Stars versus warnings: Comparison of the Australasian Health Star Rating nutrition labelling system with Chilean Warning Labels

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Abstract

Objective: The Health Star Rating (HSR) is a voluntary front-of-pack nutrition labelling system that rates products from ½ to 5 stars (five being healthiest). The Chilean Warning Label system displays warnings on foods high in sugar, saturated fat, sodium, or energy. We aimed to evaluate alignment between the systems.

Methods: New Zealand packaged products (n=13,868) were classified according to the two systems. Alignment was assessed by cross-checking the number of products meeting the criteria for warnings against star ratings. Products with no warnings but an HSR <2, or with >1 warning but an HSR of ≥3.5 were considered outliers.

Results: Two-thirds of products met the criteria for at least one warning. There was a significant positive relationship between the number of warnings and mean HSR: 0 warnings = HSR 3.77±.0166 ($p<0.001$), 1 warning = HSR 2.70±.0206 ($p<0.001$) and >1 warning = HSR 2.00±.0160 ($p<0.001$). The systems were non-aligned for 1,117 products (8%).

Conclusion: HSR and the Chilean Warning Label systems are broadly aligned. Non-alignment is due to the Chilean system restricting warnings to foods containing added ingredients and HSR awarding points for positive components.

Implications for public health: These results could be helpful in informing improvements to the HSR system.

Key words: nutrition labelling, food labels, Health Star Rating, Chilean Warning Labels

Unhealthy diet is a leading preventable risk for poor health worldwide, and a major contributor to non-communicable diseases such as type-2 diabetes mellitus, cardiovascular diseases and some cancers.[1] In New Zealand, dietary risk factors are the leading cause of health loss accounting for 9.4% of total disability-adjusted life years (DALYs).[2] In 2017/2018, 32% of New Zealand adults (15 years and older) and 12% of children aged 2–14 years were obese.[3] The healthcare costs attributed to overweight and obesity in New Zealand were estimated to be NZ$623.9 million in 2006 and are likely to be greater now given increases in obesity rates over the intervening period.[4] In an attempt to reduce obesity through helping consumers make informed choices, the World Health Organization (WHO) recommended the use of food labelling in their *Global Strategy on Diet, Physical Activity and Health* published in 2004.[5] Today, the focus of food labelling has shifted towards front-of-pack (FOP) labelling, which can provide additional and/or more interpretive information compared with traditional back-of-pack labelling schemes, and may help the consumer to identify healthier foods more easily. In 2015, the WHO regional office of Europe published the *European Food and Nutrition Action Plan 2015–2020*, promoting the "use of interpretative, consumer-friendly labelling on the front of packages".[6]

The Health Star Rating (HSR) system is a voluntary FOP nutrition label in Australia and New Zealand developed through a public-private partnership with the food industry, which was implemented in 2014.[7] The system rates products from 0.5 to 5 stars (five being healthiest) depending on the product nutrient profile and is intended to compare products within broad categories. The algorithm underpinning the system is based on a nutrient profiling model that considers the energy, saturated fat, total sugars and sodium contents of foods along with positive dietary components (fruits, vegetables, nuts and legumes [FVNL]) and, for some categories of food and beverages, protein and dietary fibre content.[8] Points are awarded according to the nutrient composition per 100 g or 100 mL and translated into an overall score and HSR star rating.[8] Approximately 5% of products in New Zealand displayed HSR in 2016, but this increased to ~21% in 2018.[9,10] Five years after its original implementation, the HSR is currently under review.[10] The labelling system has also received criticism for allowing some discretionary products to display high star ratings.[11] Therefore, it is timely to investigate how the HSR system compares with other international government-endorsed FOP labelling systems,

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specifically the Chilean Warning Label system, for potential future co-existence.

In 2016, the Chilean Government implemented a new law requiring products high in energy, sodium, total sugars, and saturated fat (hereby referred to as nutrients) to display a mandatory warning label.[12] Chilean law proclaims that products containing adverse nutrients above a certain threshold require a warning label for that specific nutrient, and a product can display up to four warning labels. To be eligible for a warning label a food must first contain *added* sugars, saturated fatty acids or sodium. Thereafter, the product is compared against a threshold for that specific nutrient, and if exceeding the threshold, the product is required to display a warning label for that nutrient. A product can be eligible for a warning label for sugar, saturated fat or sodium alone, but to be eligible for a warning label for energy, a product needs to contain added ingredients of either sugar or saturated fat.

The overall goal of this study was to evaluate how the application of the Chilean Warning Label criteria would have an impact on packaged food and beverages in New Zealand. Therefore, two objectives were set: i) to estimate the proportion of New Zealand packaged food and beverages that would receive a "High in" warning label for sugar, saturated fat, sodium and energy by food group; and ii) to determine the degree of alignment between the HSR system and the Chilean Warning Label system.

Method

2018 Nutritrack database

We used the New Zealand Nutritrack database, which contains nutritional composition and labelling information for 15,193 packaged foods and beverages available for sale in 2018. The data were collected at four major New Zealand supermarket stores (New World, Countdown, PAK'nSAVE and 4Square) in the Auckland region in 2018. Product information includes barcode, brand, product name, pack size, recommended serving size, gluten-free status, HSR status (displayed labels and estimated ratings for products that don't display the voluntary label), Daily Intake Guide label, nutrition information panel (NIP) values, and listed ingredients. Products not displaying a NIP, alcohol, unpackaged fresh foods, bulk buy items, seasonal products, and dietary supplements (except sports foods) are not included in Nutritrack. The database contains 15 major food groups, 66 categories, and 197 subcategories using a hierarchical structure.[13] Quality checks are conducted on a random sample of 15% of all products each year and quality reports are run to identify any extreme and missing values.

Exclusion of products

Products that: displayed NIP errors (e.g. where the amount of saturated fat listed for a product was greater than total fat); displayed more than one NIP (i.e. more than one product per package); were in need of reconstitution before consumption (e.g. packaged soup); had missing information for any adverse nutrients required to estimate HSR or warning labels (energy, saturated fat, sugar or sodium); had nutrient values that were only reported per serving size (i.e. not per 100g); were vitamins and supplements; or were unable to be categorised were excluded prior to analysis. After initial product exclusions, a total of 13,868 products (91% of original database) were included in the analysis.

Eligibility for warning labels

A product met the criteria for a warning for sugar if it contained added sugar and had a total sugar content of >10g/100g (foods) or >5g/100mL (beverages). A product met the criteria for a warning for saturated fat if it contained added saturated fat and had a saturated fat content of >4g/100g or >3g/100mL, and a product met the criteria for a warning for sodium if it contained added sodium and had a sodium content of >400mg/100g or >100mg/100mL. A product met the criteria for a warning for energy if it contained either added sugar or saturated fat ingredients and had a total energy content of >1151kJ/100g or >293kJ/100mL.

Estimation of the Health Star Rating

A total of 2,404 products (~17%) in the 2018 Nutritrack database displayed the HSR voluntarily. For the remaining products, an estimation was made of the HSR score. In order to calculate the HSR, standardised points were applied at food category level for FVNL, because information on these components of the HSR algorithm is not mandatory on the NIP in New Zealand. Products missing fibre values (also voluntary on the NIP) were allocated the median reported fibre value for similar products in the same food category.

Alignment of the Chilean Warning Label system with the Health Star Rating system

The alignment of the two nutrition labelling systems was evaluated by cross-tabulation of the number of Chilean Warning Labels a product met the criteria for against the product HSR score.

Statistical analysis

A one-way ANOVA was used to detect any differences in the HSR score of products meeting the criteria for either 0, 1 or >1 warning, using SPSS version 24 with a significance level of $p<0.05$. Products were identified as 'outliers' when a product received no warning label but had an HSR score of <2, or those that received >1 warning label but had an HSR score ≥3.5. The HSR cut-offs used were based on analyses that found that core foods in Australia had a mean HSR score of 3.7, while discretionary foods had a mean HSR score of 1.9.[14] Considering that most discretionary foods are high in more than one adverse nutrient, >1 warning was chosen.

Results

A total of 4,591 of the 13,868 New Zealand packaged products (33%) met the criteria for a warning for sugar, 4,028 (29%) met the criteria for a warning for saturated fat, 4,690 (34%) met the criteria for a warning for sodium, and 5,140 products (37%) met the criteria for a warning for energy (Table 1). Two-thirds (n=9,359) of products met the criteria for at least one warning label.

Confectionery was the group with the highest proportion of products meeting the criteria for warnings for both sugar (91.7%) and saturated fat (65.5%), see Table 1. Meat and meat products was the group with the highest proportion of products meeting the criteria for warnings for sodium (80.2%), while snackfood products had the highest proportion of warnings for energy (96.6%). Although confectionery also had the highest absolute number of products meeting the criteria for a warning for sugar (n=798), dairy had the highest absolute number of products meeting the criteria for a warning for saturated fat (n=1,114). Sauces and spreads was the food group with the highest absolute number of products meeting the criteria for a

warning for sodium (n=1148), and bread and bakery products had the highest absolute number of products meeting the criteria for a warning for energy (n=1182) (Table 1).

The food group with the highest average number of warning labels per product was confectionery, with 2.5 warnings per product, followed by snackfoods with 2.2 warnings per product, and bread and bakery products with 2.1 warnings per product (Table 1). The food groups with the least average number of warnings per products were eggs (0.0 warnings per product), and convenience foods (0.4 warnings per product), followed by edible oils and oil emulsions and non-alcoholic beverages (both with 0.6 warnings per product), see Table 1.

Bread and bakery products was the food group eligible for both the highest proportion (5.9%) and highest absolute number of products (n=98) that met the criteria for all four warnings (Figure 1). Snackfoods was the food group with the highest proportion of products with at least 1 warning (97.6%) followed by confectionery (94.5%), see Figure 1.

Degree of alignment between the two food labelling systems

A total of 12,454 products were included in the analysis of alignment between the HSR and the Chilean labelling system. A significant difference was observed in the mean HSR score of products according to the number of warning labels they qualified for: 0 warnings = mean HSR 3.77 ± .0166 (p<0.001); one warning = mean HSR 2.70 ± .0206 (p<0.001);

Table 1: Number and proportion of products by food group that met the criteria for a warning label.

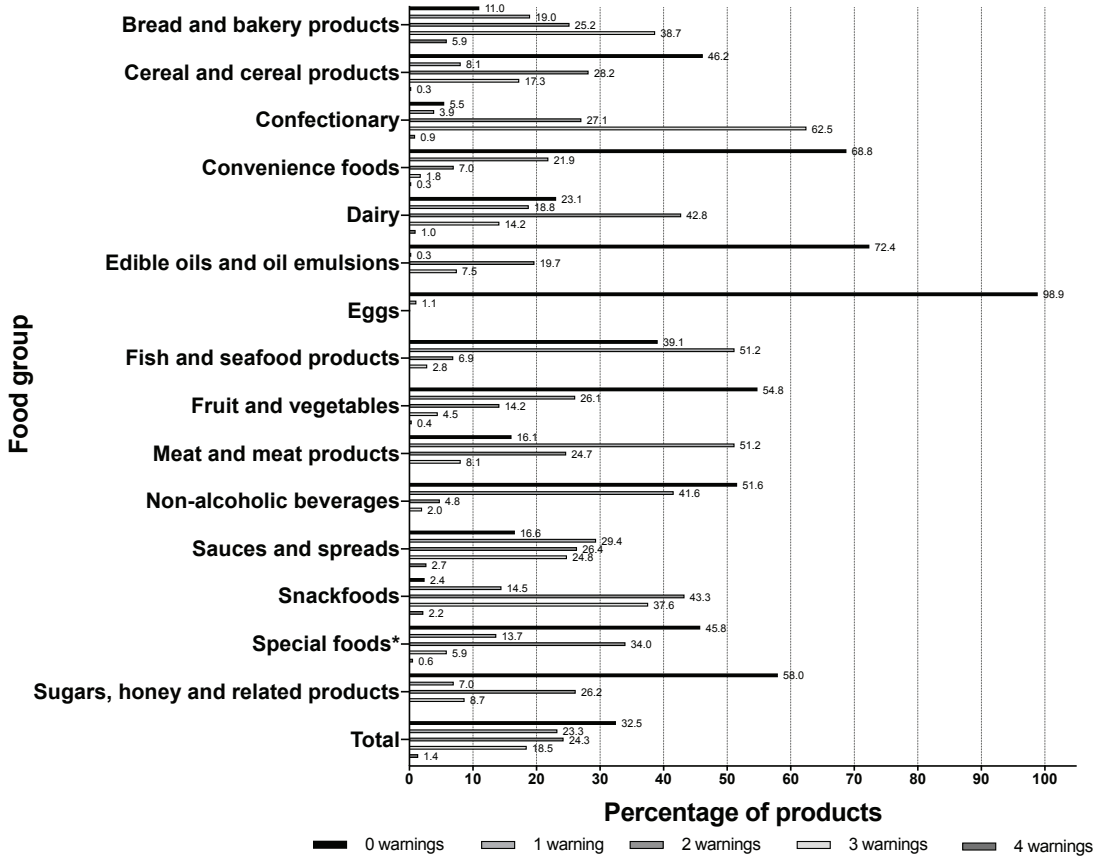
Food group	Sugar n (%)	Saturated fat n (%)	Sodium n (%)	Energy n (%)	Mean warnings/ product
Bread and bakery products (n=1,650)	718 (43.5%)	827 (50.1%)	728 (44.1%)	1,182 (71.6%)	2.1
Cereal and cereal products (n=1,378)	486 (35.3%)	259 (18.8%)	198 (14.4%)	676 (49.1%)	1.2
Confectionary (n=870)	798 (91.7%)	570 (65.5%)	11 (1.3%)	791 (90.9%)	2.5
Convenience foods (n=597)	15 (2.5%)	53 (8.9%)	156 (26.1%)	32 (5.4 %)	0.4
Dairy (n=1,833)	700 (38.2%)	1114 (60.8%)	579 (31.6%)	377 (20.6%)	1.5
Edible oils and oil emulsions (n=319)	0 (0%)	88 (27.6%)	24 (7.5%)	87 (27.3%)	0.6
Eggs (n=89)	0 (0%)	0 (0%)	1 (1.1%)[b]	0 (0%)	0.0
Fish and seafood products (n=422)	3 (0.7%)	26 (6.2%)	244 (57.8%)	37 (8.8%)	0.7
Fruit and vegetables (n=1,841)	398 (21.6%)	159 (8.6%)	388 (21.1%)	336 (18.3%)	0.7
Meat and meat products (n=1,026)	23 (2.2%)	230 (22.4%)	823 (80.2%)	204 (19.9%)	1.2
Non-alcoholic beverages (n=1,056)	493 (46.7%)	21 (2.0%)	24 (2.3%)	66 (6.3%)	0.6
Sauces and spreads (n=1,683)	696 (41.4%)	367 (21.8%)	1148 (68.2%)	614 (36.5%)	1.7
Snackfoods (n=497)	64 (12.9%)	212 (42.7%)	351 (70.6%)	480 (96.6%)	2.2
Special foods[a] (n=321)	86 (26.8%)	78 (24.3%)	8 (2.5%)	155 (48.3%)	1.0
Sugars, honey and related products (n=286)	111 (38.8%)	24 (8.4%)	7 (2.4%)	103 (36.0%)	0.9
Total (n=13,868)	4,591 (33%)	4,028 (29%)	4,690 (34%)	5,140 (37%)	1.3

Note:

a: Babyfood, breakfast beverages, diet drink mixes, meal replacements, protein bars, protein powders, and other fitness or diet products.

b: Cooked salted duck eggs met the criteria for a warning for sodium.

Figure 1: Proportion of products meeting the criteria for 0, 1, 2, 3 or 4 warnings by food group.



Note:

** Babyfood, breakfast beverages, diet drink mixes, meal replacements, protein bars, protein powders, and other fitness or diet products.*

and more than one warning = mean HSR 2.00 ± .0160 (p<0.001), indicating broad alignment in the expected direction between the two nutrition labelling systems (Table 2). However, 1,117 products (8%) were identified as outliers. There were 249 products that did not meet the criteria for any warning label but had an HSR of <2 (indicating an unhealthy nutritional profile). The major food groups accounting for these outlier products were sugars, honey and related products with 138 products (55.4% outliers), dairy with 35 products (14.1%), edible oils and oil emulsions with 35 products (14.1%), and non-alcoholic beverages with 33 products (13.3%), see Supplementary Table 1. A further 868 products were also considered outliers because they received >1 warning label but had an HSR of ≥3.5 (indicating a healthy nutritional profile). Of these products, cereal and cereal products accounted for 27.3% (n=237), fruit and vegetables for 19.9% (n=173), sauces and spreads for 15.6% (n=135) and dairy for 13.4% (n=116), see Supplementary Table 2.

Outliers were predominantly due to products meeting the criteria for energy warning labels while also having an HSR of ≥3.5, where 692 products (62% of all outliers) met the criteria for a warning for energy (Supplementary Table 3). A total of 430 products (38% of all outliers) met the criteria for a warning for sugar; 397 (36% of all outliers) met the criteria for a warning for sodium; and 341 (31% of all outliers) met the criteria for a warning for saturated fat. Energy density accounted for warning labels on all 237 products considered outliers within the food group of cereal and cereal products, representing the largest absolute number of warnings for any food group among the outliers (Supplementary Table 3). The second-largest absolute number of outliers was also among cereal and cereal products, with 209 products meeting the criteria for a warning for sugar.

Analysis of food categories (subcategories to the food groups) showed that breakfast cereals, with 180 products (16% of all outliers), was the largest food category meeting the criteria for >1 warning label while having an HSR of ≥3.5 (Supplementary Table 4). The second-largest subcategory was cheese (n=102, 9% of all outliers), followed by nuts and seeds (n=87, 8% of all outliers) and spreads (n=78, 7% of all outliers). Breakfast beverages had 24 products (2% of all outliers) meeting the criteria for >1 warning but with an HSR of ≥3.5.

Discussion

Summary of key findings

We investigated how New Zealand packaged foods and beverages would rate under the Chilean Warning Label system and how this system would align with the current HSR. The study found that a warning label for high energy content (37% of products) would be the most common, followed by warnings for high sodium (34%), sugar (33%) and saturated fat (29%) contents. The study also found that two-thirds (n=9,359) of products would meet the criteria for at least one warning. The analysis indicates a broad alignment between the HSR system and the Chilean Warning Label system, but approximately one in 12 (8%) of products were found to be outliers (non-aligned).

Possible reasons for the discrepancy between systems

The two labelling systems are broadly aligned with a significant difference in the expected direction in HSR score between products eligible for 0, 1 and >1 warning label. Nonetheless, 1,117 products (8%) were identified as outliers. Sugars, honey and related products was the food group with the greatest number of products with no warnings but an unhealthy nutritional profile according to the HSR (n=138). These products did not meet the criteria for any warning label, mainly because they are single-ingredient foods without the addition of other adverse nutrients, therefore making them non-eligible for warning labels according to the Chilean regulations. The HSR, on the other hand, does not consider additives to food (such as added sugars) and instead scores the overall nutritional profile.

The food group cereal and cereal products contained 237 products considered outliers due to a healthy nutritional profile according to the HSR but which met the criteria for more than one warning. Of these, 180 were breakfast cereals, corresponding to nearly half (46%) of all breakfast cereals in the dataset. Warnings in this category were most common for high energy content (204 products) and high sugar content (195 products). The discrepancy between systems is most likely a consequence of: i) the HSR system awarding points for positive components (fibre, FVNL, and protein) often found in breakfast products, which can offset the negative nutrient points; and ii) the HSR using total sugars instead of added sugars. Both of these differences could lead to some foods displaying higher than expected HSRs. Of note, cereal and cereal products was the food group with the highest uptake of the voluntary HSR label at a two-year post-implementation review of the HSR conducted in 2016 (216 products or 13% of 1,555 cereal and cereal products).[15] The relatively high star ratings achieved by these products might be a reason for widespread adoption by the category of the voluntary HSR system.

Eligibility for a warning for high energy density but with an HSR of ≥3.5 was the main reason for outlier products. Since all of the 237 cereal and cereal products identified as outliers met the criteria for a warning for energy, there seems to be a discrepancy between the two labelling systems with respect to energy content. The HSR algorithm might be too lenient towards energy-dense products that also contain positive nutrients in the form of FVNL, protein and dietary fibre. Furthermore, the HSR system has been criticised for food industry influence on development of the product nutrient profiling algorithm leading to some foods with high levels of risk nutrients scoring better than expected.[16] It seems that, even though a public–private partnership might be considered desirable when developing public health initiatives order to increase participation and impact, the private sector may have had an inappropriate influence on the HSR, leading to a perceived advantage for some companies and product types.

Table 2: Cross-tabulation of the Health Star Rating system and the Chilean Warning Label system. Products were categorised as meeting the criteria for either 0 warnings, 1 warning or >1 warning.

	Health Star Rating (HSR)										Mean HSR	
Warning labels	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	(95% CI)	p-value
0	71	95	83	293	89	219	782	1,138	541	851	3.77 (3.74–3.81)	<0.001
1	132	270	415	327	226	445	675	430	80	69	2.70 (2.66–2.74)	<0.001
>1	953	627	871	897	678	420	284	376	144	64	2.00 (1.97–2.03)	<0.001

Note:
CI = Confidence interval

Evidence for warning labels to date

The Chilean Warning Labels have been in effect since June 2016 and studies examining the effect of their implementation are underway. So far, study methods have focused on either virtual stores or shopping simulations, and no studies have investigated in-store sales. A paper published in 2017 by Cabrera et al. evaluated the influence of the design of FOP nutrition warning labels on perceived healthfulness and consumer attention. The authors conducted five different trials including variation in colour, shapes, textual information and position of warning labels. The authors concluded that black octagons with the text "excess of..." had the strongest connection to perceived unhealthfulness.[17] This is similar to the final format of the labels implemented in Chile, with a slight difference in wording, which ended up with the text "High in…" for the warning labels.

If the Chilean Warning Label system were implemented in New Zealand, two-thirds of supermarket products would meet the criteria for at least one warning label (assuming no product reformulation since 2018). Similar numbers were found for products in Colombia, where 66.4% out of 6,708 products met the criteria for at least one warning label.[18] Another study, conducted by Kanter et al. on Chilean products, showed that 83% (n=6,861) of products would receive at least one warning label.[19] However, the Chilean study focussed on food and beverage categories most likely to be subjected to the labelling regulations (rather than all packaged foods), making a direct comparison inappropriate. These results indicate that adoption of warning labels could have a major impact on the labelling of foods and beverages in New Zealand, with most available products meeting the criteria for at least one nutrient warning.

Strengths and weaknesses of this study

This cross-sectional study of packaged foods and beverages included 13,868 products sampled from four major supermarkets in Auckland. The study product sample is considered representative of the New Zealand market because around 74% of packaged foods in New Zealand are sold in supermarkets and the data were collected at four major stores owned by the two retailers dominating the New Zealand market: Progressive Enterprises Ltd (Countdown) and Foodstuffs New Zealand Ltd (New World, PAK'nSAVE and 4Square).[20]

However, the study had some limitations. Due to the lack of products displaying the voluntary HSR, this study used estimated HSR scores for most (~80%) products. Because fibre and FVNL values were estimated based on the within-category median values, there might be a discrepancy between the estimations and actual HSR scores. This could potentially lead to either more or less products being considered outliers depending on over- or under-estimation of the values.

Implications for policy/practice

The findings of this study indicate that the majority (67%) of packaged foods and beverages sold in New Zealand supermarkets contain high levels of adverse nutrients such that they would meet the criteria to display warning labels under the Chilean labelling system. These levels of adverse nutrients contribute to an unhealthy food environment and are contributors to the high levels of obesity and diet-related disease in New Zealand. If warning labels were to be implemented, they have the potential to increase public awareness of unhealthy foods and thereby aid in helping consumers choose healthier products.

Scoring of both positive and negative nutrients in the HSR algorithm is intended to reflect the Australian and New Zealand dietary guidelines. However, the points awarded for positive nutrients may distort the apparent healthiness of some products. In contrast, the Chilean warning labels only direct consumers away from products high in critical nutrients and do not provide guidance on healthier alternatives. Although there are differences between the systems, the HSR system and the Chilean Warning Label system could potentially co-exist, which may alleviate the limitations of each system. Warning labels could be an aid in helping consumers identify unhealthy foods while the HSR could be used to guide consumers towards healthier foods. However, changes to both the HSR algorithm and the warning label criteria would be necessary to improve alignment.

In terms of specific food groups, confectionery and snack foods had the highest proportion of products meeting the criteria for warning labels. Products within these food groups are often considered discretionary. Consumers generally comprehend that these products are unhealthy, but even so, the products are still purchased and consumed frequently. Nonetheless, if warning labels could encourage consumers to avoid products with warnings and/or choose products containing fewer warnings, it could lead to small improvements in population dietary intake. A qualitative study published in 2019 by Correa et al. investigated the responses of mothers in Santiago, Chile after the implementation of the warning labels law and found the system prompted some shoppers to choose products with fewer warnings.[21]

Product reformulation

Front-of-pack labelling may prompt product reformulation.[9] A review published in 2019 concluded that food labelling influenced manufacturers to reduce product content of artificial trans-fat and sodium, while also reducing dietary intake of selected nutrients among consumers.[22] One modelling study conducted on food available in the French market evaluated the health impact of product reformulation regardless of the reason of the reformulation.[23] The study concluded that product reformulation would result in significant improvements in population health outcomes even without any changes in consumers' behaviours, although the authors stated that the results should be interpreted with caution due to uncertainties in modelling assumptions and food composition. Consumer acceptability of reformulated products is of importance for manufacturers. A review published in 2017 by Jaenke et al. evaluated consumer acceptability of salt-reduced foods. One meta-analysis indicated that a salt reduction of up to 37% in breads and 67% in processed meats was acceptable to consumers.[24]

Two studies on product reformulation regarding the Chilean Warning Labels were published in 2018 by a research group in Uruguay. One conclusion from the studies was that consumers preferred reformulated products without nutritional warnings compared to their original (less healthy) versions containing warnings.[25,26] Therefore, warning labels might be a powerful incentive for manufacturers to reformulate their products if they want to be market leaders.

Conclusions

This study shows that should the Chilean Warning Labels criteria be applied to packaged foods and beverages sold in New Zealand, more than two-thirds of products would display at least one warning label. A warning on foods with high energy content would be the most common warning label, followed by warnings for high sugar, sodium, and saturated fat contents. The results indicate a broad alignment between the current HSR nutrition labelling system and the Chilean Warning Label system, but almost one in 10 products were found to be outliers (non-aligned). Non-alignment (most common among the food groups sugars, honey and related products, and cereal and cereal products) was largely due to the Chilean system restricting warnings to foods containing added ingredients (and hence excluding single ingredient unhealthy products such as sugar) and the HSR system not differentiating between intrinsic and added sugars and awarding points for positive components, which can offset negative nutrient content scores and lead to some foods displaying higher than expected HSRs.

Future perspectives

There is a need for high-quality studies to assess the impact of food labels on consumers' behaviour. Such studies should ideally use sales data to evaluate if nutrition labels influence shopper purchase behaviours. More research is needed to understand the relationship between nutrition labels and actual consumption in order to determine if warning labels would influence dietary intakes positively.

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Supporting Information

Additional supporting information may be found in the online version of this article:

Supplementary Table 1: Products per food group with 0 warnings and a Health Star Rating of <2.

Supplementary Table 2: Products per food group with >1 warning and a Health Star Rating of >3.5.

Supplementary Table 3: Products per food group with >1 warning and a HSR score ≥3.5 distributed among the nutrients.

Supplementary Table 4: Products per food group and food category with >1 warning and a Health Star Rating score of >3.5.