The ability of five different front-of-pack labels to assist Australian consumers to identify healthy versus unhealthy foods

Simone Pettigrew,[1]* Michelle I. Jongenelis,[2] Zenobia Talati,[3] Liyuwork M. Dana,[3] Serge Hercberg,[4,5] Chantal Julia[4,5]

[1]The George Institute for Global Health, University of New South Wales, Australia
[2]Melbourne Centre for Behaviour Change, Melbourne School of Psychological Sciences, University of Melbourne, Victoria, Australia
[3]School of Population Health, Curtin University, Western Australia, Australia
[4]Sorbonne Paris Nord University, Inserm U1153, Inrae U1125, Cnam, Nutritional Epidemiology Research Team (EREN), Epidemiology and Statistics Research Center, University of Paris-Cité (CRESS), Bobigny, France
[5]Public Health Department, Avicenne Hospital, AP-HP, Bobigny, France

Submitted: 16 June 2022; Revision requested: 29 August 2022; Accepted: 30 September 2022

Abstract

Objective: The aim of this study was to assess the relative ability of different interpretive front-of-pack food labels to alert consumers to both healthier and unhealthier options to inform their food choices.

Methods: One thousand Australians completed an online experiment where they rated the nutritional quality of sets of fictional products pre- and post-randomisation to one of five front-of-pack labels: Health Star Rating, Multiple Traffic Lights, Nutri-Score, Reference Intakes and Warning Label. Two sample z-tests were used to assess the ability of each label to facilitate the correct identification of the least and most healthy product options.

Results: The Nutri-Score was superior in assisting respondents to identify both the healthiest and unhealthiest options. The Health Star Rating ranked second for both outcomes, followed by the Multiple Traffic Lights.

Conclusions: Results reinforce the role of interpretive front-of-pack labels in assisting consumers to understand the nutritional quality of food products and suggest spectrum labels may provide superior utility in assisting consumers to identify both the most and least nutritious products from among available product options.

Implications for public health: The strongest performance of a highly interpretive front-of-pack label (Nutri-Score) featuring colour in a summary indicator suggests potential strategies for enhancing the performance of the Health Star Rating.

Key words: nutrition, food labels, Health Star Rating, interpretive

Front-of-pack labels (FoPLs) are recommended by the World Health Organization and other multilateral health organisations as an effective tool to assist healthy eating by enabling consumers to better understand the nutritional quality of packaged food products.[1-5] FoPLs aim to provide more accessible and understandable information compared to the more complex Nutrition Information Panel located on the back or side of packs in many countries. Importantly, they constitute an equitable nutrition intervention due to their ability to assist consumers of varying income levels to understand variations in nutritional quality between different food products.[6] However, their effect sizes have been typically found to be modest and they are recommended as just one component of comprehensive nutrition policies.[1,7,8]

In 2014, the Australian and New Zealand Governments introduced the voluntary Health Star Rating (HSR) food labelling system. This development reflected growing concerns about high rates of overweight and obesity and the increasing prevalence of diet-related diseases.[9,10] In addition, the dominance of highly processed foods in national diets and a reliance on ineffectual voluntary food composition targets in many countries has highlighted the need for effective mechanisms to communicate product healthiness to consumers.[11,12]

The HSR is a monochrome label that has two components – a summary indicator (with 10 ratings ranging from half a star to five stars) and optional per 100g (or per package) indicators for specified

*Correspondence to: Professor Simone Pettigrew, The George Institute for Global Health, University of New South Wales, 1 King St Newtown, 2042, Sydney, NSW, Australia; e-mail: spettigrew@georgeinstitute.org.au.

Aust NZ J Public Health. 2023; Online; https://doi.org/10.1016/j.anzjph.2022.100017

nutrients. The recent 5-year review of the HSR system refined the nutrition profiling system on which star ratings are based.[13] To date, there do not appear to have been any efforts to improve the visual depiction of the HSR to enhance its ability to communicate product healthiness to consumers. Some previous work has found that FoPLs that use colour are more effective than monochrome FoPLs,[14,15] including the comparison of colour versus black and white versions of the HSR.[16,17] This work also suggests that summary indicators (e.g. just the star rating component of the HSR without the nutrient indicators) could have greater utility for consumers than more detailed FoPLs.[16,17]

An under-researched aspect of FoPLs is the extent to which they can signal unhealthy versus healthy foods.[18-20] Some labels (e.g. the Warning Label implemented in Chile and Mexico) are specifically intended to signal when products are unhealthy according to predefined criteria.[21,22] Other labels are designed to alert consumers to products that have favourable nutritional profiles (e.g. the Healthier Choices logo used in some parts of Southeast Asia.[23]). A third category is spectrum labels (also known as graded labels), which aim to assist consumers in understanding where individual products sit across a continuum from least to most healthy within product categories. The HSR is an example of the latter, along with the Multiple Traffic Lights (MTL) label currently being used in the United Kingdom and the Nutri-Score label being implemented in parts of Europe.[24,25] There has been some concern expressed that spectrum FoPLs could produce a 'health halo' effect that involves consumers over-eating processed foods that receive higher ratings.[26]

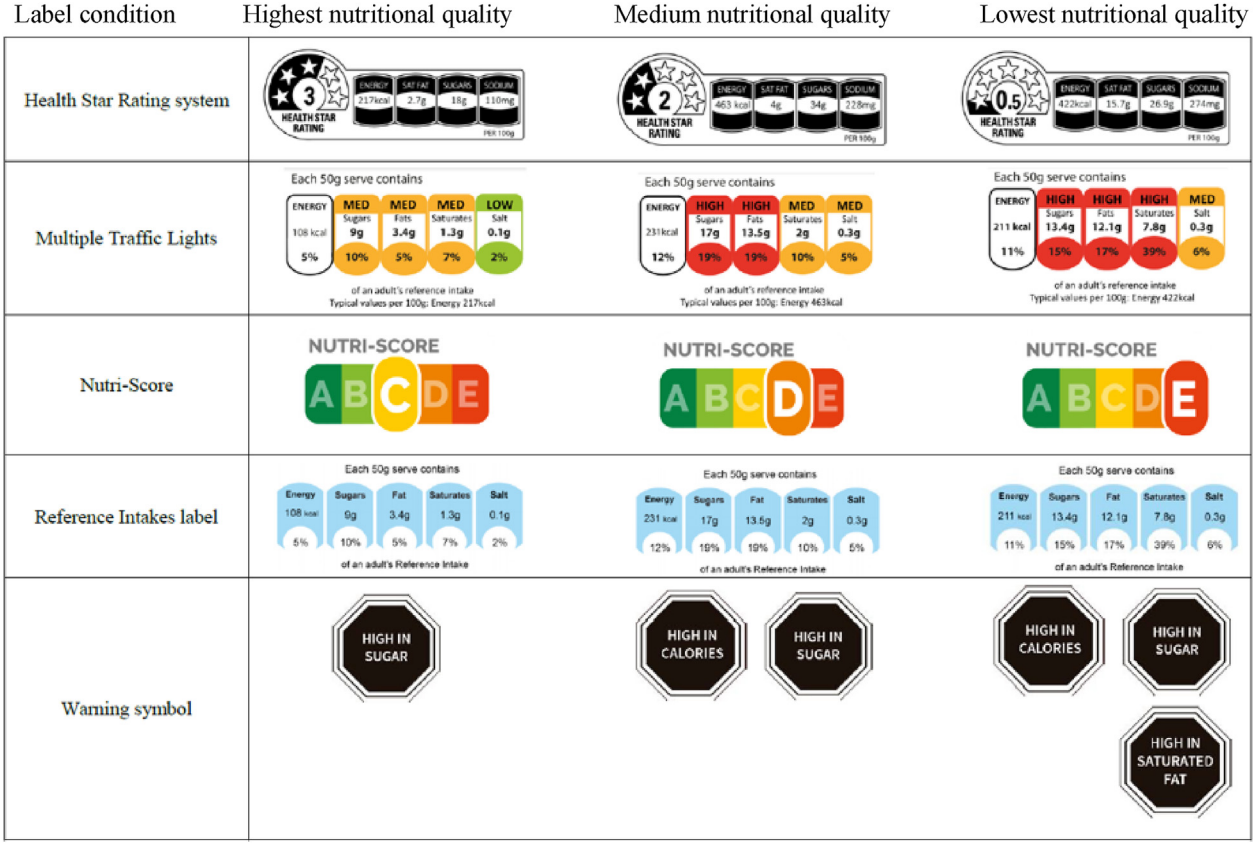
The aim of the present study was to assess the relative ability of different interpretive front-of-pack food labels to alert Australian consumers to both healthier and unhealthier options to inform their food choices. The results provide insights into potential means of enhancing the performance of the HSR by modifying the graphic to include characterising elements that are particularly effective in aiding understanding.

Methods

As part of the FOP-ICE international FoPL study (protocol described at http://www.ANZCTR.org.au/ACTRN12618001221246.aspx), 1,000 Australian adults were recruited by an ISO-accredited web panel provider (Pureprofile) to complete an online survey (sample profile shown in Supplementary Table S1). The FoPL images used in this study reflect formats currently in use around the world and are shown in Figure 1.

To assess objective understanding of the FoPLs, respondents were shown three products of varying nutritional quality for each of the three product categories of breakfast cereals, cakes and pizzas and asked to rank them by nutritional quality. The nutrition ratings ascribed to each mock product were based on the nutrition profiles obtained for similar real-world products, enabling the inclusion of products with objectively different levels of nutritional quality (as shown in Figure 1). Respondents assigned each product within the product category as either "Highest nutritional quality", "Medium nutritional quality", or Lowest nutritional quality". There was also the option to select "I don't know", which was classified as 'incorrect'. The

Figure 1: The five sets of front-of-pack label images for the cakes category (adapted from (Egnell et al.,[32]).



product assessment tasks were repeated after random assignment to one of the five FoPLs. A randomisation check found one statistically significant demographic difference in the profiles of respondents assigned to the different FoPLs: those in the Nutri-Score condition were on average older than those in the Warning Labels condition (45.5 years vs. 40.2 years, $p<0.05$: see Supplementary Table S1). There were no significant differences by gender, education, or income.

During analysis, each respondent was assessed pre- and post-label exposure for making a correct identification of the healthiest of the three options (coded as yes/no) and the unhealthiest option (coded as yes/no). For each product category, proportions were calculated of those who made correct identifications of the healthiest and least healthy product options in the post-exposure conditions among those who made incorrect identifications in the pre-exposure conditions. Two sample z-tests for proportions were then conducted to assess significant differences between each of the FOPLs on their ability to assist respondents to correctly interpret nutrition information (i.e. correctly identify the healthiest and unhealthiest product options).

Results

The Nutri-Score performed best in assisting respondents to identify the healthiest and least healthy options within choice tasks (results presented in Table 1). Across the three product categories, among those who did not correctly identify the healthiest product in the pre-exposure condition, 41% made a correct identification post-exposure. Similarly, among those who did not correctly identify the unhealthiest product option pre-exposure, 51% were able to do so post-exposure. The next best-performing FoPLs were the HSR (33% and 36%, respectively) and the Multiple Traffic Lights (33% and 30%, respectively). The Warning Label ranked fifth for assisting respondents to identify the healthiest products (25%) and fourth for the unhealthiest products (29%).

Discussion

The highly interpretive Nutri-Score substantially outperformed the other FoPLs in these objective understanding analyses. It produced the best results for assisting consumers to assess both the least healthy and healthiest product options. The other two interpretive spectrum FoPLs were ranked second and third for both outcomes.

These results indicate that spectrum FoPLs have utility for steering consumers away from unhealthier options as well as guiding them towards healthier options. This is an important finding in the context of ongoing discussions about whether Warning Labels represent the most effective FoPL format for steering consumers away from unhealthy products and concerns that spectrum FoPLs may produce halo effects for products interpreted as healthier.[20,26,27] Spectrum FoPLs appear to be an efficient method of signalling nutritional quality in both directions, and the results of the present study support recent research demonstrating the ability of the Nutri-Score in particular to improve the nutritional quality of food choices in simulated and real-world settings.[28,29]

Of relevance to the Australian and New Zealand contexts, the results indicate the potential to enhance the performance of the HSR by integrating features of the high-performing Nutri-Score. This could include incorporating colour into the label design and potentially presenting only the star rating indicator (i.e. removing the nutrient icons that largely repeat information contained within the Nutrition Information Panel).[16,17] Future research could focus on testing variations of the HSR graphic to determine which alternative formats with these features are most effective in influencing consumers' food choices. Such improvements would constitute important elements of broader public health nutrition policy advancements that also include strategies to reduce the demand and supply of ultra-processed foods. For example, recent research indicates very strong support in Australia for policies involving the reduction of sugar, saturated fat and salt in processed foods,[30] indicating the important role of more stringent food composition targets.

Table 1: Performance of 5 front-of-pack labels on objective understanding outcomes (n = 1,000).

FoPL	Outcome	Breakfast cereals			Cakes			Pizzas			3-product average	Rank among FoPLs
		N	n	%	N	n	%	N	n	%	%	
Health Star Rating n = 200	A: Identified healthiest	59	18	30.5	141	51	36.2[a]	91	30	33.0[abc]	33.2	2
	B: Identified unhealthiest	136	43	31.6[a]	160	49	30.6[a]	74	33	44.6[a]	35.6	2
Multiple Traffic Lights n = 200	A: Identified healthiest	47	13	27.7	147	51	34.7[a]	95	35	36.8[ac]	33.1	3
	B: Identified unhealthiest	133	38	28.6[a]	174	45	25.9[a]	81	28	34.6[ab]	29.7	3
Nutri-Score n = 200	A: Identified healthiest	54	16	29.6	145	70	48.3[b]	107	49	45.8[a]	41.2	1
	B: Identified unhealthiest	134	72	53.7[b]	172	94	54.7[b]	93	42	45.2[a]	51.2	1
Reference Intakes n = 199	A: Identified healthiest	52	11	21.2	152	52	34.2[a]	94	30	31.9[bc]	29.1	4
	B: Identified unhealthiest	125	31	24.8[a]	178	21	11.8[c]	75	20	26.7[b]	21.1	5
Warning Label n = 201	A: Identified healthiest	63	16	25.4	145	38	26.2[a]	82	18	22.0[b]	24.5	5
	B: Identified unhealthiest	132	39	29.5[a]	160	50	31.3[a]	70	19	27.1[b]	29.3	4

N = percentage denominator (number of respondents incorrect in pre-exposure condition); n = percentage numerator (number of respondents correct in post-exposure condition).

A: Proportion of those identifying the healthiest option in the FoPL exposure condition, assessed among those who did not correctly rank the healthiest option in the pre-exposure condition.

B: Proportion of those identifying the unhealthiest option in the FoPL exposure condition, assessed among those who did not correctly rank the unhealthiest option in the pre-exposure condition.

Notes: Different superscript letters denote significant differences between FOPLs within a product category for each outcome (A or B). For example, within the cakes category the proportion of those in the Nutri-Score condition who were able to identify the healthiest product option was significantly larger (denoted by superscript 'b') than the proportions for the other four front-of-pack labels (denoted by superscript 'a'). Significance testing could not be conducted for the 3-product averages due to differing denominators.

The primary limitation of this study was the reliance on a web panel for participant recruitment. While quotas were used to achieve appropriate distribution across key demographic characteristics, the use of an online survey may have introduced sampling bias as evidenced by the large proportion of respondents self-assessing their diets as healthy or very healthy. The inclusion of study participants with higher-than-average nutrition knowledge could indicate that the effects observed in this study may be underestimated compared to the population-level outcomes that could eventuate from the provision of effective nutrition labels. However, over-estimation of diet quality is common with the use of subjective assessment measures,[31] and future research could use objective measures to address this issue. A further limitation was the modest sample size of each FoPL condition, which precluded analysis of variations in outcomes according to specific demographic characteristics.

In conclusion, the results of this study demonstrate that the Nutri-Score performed best in assisting Australian consumers to identify both healthier and unhealthier options within product sets. The Health Star Rating also performed well but may benefit from the integration of key presentation elements that contribute to the Nutri-Score's superior efficacy.

Ethical statement

The study protocol was deemed low risk and approved by the Institutional Review Board of the French Institute for Health and Medical Research (IRB Inserm n°17-404) and the Curtin University Human Research Ethics Committee (approval reference: HRE2017-0760). All participants provided informed consent prior to completing the survey.

Funding

The study received funding from Santé Publique France (French Agency for Public Health: https://www.santepubliquefrance.fr/). The funders had no role in the study design, data collection and analyses, decision to publish nor the preparation of the manuscript.

Conflict of interest

The authors have no conflicts of interest to declare.

References

1. World Health Organization Nutrition and Food Safety Team. *Guiding Principles and Framework Manual for Front-of-pack Labelling for Promoting Healthy Diet*. Geneva (CHE): WHO; 2019.
2. United Nations Office of the High Commissioner for Human Rights. *Statement by the UN Special Rapporteur on the Right to Health on the Adoption of Front-of-package Warning Labelling to Tackle NCDs*. Geneva (CHE): United Nations; 2020.
3. Pan American Health Organization. *Front-of-package Labeling as a Policy Tool for the Prevention of Noncommunicable Diseases in the Americas*. Washington (DC): PAHO; 2020.
4. World Heart Federation. *World Heart Federation Policy Brief: Front-of-pack Labelling*. Geneva (CHE): WHF; 2020.
5. Global Health Advocacy Incubator. *Behind the Labels: Big Food's War on Healthy Food Policies*. Washington (DC): GHAI; 2021.
6. Pettigrew S, Jongenelis MI, Hercberg S, Julia C. Front-of-pack nutrition labels: An equitable public health intervention. *Eur J Clin Nutr* 2022. https://doi.org/10.1038/s41430-022-01205-3.
7. Dereń K, Ł Dembiński, Wyszyńska J, Mazur A, Weghuber D, Łuszczki E, et al. Front-of-pack nutrition labelling: A position statement of the European Academy of Paediatrics and the European Childhood Obesity Group. *Ann Nutr Metab* 2021;**77**(1):23–8.
8. Trafford EP, de la Hunty A. A gentle nudge: Can choice architecture play a role in retailers' efforts to promote healthier choices? *Nutr Bull* 2021;**46**(1):98–109.
9. Moore M, Jones A, Pollard CM, Yeatman H. Development of Australia's front-of-pack interpretative nutrition labelling Health Star Rating system: lessons for public health advocates. *Aust N Z J Public Health* 2019;**43**(4):352–4.
10. Maganja D, Buckett K, Stevens C, Flynn E. Consumer choice and the role of front-of-pack labelling: The Health Star Rating system. *Public Health Res Pract [Internet]* 2019;**29**(1):2911909 [cited 2022 Sep 8], https://www.phrp.com.au/issues/march-2019-volume-29-issue-1/consumer-choice-and-the-role-of-front-of-pack-labelling-the-health-star-rating-system/.
11. Monteiro CA, Cannon G, Moubarac JC, Levy RB, Louzada MLC, Jaime PC. The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutr* 2018;**21**(1):5–17.
12. Crino M, Sacks G, Dunford E, Trieu K, Webster J, Vandevijvere S, et al. Measuring the healthiness of the packaged food supply in Australia. *Nutrients* 2018;**10**(6):702.
13. Health Star Rating Advisory Committee. *Formal Review of the System after Five Years of Implementation (June 2014 to June 2019) [Internet]*. Canberra (AUST): Australian Government Department of Health; 2020 [cited 2022 Sep 8]. Available from: http://www.healthstarrating.gov.au/internet/healthstarrating/publishing.nsf/Content/formal-review-of-the-system-after-five-years.
14. Egnell M, Talati Z, Hercberg S, Pettigrew S, Julia C. Objective understanding of front-of-package nutrition labels: An international comparative experimental study across 12 countries. *Nutrients* 2018;**10**(10):1542.
15. Talati Z, Egnell M, Hercberg S, Julia C, Pettigrew S. Food choice under five front-of-package nutrition label conditions: An experimental study across 12 countries. *Am J Public Health* 2019;**109**(12):1770–5.
16. Pettigrew S, Dana L, Talati Z. Enhancing the effectiveness of the Health Star Rating via presentation modifications. *Aust N Z J Public Health* 2020;**44**(1):20–1.
17. Pettigrew S, Dana LM, Talati Z, Tian M, Praveen D. The role of colour and summary indicators in influencing front-of-pack food label effectiveness across seven countries. *Public Health Nutr* 2021;**24**(11):3566–70.
18. Acton RB, Kirkpatrick SI, Hammond D. Comparing the effects of four front-of-package nutrition labels on consumer purchases of five common beverages and snack foods: Results from a randomized trial. *J Acad Nutr Diet* 2022;**122**(1):38–48. e9.
19. Andrews JC, Netemeyer R, Burton S, Kees J. What consumers actually know: The role of objective nutrition knowledge in processing stop sign and traffic light front-of-pack nutrition labels. *J Bus Res* 2021;**128**:140–55.
20. Song J, Brown MK, Tan M, MacGregor GA, Webster J, Campbell NRC, et al. Impact of color-coded and warning nutrition labelling schemes: A systematic review and network meta-analysis. *PLoS Med* 2021;**18**(10):e1003765.
21. Reyes M, Garmendia ML, Olivares S, Aqueveque C, Zacarías I, Corvalán C. Development of the Chilean front-of-package food warning label. *BMC Public Health* 2019;**19**:906.
22. White M, Barquera S. Mexico adopts food warning labels, why now? *Health Syst Reform* 2020;**6**(1):e1752063.
23. Pettigrew S, Coyle D, McKenzie B, Vu D, Lim SC, Berasi K, et al. A review of front-of-pack nutrition labelling in Southeast Asia: Industry interference, lessons learned, and future directions. *Lancet Reg Health Southeast Asia* 2022;**3**:100017.
24. United Kingdom Department of Health. *Guide to Creating a Front of Pack (FoP) Nutrition Label for Pre-packed Products Sold Through Retail Outlets [Internet]*. London (UK): Government of UK; 2016. Available from: https://www.food.gov.uk/sites/default/files/media/document/fop-guidance_0.pdf.
25. International Agency for Research on Cancer. *The Nutri-Score: A Science-Based Front-of-Pack Nutrition Label, IARC Evidence Summary Brief No. 2 [Internet]*. Geneva (CHE): World Health Organization; 2021 [cited 2022 Sep 8]. Available from: https://www.iarc.who.int/featured-news/brief2-nutri-score/.
26. Lawrence MA, Dickie S, Woods JL. Do nutrient-based front-of-pack labelling schemes support or undermine food-based dietary guideline recommendations? Lessons from the Australian Health Star Rating System. *Nutrients* 2018;**10**(1):32.
27. Taillie LS, Hall MG, Popkin BM, Ng SW, Murukutla N. Experimental studies of front-of-package nutrient warning labels on sugar-sweetened beverages and ultra-processed foods: A scoping review. *Nutrients* 2020;**12**(2):569.
28. Egnell M, Galan P, Fialon M, Touvier M, Péneau S, Kesse-Guyot E, et al. The impact of the Nutri-Score front-of-pack nutrition label on purchasing intentions of unprocessed and processed foods: Post-hoc analyses from three randomized controlled trials. *Int J Behav Nutr Phys Act* 2021;**18**(1):38.
29. Julia C, Arnault N, Agaësse C, Fialon M, Deschasaux-Tanguy M, Andreeva VA, et al. Impact of the Front-of-Pack Label Nutri-Score on the nutritional quality of food choices in a quasi-experimental trial in catering. *Nutrients* 2021;**13**(12):4530.
30. Pettigrew S, Booth L, Dunford E, Scapin T, Webster J, Wu J, et al. An examination of public support for 35 nutrition interventions across seven countries. *Eur J Clin Nutr* 2022. https://doi.org/10.1038/s41430-022-01211-5.
31. Variyam JN, Shim Y, Blaylock J. Consumer misperceptions of diet quality. *J Nutr Educ* 2001;**33**(6):314–21.
32. Egnell M, Galan P, Farpour-Lambert NJ, Talati Z, Pettigrew S, Hercberg S, et al. Compared to other front-of-pack nutrition labels, the Nutri-Score emerged as the most efficient to inform Swiss consumers on the nutritional quality of food products. *PLoS One* 2020;**15**(2):e0228179.

Appendix A Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.anzjph.2022.100017.