54.0	>1,121
13	—	>13.9	>58.0	>1,251
14	—	>15.5	>63.0	>1,397
15	—	>17.3	>67.0	>1,559
16	—	>19.3	>72.0	>1,740
17	—	>21.6	>76.0	>1,942
18	—	>24.1	>81.0	>2,168
19	—	>26.9	>85.0	>2,420
20	—	>30.0	>90.0	>2,701
21	—	>33.5	>94.0	>3,015
22	—	>37.4	>99.0	>3,365
23	—	>41.7	—	>3,756
24	—	>46.6	—	>4,192
25	—	>52.0	—	>4,679
26	—	>58.0	—	>5,223
27	—	>64.7	—	>5,829
28	—	>72.3	—	>6,506
29	—	>80.6	—	>7,262
30	—	>90	—	>8,106

Table B. Health Star Rating baseline points for category 3 and 3D foods

Baseline points	Energy content (kJ) per 100 g or 100 mL	Saturated fatty acids (g) per 100 g or 100 mL	Total sugars (g) per 100 g or 100 mL	Sodium (mg) per 100 g or 100 mL
0	≤335	≤1.0	≤5.0	≤90
1	>335	>1.0	>5.0	>90
2	>670	>2.0	>9.0	>180
3	>1,005	>3.0	>13.5	>270
4	>1,340	>4.0	>18.0	>360
5	>1,675	>5.0	>22.5	>450
6	>2,010	>6.0	>27.0	>540
7	>2,345	>7.0	>31.0	>630
8	>2,680	>8.0	>36.0	>720
9	>3,015	>9.0	>40.0	>810
10	>3,350	>10.0	>45.0	>900

(*continued on next page*)

Table B. Health Star Rating baseline points for category 3 and 3D foods (*continued*)

Baseline points	Energy content (kJ) per 100 g or 100 mL	Saturated fatty acids (g) per 100 g or 100 mL	Total sugars (g) per 100 g or 100 mL	Sodium (mg) per 100 g or 100 mL
11	>3,685	>11.0	—	>990
12	—	>12.0	—	>1,080
13	—	>13.0	—	>1,170
14	—	>14.0	—	>1,260
15	—	>15.0	—	>1,350
16	—	>16.0	—	>1,440
17	—	>17.0	—	>1,530
18	—	>18.0	—	>1,620
19	—	>19.0	—	>1,710
20	—	>20.0	—	>1,800
21	—	>21.0	—	>1,890
22	—	>22.0	—	>1,980
23	—	>23.0	—	>2,070
24	—	>24.0	—	>2,160
25	—	>25.0	—	>2,250
26	—	>26.0	—	>2,340
27	—	>27.0	—	>2,430
28	—	>28.0	—	>2,520
29	—	>29.0	—	>2,610
30	—	>30.0	—	>2,700

Table C. Health Star Rating fruit and vegetable (V) points

Points	% Concentrated fruit or vegetables	% FVNL[a]
0	<25	≤40
1	≥25	>40
2	≥43	>60
3	≥52	>67
4	≥63	>75
5	≥67	>80
6	≥80	>90
7	≥90	>95
8[b]	100	100

[a]FVNL=fruits, nuts, vegetables, and legumes.
[b]For the purposes of Health Star Rating calculator, a food that is >99.5% FVNL counts as 100% FVNL where food additives or fortificants have been added, eg, pure fruit juice with added vitamin C.

Table D. Health Star Rating protein and dietary fiber points

Points	Protein (g) per 100 g or 100 mL	Dietary fiber (g) per 100 g or 100 mL
0	≤1.6	≤0.9
1	>1.6	>0.9
2	≥3.2	>1.9
3	>4.8	>2.8
4	>6.4	>3.7
5	>8.0	>4.7
6	>9.6	>5.4
7	>11.6	>6.3
8	>13.9	>7.3
9	>16.7	>8.4
10	>20.0	>9.7
11	>24.0	>11.2
12	>28.9	>13.0
13	>34.7	>15.0
14	>41.6	>17.3
15	>50.0	>20.0

Table E. Final scores used to assign Heath Star Ratings

Health Star Rating	Food Category					
	1	1D	2[a]	2D[b]	3	3D
5	≤−6	≤−2	≤−11	≤−2	≤13	≤22
4½	−5	−1	−10 to −7	−1	14 to 16	23 to 24
4	−4	0	−6 to −2	0	17 to 20	25 to 26
3½	−3	1	−1 to 2	1	21 to 23	27 to 28
3	−2	2	3 to 6	2	24 to 27	29 to 30
2½	−1	3	7 to 11	3	28 to 30	31 to 32
2	0	4	12 to 15	4	31 to 34	33 to 34
1½	1	5	16 to 20	5	35 to 37	35 to 36
1	2	6	21 to 24	6	38 to 41	37 to 38
½	≥3	≥7	≥25	≥7	≥42	≥39

[a]All foods other than dairy not in Category 1 or 3.
[b]All dairy foods not in Category 1D or 3D.

Core	Discretionary
Cereals	
Cereal with ≤30 g added sugar	Cereal with ≥30 g added sugar
Fruit	
Unsweetened dried fruit (excluding coconut) Unsweetened dried fruit with nuts/seeds Fresh/frozen fruit Fruit in juice Unsweetened fruit purée	Coconut Sweetened dried fruit Sweetened dried fruit with nuts/seeds Fruit bars/bites Fruit in syrup Sweetened fruit puree Yogurt-coated fruit products All miscellaneous products
Milk	
All plain dairy milk All flavored dairy milk Plain milk alternatives with >100 mg calcium/100 mL Flavored milk alternatives with >100 mg calcium/100 mL Probiotic drinks with >100 mg calcium/100 mL	Coconut cream/milk Plain milk alternatives with <100 mg calcium/100 mL Flavored milk alternatives with <100 mg calcium/100 mL Condensed milk Probiotic drinks with <100 mg calcium/100 mL
Nonalcoholic beverages	
Fruit/vegetable juices Plain sparkling/still water	Fruit drinks Sugar-sweetened beverages Sugar-free beverages Coconut water
Vegetables	
Canned vegetables Dried vegetables (excluding fried shallots but including instant mashed potato) Fresh packaged fruit and vegetables All frozen vegetables (including flavored) Frozen roast potato, mashed potato	Potato chips Hash browns/potato gems Frozen potato bakes and similar Wedges All pickled/marinated vegetables
Yogurt	
Drinking yogurt All dairy-based yogurt (excluding those with chocolate additions) Soy yogurt alternatives with >100 mg calcium/100 g	Dairy-based yogurts with chocolate pieces Soy yogurt alternatives with <100 mg calcium/100 g Coconut yogurts

Figure 3. Categorization of products as core or discretionary as per the Australian Dietary Guidelines.

Table 2. Nutrient composition (energy, protein, saturated fat, sodium) of packaged food products in these analyses

Category	n	Nutrients/100 g or 100 mL			
		Energy (kJ)	Protein (g)	Saturated Fat (g)	Sodium (mg)
		median (IQR[a])			
Breakfast cereals	513	1,610 (1,557-1,710)	10.1 (8.4-12.0)	1.5 (0.6-2.3)	46 (10-245)
Brans	22	1,475 (1,370-1,560)	11.8 (9.5-15.2)	0.9 (0.5-1.5)	265 (5-315)
Breakfast biscuits	26	1,490 (1,480-1,570	10.7 (9.3-12.4)	0.4 (0.3-1.0)	278 (235-360)
Cookie/toaster pastry	26	1,764 (1,670-1,840)	7.5 (5.3-8.4)	3.2 (1.5-4.8)	323 (164-380)
Flakes	82	1,555 (1,520-1,600)	8.7 (7.8-10.1)	0.5 (0.3-0.9)	235 (120-350)
Flavored oats	39	1,600 (1,570-1,630)	10.4 (9.5-11.1)	1.3 (1.2-1.8)	20 (10-35)
Fruit muesli	134	1,639 (1,570-1,750)	10.7 (9.8-11.7)	1.9 (1.5-3.5)	18 (9-38)
Granola/cluster	51	1,810 (1,740-1,880)	9.6 (8.9-11.3)	2.4 (1.6-4.1)	50 (11-140)
Plain muesli	18	1,780 (1,720-1,871)	12.2 (10.7-14.9)	2.9 (1.9-3.1)	20 (9-60)
Plain oats	53	1,590 (1,567-1,602)	12.4 (10.9-13.6)	1.5 (1.4-1.7)	5 (3-7)
Puffed	24	1,603 (1,553-1,629)	7.8 (6.9-12.1)	0.4 (0.3-0.6)	10 (4-270)
Sweet	38	1,620 (1,600-1,660)	7.0 (6.2-8.0)	0.7 (0.3-1.1)	273 (138-360)
Fruit	571	1,210 (265-1,540)	1.5 (0.6-4.0)	0.3 (0.1-2.0)	10 (5-34)
Dried	176	1,341 (1,150-1,469)	2.4 (1.8-3.4)	0.4 (0.1-1.0)	20 (7-41)
Dried with nuts/seeds	64	1,960 (1,834-2,063)	11.5 (9.5-12.8)	4.4 (3.5-5.5)	20 (11-46)
Extruded snacks	87	1,480 (1,360-1,630)	2.7 (1.6-7.5)	1.3 (0.5-3.0)	28 (10-47)
Fresh/frozen	54	211 (180-238)	1.0 (0.7-1.2)	0.1 (0.1-1.0)	5 (1-5)
In juice/syrup	140	257 (228-293)	0.5 (0.3-0.7)	0.1 (0.0-0.1)	5 (5-7)
Other sweetened	6	1,564 (1,210-1,930)	3.6 (0.7-7.4)	1.9 (0.1-2.2)	120 (17-140)
Purée	33	275 (235-296)	0.4 (0.2-0.5)	0.1 (0.0-0.1)	5 (4-12)
Yogurt-coated	11	2,057 (1,956-2,110)	3.9 (2.9-4.6)	22.3 (21.6-23.6)	66 (44-72)
Milk	309	250 (182-297)	3.1 (1.9-3.4)	1.0 (0.4-2.2)	43 (38-52)
Coconut cream/milk	37	652 (435-782)	1.1 (1.0-1.9)	12.1 (9.0-15.2)	24 (17-43)
Condensed	7	1,370 (1,250-1,400)	7.1 (6.9-8.7)	5.4 (4.2-6.0)	90 (90-100)
Flavored dairy	73	277 (249-310)	3.3 (3.0-3.5)	1.1 (0.9-1.5)	45 (39-52)
Flavored milk alternatives	10	182 (116-238)	1.0 (0.5-2.9)	0.2 (0.1-1.0)	55 (50-59)
Plain dairy	118	205 (170-261)	3.3 (3.2-3.4)	1.0 (0.6-2.2)	43 (39-48)
Skim (<0.2% fat)	25	145 (141-147)	3.4 (3.3-3.4)	0.1 (0.1-0.1)	43 (39-52)
Light (<2% fat)	46	187 (178-207)	3.3 (3.2-3.5)	0.9 (0.8-1.0)	43 (39-47)
Full cream (>2% fat)	47	262 (254-275)	3.2 (3.1-3.4)	2.3 (2.2-2.6)	43 (39-48)
Plain milk alternatives	57	175 (115-244)	0.7 (0.5-2.9)	0.3 (0.1-0.4)	45 (37-57)
Probiotic drinks	7	297 (220-319)	1.3 (1.2-4.0)	0.1 (0.1-0.6)	24 (15-66)
Nonalcoholic beverages	1040	170 (99-193)	0.1 (0.0-1.0)	0.0 (0.0-0.1)	8 (4-12)
Coconut water	39	90 (80-111)	0.1 (0.0-0.2)	0.0 (0.0-0.0)	20 (17-40)
Fruit drinks	165	179 (138-197)	0.1 (0.1-1.0)	0.0 (0.0-0.0)	5 (1-8)
Fruit/vegetable juices	366	187 (172-204)	0.6 (0.3-1.0)	0.0 (0.0-0.1)	6 (4-8)
Plain sparkling/still water	22	0 (0-0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	4 (1-5)
Sugar-free	92	5 (2-12)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	11 (7-15)
Sugar-sweetened	356	139 (94-191	0.0 (0.0-0.1)	0.0 (0.0-0.0)	9 (5-13)

(*continued on next page*)

Table 2. Nutrient composition (energy, protein, saturated fat, sodium) of packaged food products in these analyses (*continued*)

Category	n	Nutrients/100 g or 100 mL			
		Energy (kJ)	Protein (g)	Saturated Fat (g)	Sodium (mg)
		median (IQR[a])			
Vegetables	787	300 (128-499)	2.1 (1.2-3.6)	0.2 (0.1-1.0)	230 (27-400)
Canned	278	275 (107-389)	2.6 (1.2-5.5)	0.1 (0.1-0.2)	240 (100-298)
Dried	13	375 (331-690)	4.3 (1.9-5.2)	0.6 (0.1-1.4)	160 (60-275)
Flavored fresh/frozen	34	384 (337-488)	1.9 (1.6-3.3)	1.0 (0.2-3.2)	211 (140-263)
Fresh/frozen	180	151 (114-266)	2.5 (1.7-3.3)	0.1 (0.1-0.6)	17 (5-30)
Frozen potato products	73	629 (559-701)	2.5 (2.0-2.9)	0.5 (0.4-0.7)	220 (68-330)
Pickled/marinated	209	413 (177-788)	1.2 (0.9-2.2)	1.0 (0.1-2.3)	770 (440-1,450)
Yogurt	390	420 (362-540)	4.9 (4.2-5.7)	1.9 (1.0-3.6)	54 (44-65)
Drinking	5	322 (321-389)	4.1 (3.5-4.1)	0.6 (0.6-1.7)	51 (40-52)
Flavored	89	441 (376-544)	4.7 (4.1-5.1)	2.5 (1.2-3.6)	52 (44-61)
Fruit	191	398 (362-521)	4.9 (4.2-5.4)	1.4 (1.0-3.4)	53 (43-63)
Natural	67	366 (298-435)	5.6 (4.8-6.5)	2.6 (1.3-4.4)	65 (49-81)
Nonfruit addition	23	602 (535-631)	6.0 (4.9-6.4)	2.1 (1.0-3.3)	60 (52-65)
Yogurt alternative	15	611 (421-900)	2.3 (2.2-3.8)	11.5 (1.0-18.5)	20 (19-126)
Total	3,610	280 (174-891)	2.0 (0.6-5.2)	0.3 (0.0-1.3)	27 (7-72)

[a]IQR=interquartile range.

Table 3. Comparison of median Health Star Rating calculated with total sugars and added sugars of packaged food products available in Australian supermarkets

		HSR[a] Calculated with Total Sugar (Stars)		HSR Calculated with Added Sugar (Stars)		
Category	n	Median	IQR[b]	Median	IQR	*P* value
Breakfast cereals	513	4.0	3.5-4.5	4.0	4.0-4.5	<0.001
Brans	22	5.0	4.0-5.0	5.0	4.5-5.0	0.03
Breakfast biscuits	26	4.5	4.0-5.0	4.5	4.0-5.0	>0.99
Cookie/toaster pastry	26	2.5	2.0-2.5	2.5	2.0-2.5	0.08
Flakes	82	4.0	4.0-4.0	4.0	4.0-4.5	0.002
Flavored oats	39	4.0	4.0-4.0	4.0	4.0-4.0	0.046
Fruit muesli	134	4.0	4.0-4.5	4.5	4.0-4.5	<0.001
Granola/cluster	51	4.0	3.0-4.0	4.0	3.5-4.0	<0.001
Plain muesli	18	4.5	4.0-4.5	4.5	4.0-4.5	>0.99
Plain oats	53	5.0	5.0-5.0	5.0	5.0-5.0	>0.99
Puffed	24	4.0	3.5-4.5	4.0	3.5-4.5	>0.99
Sweet	38	2.5	2.5-3.5	2.5	2.5-3.5	>0.99
Fruit	571	3.5	3.0-4.0	4.0	3.5-4.5	<0.001
Dried	176	3.5	3.0-4.0	5.0	3.5-5.0	<0.001
Dried with nuts/seeds	64	3.0	2.5-3.0	4.5	3.3-4.5	<0.001
Extruded snacks	87	2.5	2.0-3.0	4.0	3.0-4.5	<0.001
Fresh/frozen	54	4.5	4.5-4.5	4.5	4.5-4.5	>0.99
In juice/syrup	140	3.5	3.5-3.5	3.5	3.5-4.0	<0.001
Other sweetened	6	1.5	1.5-1.5	2.3	2.0-2.5	0.02
Purée	33	4.0	4.0-4.0	4.0	4.0-4.0	0.08
Yogurt-coated	11	0.5	0.5-0.5	0.5	0.5-0.5	0.16
Milk	309	4.0	2.5-4.5	4.0	2.5-4.5	<0.001
Coconut cream/milk	37	2.0	2.0-2.5	2.0	2.0-2.5	>0.99
Condensed	7	1.0	1.0-1.5	1.5	1.5-1.5	0.03
Flavored dairy	73	3.5	3.0-4.0	4.0	3.5-5.0	<0.001
Flavored milk alternatives	10	2.0	1.5-4.0	2.0	2.0-4.0	0.16
Plain dairy	118	4.5	4.0-4.5	4.5	4.0-5.0	<0.001
Skim (<0.2% fat)	25	4.5	4.5-5.0	5.0	5.0-5.0	<0.001
Light (<2% fat)	46	4.5	4.5-5.0	4.5	4.5-5.0	<0.001
Full cream (>2% fat)	47	4.0	3.5-4.0	4.0	3.5-4.0	0.008
Plain milk alternatives	57	3.5	2.0-4.5	3.5	2.0-4.5	0.32
Probiotic drinks	7	1.0	0.5-4.0	1.5	1.0-4.0	0.08
Nonalcoholic beverages	1,040	4.0	1.5-5.0	4.0	1.5-5.0	<0.001
Coconut water	39	2.0	1.5-2.0	2.0	2.0-2.0	<0.001
Fruit drinks	165	4.5	4.0-5.0	5.0	4.5-5.0	<0.001
Fruit/vegetable juices	366	5.0	4.5-5.0	5.0	5.0-5.0	<0.001
Plain sparkling/still water	22	5.0	5.0-5.0	5.0	5.0-5.0	>0.99
Sugar-free	92	2.0	2.0-2.0	2.0	2.0-2.0	0.32
Sugar-sweetened	356	1.5	1.0-1.5	1.5	1.0-1.5	0.08

(*continued on next page*)

Table 3. Comparison of median Health Star Rating calculated with total sugars and added sugars of packaged food products available in Australian supermarkets (*continued*)

		HSR[a] Calculated with Total Sugar (Stars)		HSR Calculated with Added Sugar (Stars)		
Category	**n**	**Median**	**IQR[b]**	**Median**	**IQR**	***P* value**
Vegetables	787	4.0	3.5-4.5	4.0	3.5-4.5	<0.001
Canned	278	4.0	4.0-4.5	4.0	4.0-4.5	<0.001
Dried	13	4.5	4.0-4.5	4.5	4.0-4.5	0.16
Flavored fresh/frozen	34	4.0	4.0-4.5	4.0	4.0-4.5	0.05
Fresh/frozen	180	5.0	5.0-5.0	5.0	5.0-5.0	0.005
Frozen potato products	73	4.0	3.5-4.0	4.0	3.5-4.0	0.32
Pickled/marinated	209	2.5	2.0-3.0	3.0	2.0-3.5	<0.001
Yogurt	390	3.0	2.0-4.0	3.5	2.5-4.5	<0.001
Drinking	5	4.0	3.0-4.0	5.0	4.0-5.0	0.03
Flavored	89	2.5	2.0-3.0	3.5	2.5-3.5	<0.001
Fruit	191	3.0	2.0-4.0	3.5	2.5-4.5	<0.001
Natural	67	3.5	2.5-4.5	4.0	3.0-5.0	<0.001
Nonfruit addition	23	2.5	2.0-3.5	3.5	2.5-4.0	<0.001
Yogurt alternative	15	2.0	1.5-3.5	2.0	1.5-3.5	>0.99
Total	3,610	4.0	2.5-4.5	4.0	2.5-5.0	<0.001

Wilcoxon signed-rank test was used to calculate the *P* value.
[a]HSR=Health Star Rating.
[b]IQR=interquartile range.