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Short Communication

The role of colour and summary indicators in influencing front-of-pack food label effectiveness across seven countries

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Abstract

Objective: Many countries are considering the implementation of front-of-pack nutrition labels as a strategy to address high and increasing levels of overweight and obesity. A growing body of work demonstrates the superiority of labels that use colour and/or provide a summary indicator of product healthiness to enhance comprehension. However, previous studies have been confounded in determining the relative effectiveness of these two attributes by comparing labels that also differ in other ways. The present study tested labels that varied only on use of colour and/or reliance on a summary indicator across an international sample to provide unique insights into the relative importance of these attributes.

Design: Participants were randomised to see one of four variations of the Health Star Rating label that differed on the basis of use of colour and sole provision of a summary indicator.

Setting: Australia, Canada, China, India, New Zealand, the UK and the USA.

Participants: Adults (n 7545) in seven countries were exposed to online choice tasks requiring them to select a preferred breakfast cereal and then nominate the healthiest cereal.

Results: Overall, the coloured versions, and particularly the one with just a summary indicator, outperformed the monochrome version that included nutrient-specific information. However, there were some differences by country, with results from Canada and China indicating superior outcomes for monochrome labels and those providing nutrient-specific information.

Conclusions: The results highlight the importance of colour, but suggest that the introduction of front-of-pack nutrition labels should be preceded by country-specific formative testing to identify potential differences in outcomes.

Keywords
Front-of-pack
Nutrition labels
Purchase intentions
Understanding

The provision of on-pack nutrition information is recognised as an important population-level strategy to assist consumers to identify and select healthier foods, with potential long-term benefits for the prevalence of obesity and other diet-related diseases[1–3]. Front-of-pack labels (FoPLs) have been shown to be able to improve consumers' ability to assess the relative healthiness of different products ('understanding') and their food choices[4–6] and have been identified as an important complement to the Nutrient Facts Panel that has been implemented in many countries[2].

Various FoPL formats have been developed and implemented around the world, ranging from more reductive (numerical summaries of the information contained in the Nutrition Facts Panel) to more interpretive versions (characterised by symbols, colours and/or other methods

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of providing a summary of product healthiness)[7,8]. Recent research undertaken across twelve countries demonstrates that more interpretive FoPLs featuring summary indicators and/or colour are more likely than FoPLs in reductive and monochrome formats to be effective in terms of both understanding of nutritional quality and influencing purchase intentions and that this appears to be the case regardless of FoPL familiarity[4,5]. However, this work has been confounded in determining the relative effectiveness of these two attributes by comparing outcomes across labels that also differed in other important ways. Additional work is thus required to isolate the relative effects of the provision of a summary indicator and the use of colour to assist policymakers in selecting an optimal FoPL system.

The Health Star Rating (HSR), introduced in Australia and New Zealand in 2014, is a hybrid FoPL that includes both a summary indicator (in the form of a star rating that ranges from half a star to five stars) and nutrient-specific information. The hybrid format reflects a compromise between the need to provide interpretive information to enhance comprehension and speed of use[2,3], consumers' desire for nutrient-specific information[9] and the food industry's reluctance to relinquish the reference intakes FoPL, despite the poor performance of this label format (for a review see Ref. (10)). Due to industry resistance to mandatory FoPLs that include colour, the HSR was introduced in Australia and New Zealand on a voluntary basis and in a monochrome format.

The recent international results noted above suggest that a simplified (star-only), colour-coded version of the HSR may be more effective than the current monochrome hybrid version[4,5]. Indeed, a subsequent Australian study comparing four forms of the HSR featuring varying combinations of the use of a summary indicator and colour showed that a simplified colour version of the HSR was most effective for both understanding and purchase intention outcomes[11]. Given the common use of both stars and traffic light colours as communication devices across the world, of interest is how consumers in different countries would respond to these different HSR formats. To investigate this issue, the aim of the present study was to test the effectiveness of the four versions of the HSR across six additional countries, three of which have been the focus of previous international comparison studies (UK, USA, Canada) and three new countries (New Zealand, India, China). New Zealand was included due to the current use of the HSR in this country and hence the potential value of the results to policymakers. India and China have large populations and are yet to introduce front-of-pack food labels, making them important contexts for research designed to inform FoPL implementation. The selected range of countries covers those with higher and lower levels of average healthiness of the available packaged food supply[12].

Method

As part of a larger international study examining a range of food and alcohol policies, the protocol used to test the four FoPL variations in Australia[11] was replicated in the six additional countries. Consistent with the methodology employed in previous international FoPL studies[4,5], an ISO-accredited web panel provider (Pureprofile) was commissioned to administer the online survey to a sample of 1000 adults per country with quotas applied for equal distribution by gender and three age categories (18–34, 35–54, 55+ years), and with at least two-thirds of the sample in the low- and middle-income categories. These quotas were met in most instances (see Table 1). The specified sample size provided appropriate power for analyses across the four conditions.

The surveys for China and India were presented in Mandarin and Hindi, respectively, with an English option also provided. After responding to demographic items that

Table 1 Sample composition by country and demographic characteristics*

	Australia (*n* 1033)		Canada (*n* 1079)		China (*n* 1099)		India (*n* 1072)		New Zealand (*n* 1090)		UK (*n* 1079)		USA (*n* 1093)		Total sample (*n* 7545)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Gender																
Female	522	51	529	51	537	49	506	47	565	52	549	51	561	51	3790	50
Male	511	49	55	49	562	51	566	53	525	48	530	49	532	49	3755	50
Age (years)																
18–34	322	31	311	29	352	32	515	48	324	30	310	29	328	30	2462	33
35–54	348	34	367	34	463	42	360	34	424	39	377	35	371	34	2710	36
55+	363	35	401	37	284	26	197	18	342	31	392	36	394	36	2373	31
Household income																
Low	353	34	351	33	51	5	295	28	300	28	351	32	463	43	2164	29
Mid	374	36	534	49	737	67	626	58	462	42	299	28	452	41	3484	46
High	306	30	194	18	311	28	151	14	328	30	429	40	178	16	1897	25

*Income categories were calculated around the median household income for each country. A bracket around the median of +/–33 % was created, with household incomes falling below or above those figures considered low or high respectively. Worldometer population estimates: Australia 25·5 million; Canada 37·8 million; China 1·4 billion; India 1·4 billion; New Zealand 4·8 million; UK 67·9 million; USA 331 million.

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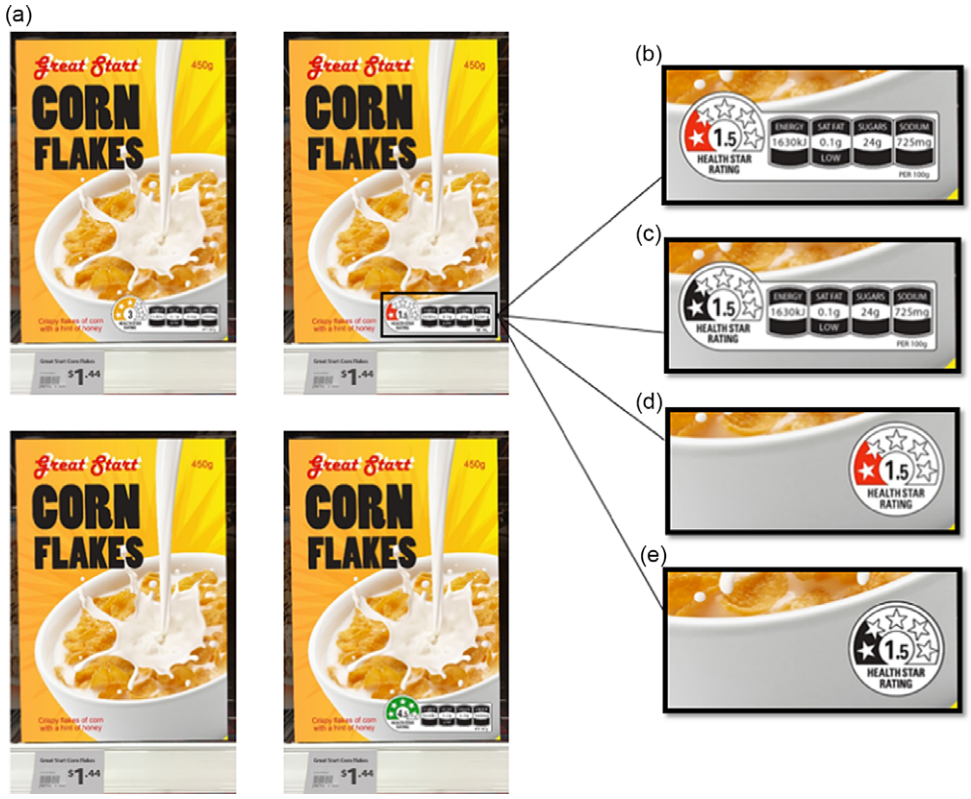

Fig. 1 (colour online) Example choice set and Health Star Rating (HSR) FoPL variations; (a) example choice set featuring coloured hybrid HSR labels, (b) coloured hybrid, (c) monochrome hybrid, (d) coloured simplified and (e) monochrome simplified

assessed eligibility according to the national recruitment quotas, respondents were randomised to one of the four FoPL conditions (monochrome hybrid, coloured hybrid, monochrome simplified and coloured simplified: depicted in Fig. 1). They were subsequently shown a choice set of four breakfast cereal products, which were presented in random order. Breakfast cereal was chosen because it is consumed around the world and is generally perceived to be a healthy product category, but has wide variation in nutritional quality. Each cereal product in the array was identical except for the FoPL to isolate the effects of label characteristics. A notional brand without price information was shown to prevent familiarity and cost variables confounding the results.

In each choice set within a label condition, respondents saw one product with no HSR, one with a 1·5-star HSR (shaded red in the coloured versions), one with a 3-star rating (shaded orange) and one with a 4·5-star rating (shaded green) (Fig. 1). Initially, respondents were asked about purchase intention, 'Assuming you were interested in purchasing this type of food, which one of the following product variations would you most prefer to buy?', followed by assessment of understanding 'Which of these products is the healthiest?'. This question order avoided respondents being primed to use healthiness as their primary selection criterion when reporting their purchase intentions. The size of the star rating was identical regardless of condition, which meant that the footprint of the hybrid versions was considerably larger than for the simplified versions.

Logistic regression analyses using the full sample and by country were performed for the outcome variables of purchase intention and demonstrating correct understanding (selection of the 4·5-star option). Given the standard HSR is a black and white monochrome hybrid, this was used as the reference condition for the logistic regression models.

Results

The aggregated data showed that despite having a substantially smaller footprint, the simplified coloured version of the HSR demonstrated the strongest performance relative to the current monochrome hybrid version for both understanding and purchase intentions across the whole sample (Table 2). The coloured hybrid version also performed well. At the aggregate level, the difference between the simplified monochrome version and the reference condition failed to reach significance for either understanding or purchase intentions.

Results by country showed some variation. For the majority of countries, at least one of the colour versions facilitated a significant improvement in understanding relative to the reference condition. The exceptions were

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Table 2 Purchase intention and understanding results by Health Star Rating (HSR) condition†

		Choice results‡,§									Understanding results‡								
		Coloured hybrid			Monochrome simplified			Coloured simplified			Coloured hybrid			Monochrome simplified			Coloured simplified		
Countries	*n*	OR	95 % CI	*P*	OR	95 % CI	*P*	OR	95 % CI	*P*	OR	95 % CI	*P*	OR	95 % CI	*P*	OR	95 % CI	*P*
All countries	7545	**1·20**	**1·04, 1·39**	**0·014**	1·05	0·91, 1·22	0·505	**1·24**	**1·07, 1·22**	**0·005**	**1·22**	**1·06, 1·40**	**0·005**	1·05	0·92, 1·20	0·489	**1·29**	**1·22, 1·48**	**< 0·001**
Australia*	1033	1·29	0·78, 2·14	0·328	1·08	0·66, 1·77	0·755	**1·75**	**1·02, 2·98**	**0·041**	1·22	0·78, 1·92	0·378	1·20	0·76, 1·88	0·435	**2·13**	**1·28, 3·54**	**0·004**
Canada	1079	0·94	0·60, 1·47	0·796	0·69	0·45, 1·06	0·093	0·97	0·62, 1·52	0·886	0·84	0·54, 1·31	0·444	**0·59**	**0·39, 0·89**	**0·013**	0·88	0·57, 1·37	0·569
China	1099	0·83	0·56, 1·25	0·385	0·83	0·55, 1·26	0·385	0·79	0·52, 1·20	0·266	**0·66**	**0·45, 0·97**	**0·035**	0·74	0·51, 1·08	0·120	0·76	0·52, 1·12	0·168
India	1072	1·29	0·91, 1·85	0·155	1·10	0·77, 1·58	0·584	1·08	0·76, 1·54	0·660	**1·54**	**1·09, 2·17**	**0·015**	1·15	0·82, 1·62	0·419	1·17	0·83, 1·64	0·361
New Zealand	1090	1·35	0·79, 2·31	0·275	1·45	0·84, 2·50	0·185	1·12	0·66, 1·89	0·671	1·31	0·78, 2·22	0·310	**1·89**	**1·06, 3·35**	**0·030**	**2·15**	**1·18, 3·94**	**0·013**
UK	1079	**2·08**	**1·37, 3·15**	**0·001**	**1·61**	**1·07, 2·44**	**0·024**	**1·87**	**1·24, 2·83**	**0·003**	**1·91**	**1·31, 2·79**	**0·001**	**1·45**	**1·00, 2·09**	**0·048**	**2·24**	**1·51, 3·31**	**< 0·001**
USA	1093	1·45	0·98, 2·14	0·060	1·15	0·77, 1·73	0·488	**2·27**	**1·49, 3·44**	**< 0·001**	**1·83**	**1·25, 2·67**	**0·002**	1·17	0·81, 1·67	0·402	**1·68**	**1·16, 2·44**	**0·006**

Significant results ($P < .05$) shown in bold.
*As per Ref. (11).
†Reference condition was standard HSR (hybrid monochrome).
‡Selection of the 4·5-star option; respondents asked which product option they would purchase.
§Respondents could opt out of making a choice.

Canada and China where significant differences were found for the monochrome simplified and coloured hybrid versions, respectively, but with both performing worse than the reference condition.

Fewer country-level differences were evident in the purchase intention data. The UK varied from the other countries in that all three comparison FoPLs outperformed the reference FoPL, with the coloured hybrid FoPL yielding the strongest outcome. The USA demonstrated the same pattern of results as Australia, with only the colour simplified version showing a significant improvement over the reference condition. No significant differences in purchase intentions by FoPL condition were found for Canada, China, India or New Zealand.

Discussion

The results of the present study suggest that colour is likely to be a potentially important determinant of FoPL effectiveness, as assessed by understanding and purchase intention outcomes in a simulated product exposure context. Simplicity in the form of the provision of a summary indicator of product healthiness also appears to be a FoPL design element worthy of consideration. These results support previous work highlighting the important role of colour and symbols in FoPLs[4,5,8,13,14] and reinforce the need to consider these elements in FoPL development work or when selecting from among pre-existing label alternatives.

The differences in results by country suggest that FoPL effectiveness can vary by national context. In particular, the superior performance of the monochrome hybrid version of the HSR for the understanding results for China and Canada was unexpected. India was also different to other countries in demonstrating a stronger effect on understanding for the coloured hybrid version. Further work is needed to investigate the factors contributing to these outcomes. For example, lower levels of familiarity with packaged breakfast cereal products in China and India may have induced higher levels of information searching, thus increasing the utility of the hybrid versions of the HSR.

The somewhat variable results by country support the WHO's recommendation[3] for formative work to be conducted in individual countries to ensure any proposed labelling scheme is appropriate for the specific cultural context. Previous work has shown that different groups of consumers can exhibit varying information processing styles, which in turn have implications for the way in which FoPLs are used and interpreted[15]. A further consideration is the likely need for appropriate education programmes to ensure consumers are aware of the existence and nature of introduced FoPLs[7,8]. The stronger effect of FoPLs on understanding relative to purchase intentions in the present study is consistent with the results of previous FoPL research[4,5] and reflects the fact that healthiness is only one choice criterion, with taste and price typically being

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more influential[16]. Education programmes to inform the public of the role and meaning of a new FoPL may be particularly important in countries such as China and India where there are low current levels of understanding of nutrition labels[17–19], and where there is the potential for colours used in traffic light nutrition signposting to communicate different meanings from those understood elsewhere[20].

An important limitation of this study was the use of a web panel for respondent recruitment and some resulting variations in demographic profiles between countries (e.g. the Indian sample was younger, lower-income consumers were under-represented in the Chinese sample and high-income consumers were over-represented in the UK sample). A second limitation was the lack of variation in the products included within the choice sets, which is likely to have introduced two competing biases: the salience of the FoPLs would have been increased relative to the situation in choice environments in which product packages are more variable, but the corresponding increase in accuracy would have reduced the ability to detect differences between FoPL types. Third, the inclusion of only a single product across all choice sets prevented a broader assessment of the ability of the FoPLs to influence understanding and purchase intentions across multiple product categories. Fourth, FoPL size was not included as a test characteristic. Previous research has identified size as an important determinant of FoPLs' ability to attract consumer attention[21], indicating that the results for the simplified versions could have been stronger if they had been presented with the same footprints as the hybrid versions. Fifth, it is possible that familiarity with the HSR in Australia and New Zealand may have affected the results. However, the lack of familiarity effects in other large-scale multi-FoPL research indicates that this is likely to have had minimal impact[4]. Other limitations included the testing of just one FoPL format, the inability to accommodate the range of languages commonly used in some countries and not accounting for any potential effects of colour blindness.

The main strength of the study was that the experimental design permitted direct observation of effects relating specifically to colour and summary indicator, thereby overcoming the limitation of previous research comparing different FoPLs. In addition, very little work has assessed consumers' reactions to FoPLs in the highly populous countries of China and India, which have yet to introduce these types of labels. The results of the present study are likely to be of use to governments across the world in their decisions to select, modify or replace a front-of-pack nutrition labelling system.

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