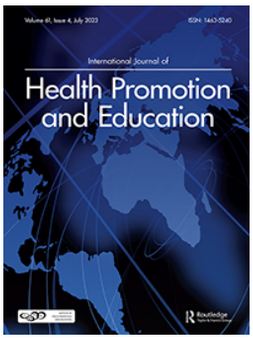

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The multiple 'traffic light' labels: are they a promising alternative for packaged foods and beverages sold in Turkey

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ABSTRACT

Food labeling is a suggested approach to guiding consumers to make healthy food choices by providing clear information at the point of purchase. The objective of this study was to examine how the multiple traffic light labels (MTL) scheme would look like if implemented in addition to evaluating the suitability of packaged products according to MTL in Turkey. Three supermarkets were chosen for this study. Data were analyzed using SPSS. Of the 2,969 food products analyzed, 49.57% of the products were found 'unhealthy' (total score ≥7). Packaged foods that were classified as 'Green' (Low) traffic light were found 31.7% for total fat, 40.7% for saturated fat, 47.5% for sugar, and 45.1% for salt, whereas these percentages for packaged beverages were 91.1%, 84.2%, 17.4%, and 97.6%, respectively. 30.7% of packaged foods for total fat, 17.2% for saturated fat, 19.7% for sugar and 31.2% for salt were classified as 'Amber' (Medium). Packaged foods classified as 'Red' (High) traffic light were found 37.6% for total fat, 42.1% for saturated fat, 32.8% for sugar, and 23.7% for salt. There were very few packaged beverages that were classified as 'Red'. The groups with the most 'Red' products were oil, fat, nuts, and olive group for total fat; sugars, sweets and other desserts group for saturated fat and total sugar; sauces, ready-to-consume seasonings, and broths group for total salt. A color-coded traffic light labeling seems to be an alternative for implementation across the packaged food supply in Turkey to support consumers to make healthy food choices.

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Traffic light food label; packaged foods and beverages; food supply; nutrient profiling; public health

Introduction

Turkey is considered an obese country due to the highest prevalence of obesity across the European countries and diet-related non-communicable diseases (NCD) are widely observed in the population (WHO 2020). 87.5% of all deaths are caused by non-communicable diseases in Turkey. The World Health Organization (WHO) announced that 39% of adults were overweight and 13% were obese in the world (WHO 2020). However, these prevalences in Turkey are higher than the world's prevalence. According

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to the last Turkey national health survey, 43.4% of men are overweight, 24.9% are obese and 1.4% are morbidly obese. In women, these rates are 29.2%, 35.6%, 7.0%, respectively (GDPH 2019a). These figures show that the NCD epidemic is increasing day by day, similar to other developing countries (GBD 2016 Mortality Collaborators 2017; Reyes et al. 2019).

Tackling nutrition and diet-related NCDs is a public health priority around the world as well as a major concern for food manufacturers (Ikonen et al. 2020). Turkey has implemented several actions to reduce NCDs and improve nutritional habits; however, most of them are related to individual responsibility (GDPH 2010, 2016, 2019b). Therefore, a multi-pronged strategy is required for the reduction of these diseases (Draper et al. 2013).

Food labeling is a suggested approach to guiding consumers to make healthy food choices by providing clear information at the point of purchase (Bayram and Ozturkcan 2021a; Besler, Buyuktuncer, and Uyar 2012; Ikonen et al. 2020). The nutrition label is a confidence component of food labeling that provides knowledge of basic nutritional principles (Besler, Buyuktuncer, and Uyar 2012; Miller and Cassady 2015).

Nutritional information can be voluntarily displayed on the front-of-pack (FOP) or the back-of-pack (BOP) (Draper et al. 2013). While BOP is mandatory in most countries, consumers seldom use it for food selection (Grunert et al. 2010; Chantal, Hercberg, and WHO 2017). A study that evaluated the penetration of the nutritional content on food labels in EU-27 and Turkey showed that 85% of the packaged foods contain BOP nutrition information while 48% contain FOP nutrition information with the lowest penetration in Turkey (24%) (Draper et al. 2013).

FOP use which is relatively new, seeks to provide consumers with simplified information such as logos, graphics, or wording for making healthy choices (Besler, Buyuktuncer, and Uyar 2012; Draper et al. 2013; Dunford et al. 2017). The presence of the FOP label can facilitate attention, processing, and consumer decision-making due to the fact that consumers spend a few seconds evaluating each choice (Mauri et al. 2021). Different types of labeling schemes, all of which are based on important nutrients such as salt, (added) sugars, and fat (total, saturated, and/or trans-fat) have been applied (van Herpen, Hieke, and van Trijp 2014). These types of schemes vary from very complicated to very easy (Temple and Fraser 2014). The more comprehensive and effective of FOP labels are, the more they help the consumer choose healthy options (Dubois et al. 2021). Additionally, in the literature, it was found that FOP labels are commonly favourably perceived and can increase consumers' awareness of the healthiness of food products (Cowburn and Stockley 2005; Hawley et al. 2013; Hersey et al. 2013).

Numerous number of FOP labeling schemes have been developed and implemented in over 40 countries (European Food Information Council 2016). The Multiple Traffic Lights label (MTL) system was first recommended by UK Food Standards Agency (FSA) in 2006 and implemented voluntarily by many businesses afterward (Malam et al. 2009). Additionally, it has inspired nutritional labels developed in many other countries, such as Latin America (Defago et al. 2020). The MTL, one of the most commonly proposed FOP labeling schemes, represents whether nutrient values are considered low, medium, or high, supported by the traffic light colors

Table 1. Summary of the main contributions of MTL.

Contributions	References
Cost-effective method for preventing obesity and NCDs	Sacks et al. 2011
Simple and easy to understand	Sacks et al. 2011
Promote awareness of the health costs of products	Sonnenberg et al. 2013; Trudel et al. 2015
Consider healthier choices at point of purchase	Hawley et al. 2013; Sonnenberg et al. 2013
Increase the value computation of healthy foods and beverages	Enax et al. 2015
Increase the consumption and sale of healthy items	Thorndike et al. 2012; Trudel et al. 2015
Decrease the consumption and sale of healthy items	Thorndike et al. 2012; Emrich et al. 2017

green, amber, or red (van Herpen, Hieke, and van Trijp 2014; FSA (Food Standards Agency) 2020; Chantal and Hercberg 2017). The main contributions of MTL are shown in Table 1.

According to the studies MTL is the most effective FOP labeling scheme in increasing the selection of healthier options and provides far clear nutrition information due to its colors in different countries (Hersey et al. 2013; Cecchini and Warin 2016; Emrich et al. 2017; Arrúa et al. 2017; Egnell et al. 2018; Findling et al. 2018; Khandpur et al. 2018; Zhang et al. 2020). Therefore, being more useful in making healthy choices for consumers. However, empirical evidence on the effectiveness of MTL in developing countries remains limited and inconclusive (Mandle et al. 2015). The Republic of Turkey Ministry of Agriculture and Forestry General Directorate of Food and Control (2020) has announced that MTL will be used for packaged foods and beverages. Thus, they published a draft for taking the opinions of the public. However, there is no scientific study that what MTL would look like if implemented in Turkish packaged products, so as to understand the potential for consumer behaviour change and product reformulation. Additionally, the distribution of the nutrient profile of packaged products receiving these MTL is unknown. Therefore, we aimed to examine how the MTL scheme would look like if implemented in addition to evaluating the suitability of packaged products according to MTL in Turkey. We hypothesized that according to the MTL classification, a large number of packaged products will be included in the 'unhealthy' group, and consumers who see 'unhealthy' products in the 'Red' traffic color can choose healthy products in the 'Green' traffic color.

Materials and methods

Data collection

The present study was a cross-sectional analysis of ingredient information from packaged food and beverage products available in three of the largest supermarkets in Istanbul, Turkey. These three chains were the largest in the country, accounting for 7,438, 2,155, and 596 stores, respectively. The food products sold in these stores are similar to those sold in other supermarket chains throughout the country. We visited one chain of these supermarkets in middle-income areas.

Nutritional label information of the packaged foods and beverages were obtained in the stores. We entered these data into Microsoft Office Excel 2016 spreadsheets without any quality control on the data entering, where each product was classified and coded according to label denomination.

Table 2. Color coded criteria for foods and beverages.

Foods	Low	Medium	High
Color code	Green	Amber	Red
Total fat	≤3.0 g/100 g	>3.0 g to ≤17.5 g/100 g	>17.5 g/100 g
Saturated fat	≤1.5 g/100 g	>1.5 g to ≤5.0 g/100 g	>5.0 g/100 g
Total sugars	≤5.0 g/100 g	>5.0 g to ≤22.5 g/100 g	>22.5 g/100 g
Salt	≤0.3 g/100 g	>0.3 g to ≤1.5 g/100 g	>1.5 g/100 g
Beverages			
Total fat	≤1.5 g/100 ml	>1.5 g to ≤8.75 g/100 ml	>8.75 g/100 ml
Saturated fat	≤0.75 g/100 ml	>0.75 g to ≤2.5 g/100 ml	>2.5 g/100 ml
Total sugars	≤2.5 g/100 ml	>2.5 g to ≤11.25 g/100 ml	>11.25 g/100 ml
Salt	≤0.3 g/100 ml	>0.3 g to ≤0.75 g/100 ml	>0.75 g/100 ml

Food categorization

All packaged foods and beverages available in the supermarket with nutritional information content were included in the study. Food for babies and toddlers, fresh fruits or vegetables, 100% of fruit juices, eggs, specific dietary use (e.g. protein powders, nutritional supplements), and those that did not require nutrition labeling (bakery products produced, packaged, and labeled in-store); and meat and cheese products (cut, packaged and labeled in-store) were excluded. Foods were categorized into 42 subgroups and 9 main groups (Supplementary Table 1).

Assignment of traffic light criteria

The packaged foods and beverages were classified as 'Red' (High), 'Amber' (Medium) or 'Green' (Low) in total fat, saturated fat, total sugar, and salt by the UK Department of Health traffic light criteria (FSA (Food Standards Agency) 2020). The traffic light criteria of total fat, saturated fat, sugar, and salt are based on per 100 g/ml for foods and beverages nutrient values (Table 2).

Evaluating products as 'healthy' or 'unhealthy'

According to the traffic light labeling scoring method found by Sack et al. For MTL, we evaluated foods as 'healthy' and 'unhealthy'. One point was assigned for each green light, two points for each yellow light and three points for each red light. If the total score is <7, it was considered 'healthy' (Sacks, Rayner, and Swinburn 2009; Sacks et al. 2011).

Statistical analysis

We conducted a descriptive statistical analysis of groups and subgroups. The mean, standard deviation, and range of values for total fat, saturated fat, sugar, and salt per 100 g/mL were also calculated by each main group and subgroup. All statistical analyses were conducted using SPSS Statistics 24.0 (Statistical Package for the Social Sciences, Inc.; Chicago, Illinois, United States).

Results

Overall results

Two thousand nine hundred and sixty-nine packaged foods and beverages were analyzed. According to the classification criteria; packaged foods that were classified as 'Green' (Low) traffic light were found 31.7% for total fat, 40.7% for saturated fat, 47.5% for sugar and 45.1% for salt. The percentages for packaged beverages were 91.1%, 84.2%, 17.4% and 97.6%, respectively. 30.7% of packaged foods for total fat, 17.2% for saturated fat, 19.7% for sugar and 31.2% for salt were classified as 'Amber' (Medium) score. These percentages for packaged beverages were 8.1%, 13.8%, 57.5% and 1.2%, respectively. Packaged foods classified as 'Red' (High) traffic light were found 37.6% for total fat, 42.1% for saturated fat, 32.8% for sugar and 23.7% for salt. There were very few packaged beverages that were classified as 'Red' (High) based on their nutritional content (Table 3).

Total fat

The group with the highest total fat content was the oil, fat, nuts and olive group with 34.86 ± 17.52 g/100 g or ml, followed by the snack foods group (20.46 ± 8.61 g/100 g or ml) and sugar, sweets, and other desserts group (18.59 ± 16.06 g/100 g or ml). The non-alcoholic beverages group had the lowest total fat content with 0.51 ± 2.40 g/100 g or ml (Table 4). Products classified as 'Red' (High) in total fat content; the highest amount of products was in oil, fat, nuts, and olive group (75.76% of the group products); followed by snack foods groups (69.97% of the group products) and sugars, sweets and other desserts group (53.63% of the group products). The non-alcoholic beverages group had the highest proportion of products receiving a 'Green' (Low) score for total fat (91.09% of the group products) (Figure 1 and Supplementary Table 2). The total fat content of the products classified as 'Red' (High) traffic light was the highest in the oil, fat, nuts, and olive group (42.89 ± 11.50 g/100 g or ml), followed by sauces, ready-to-consume seasonings, broths group with 39.40 ± 18.52 g/100 g or ml (Supplementary Table 3).

Saturated fat

Sugar, sweets and other desserts group contained the highest saturated fat content with 9.40 ± 11.45 g/100 g or ml, whereas the non-alcoholic beverages group contained the lowest saturated fat content with 0.46 ± 2.22 g/100 g or ml (Table 4). According to the 'Red'

Table 3. Total amount and percentage of packaged foods and beverages sold in Turkey with each color-coded nutrient (N = 2,969), Turkey, April–December 2020.

	Total fat	Saturated fat	Sugar	Salt
GREEN				
Foods (n,%)	864 (31.7)	1109 (40.7)	1292 (47.5)	1228 (45.1)
Beverages (n,%)	225 (91.1)	208 (84.2)	43 (17.4)	241 (97.6)
AMBER				
Foods (n,%)	836 (30.7)	468 (17.2)	537 (19.7)	850 (31.2)
Beverages (n,%)	20 (8.1)	34 (13.8)	142 (57.5)	3 (1.2)
RED				
Foods (n,%)	1022 (37.6)	1147 (42.1)	893 (32.8)	644 (23.7)
Beverages (n,%)	2 (0.8)	5 (2.0)	62 (25.1)	3 (1.2)

Table 4. The mean, standard deviation and range values of total fat, saturated fat, sugar and salt contents of main and subgroups (N = 2,969), Turkey, April–December 2020.

			Total fat		Saturated fat		Sugar		Salt	
Food Category	n	%	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Meats and eggs	252	8.49	15.88 ± 12.12	0.20–40.00	7.55 ± 8.73	0.00–74.00	0.32 ± 0.91	0.00–8.30	1.99 ± 1.42	0.00–10.00
Meat products	165	5.56	18.61 ± 13.32	1.00–40.00	9.44 ± 9.31	0.00–74.00	0.19 ± 0.37	0.00–2.20	2.28 ± 1.49	0.00–10.00
Meat and chicken	26	0.88	15.83 ± 4.84	2.00–24.50	6.05 ± 3.50	0.35–16.00	0.48 ± 0.71	0.00–2.30	1.22 ± 0.61	0.20–2.60
Seafood and seafood products	54	1.82	8.58 ± 7.10	0.20–32.40	3.19 ± 7.17	0.00–37.80	0.57 ± 1.62	0.00–8.30	1.68 ± 1.22	0.10–5.50
Eggs	7	0.24	7.98 ± 0.98	7.30–9.80	2.16 ± 1.03	0.00–3.27	0.81 ± 1.98	0.00–5.30	0.39 ± 0.30	0.00–1.00
Oil, fat, nuts and olive	132	4.45	34.86 ± 17.52	1.80–67.70	5.32 ± 3.28	0.00–15.50	6.65 ± 11.35	0.00–57.50	2.04 ± 2.20	0.00–9.00
Nuts	92	3.10	39.15 ± 17.97	1.80–67.70	5.83 ± 3.46	0.60–15.50	9.48 ± 12.60	0.00–57.50	0.92 ± 1.46	0.00–9.00
Olive	40	1.35	24.99 ± 11.61	8.00–40.00	4.14 ± 2.47	0.00–9.00	0.14 ± 0.17	0.00–0.50	4.61 ± 1.27	0.80–5.90
Dairy products	452	15.22	12.29 ± 10.03	0.00–60.00	7.31 ± 6.57	0.00–39.00	9.94 ± 11.95	0.00–85.00	1.20 ± 6.56	0.00–137.50
Flavoured milk	83	2.80	1.52 ± 0.91	0.10–4.00	0.66 ± 0.58	0.00–2.00	5.36 ± 3.32	0.00–11.00	0.21 ± 1.03	0.00–9.40
Cheese	180	6.06	20.66 ± 6.55	2.00–32.00	12.45 ± 4.98	0.00–22.00	1.90 ± 2.18	0.00–10.00	2.73 ± 10.17	0.00–137.50
Flavoured yoghurt	35	1.18	2.73 ± 3.64	0.00–22.50	1.04 ± 0.85	0.00–2.90	7.45 ± 4.59	0.00–15.00	0.08 ± 0.08	0.00–0.30
Daily desserts and creams	57	1.92	8.70 ± 11.13	0.00–60.00	5.73 ± 7.62	0.00–39.00	22.22 ± 17.79	0.00–85.00	0.15 ± 0.28	0.00–2.00
Ice cream	97	3.27	11.59 ± 6.29	0.10–29.50	6.68 ± 4.19	0.00–18.00	22.92 ± 7.90	0.00–34.20	0.21 ± 0.30	0.00–2.00
Soups, prepared dishes and desserts, canned and frozen foods	440	14.82	4.85 ± 6.21	0.00–37.80	1.66 ± 3.29	0.00–46.30	5.74 ± 7.81	0.00–37.90	1.32 ± 1.68	0.00–10.40
Packaged soup	62	2.09	3.35 ± 3.91	0.02–18.60	1.18 ± 1.78	0.00–10.50	3.60 ± 6.44	0.00–35.50	2.36 ± 2.99	0.00–9.90
Ready to eat dishes	67	2.26	10.20 ± 7.41	0.00–37.80	2.51 ± 2.64	0.00–12.00	2.39 ± 1.75	0.00–9.40	1.31 ± 1.19	0.00–10.00
Canned foods	146	4.92	0.60 ± 1.19	0.00–9.90	0.14 ± 0.29	0.00–1.70	2.89 ± 3.95	0.00–16.80	1.79 ± 1.53	0.00–10.40
Frozen foods	75	2.53	7.35 ± 6.71	0.00–28.40	3.50 ± 6.18	0.00–46.30	3.28 ± 5.15	0.00–24.00	0.84 ± 0.62	0.00–2.00
Powder dessert mixes	90	3.03	6.68 ± 6.13	0.00–30.30	2.29 ± 2.54	0.00–12.18	16.33 ± 8.87	0.00–37.90	0.24 ± 0.37	0.00–2.10
Bread products, cereals, legumes and their derivatives	294	9.90	6.52 ± 7.98	0.00–40.10	2.09 ± 3.97	0.00–38.70	10.29 ± 14.25	0.00–79.00	0.70 ± 1.69	0.00–18.00
Breakfast cereals	67	2.26	6.27 ± 6.00	0.00–24.00	1.47 ± 1.93	0.00–12.00	34.13 ± 20.41	0.50–60	0.87 ± 2.18	0.00–17.00
Packaged bread	48	1.62	3.68 ± 3.04	0.30–13.30	1.36 ± 1.16	0.10–4.40	3.09 ± 1.59	0.60–7.60	1.10 ± 0.37	0.00–1.94
Packaged pasties	35	1.18	20.46 ± 10.39	2.60 ± 40.10	9.11 ± 7.06	0.00–38.70	21.52 ± 10.56	0.00–42.20	1.41 ± 3.53	0.00–18.00
Other cereal related products	35	1.18	9.92 ± 6.05	0.20–24.81	2.82 ± 3.70	0.00–16.65	3.26 ± 5.17	0.00–29.40	1.17 ± 0.80	0.00–3.70
Legumes	109	3.67	2.48 ± 4.08	0.20–31.40	0.37 ± 1.05	0.00–10.80	7.99 ± 18.33	0.00–79	0.05 ± 0.06	0.00–0.30
Sugars, sweets and other desserts	619	20.85	18.59 ± 16.06	0.00–59.00	9.40 ± 11.45	0.00–147.80	41.32 ± 22.92	0.00–89.90	0.30 ± 2.01	0.00–35.40
Sugar, halva, molasses and related products	26	0.88	32.03 ± 7.47	10.00–37.90	6.26 ± 2.46	0.50–10.90	39.46 ± 13.06	1.70–64.80	0.19 ± 0.09	0.00–0.40
Other sugar products	34	1.15	35.52 ± 9.45	10.50–59.00	8.87 ± 8.41	0.00–49.00	34.13 ± 20.41	0.50–60.00	1.48 ± 6.05	0.00–35.40
Jams	70	2.36	0.33 ± 0.89	0.00–6.40	0.03 ± 0.27	0.00–2.30	53.37 ± 19.99	0.00–71.90	0.02 ± 0.09	0.00–0.70
Chocolates	293	9.87	30.50 ± 8.38	0.00–55.00	17.55 ± 11.35	0.00–147.80	40.38 ± 13.27	0.00–71.00	0.36 ± 1.99	0.00–34.00
Chewing gums	63	2.12	0.51 ± 0.75	0.00–2.90	0.19 ± 0.36	0.00–1.60	6.13 ± 19.06	0.00–70.00	0.02 ± 0.15	0.00–1.20
Candies	133	4.48	3.31 ± 5.17	0.00–29.90	1.34 ± 2.73	0.00–15.00	56.72 ± 25.57	0–89.90	0.72 ± 6.65	0.00–5.30
Sauces, ready-to-consume seasonings, broths	144	4.85	9.96 ± 16.93	0.00–80.00	1.50 ± 2.77	0.00–14.00	9.85 ± 11.93	0.00–59.00	3.98 ± 9.35	0.00–52.50
Meal-based sauces	16	0.54	5.61 ± 7.28	0.00–29.00	0.38 ± 0.54	0.00–1.50	6.10 ± 4.13	0.00–17.00	2.26 ± 1.18	0.00–4.50
Ready to eat sauces	101	3.40	11.79 ± 19.54	0.00–80.00	1.30 ± 2.37	0.00–13.30	11.91 ± 13.39	0.00–59.00	2.22 ± 2.94	0.00–16.80
Ready to eat seasonings	11	0.37	5.97 ± 5.73	0.40–20.00	2.11 ± 3.16	0.00–11.00	4.43 ± 4.62	0.00–13.50	5.70 ± 7.92	0.00–20.80

(*Continued*)

Table 4. (Continued).

			Total fat		Saturated fat		Sugar		Salt	
Food Category	n	%	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Broths	16	0.54	5.51 ± 5.99	0.30–19.00	3.50 ± 4.77	0.00–14.00	4.30 ± 5.63	0–15.20	15.59 ± 23.73	0.00–52.50
Snack foods	389	13.10	20.46 ± 8.61	0.00–63.00	9.37 ± 5.77	0.00–54.80	23.46 ± 15.17	0.00–64.30	1.05 ± 1.27	0.00–19.10
Packaged cakes	86	2.90	20.07 ± 4.54	7.30–30.00	10.35 ± 3.07	0–18.50	32.11 ± 7.48	10–47.10	0.65 ± 0.31	0.00–1.30
Biscuits	163	5.49	20.61 ± 6.68	2.40–43.00	10.30 ± 4.50	0.00–21.00	30.97 ± 9.25	7.60–58.00	0.58 ± 0.31	0.00–1.50
Crackers	46	1.55	18.70 ± 9.60	2.30–63.00	8.10 ± 3.26	0.80–16	7.37 ± 8.03	0.00–50.00	2.55 ± 2.79	0.00–19.10
Chips	54	1.82	28.21 ± 5.93	9.20–36.10	8.62 ± 7.09	1.70–40.00	3.24 ± 2.81	0–13.30	1.58 ± 0.57	0.60–5.00
Low calorie snacks	40	1.35	12.18 ± 13.84	0.00–57.90	6.02 ± 11.18	0.00–54.80	20.66 ± 21.00	0.00–64.30	1.33 ± 1.26	0.00–5.20
Non-alcoholic beverages	247	8.32	0.51 ± 2.40	0.00–35.00	0.46 ± 2.22	0.00–31.00	8.34 ± 5.48	0.00–34.30	0.04 ± 0.14	0.00–1.30
Soda + energy drinks	73	2.46	0.00 ± 0.05	0.00–0.50	0.00 ± 0.01	0.00–0.10	7.41 ± 5.89	0.00–34.30	0.03 ± 0.09	0.00–0.60
Fruit juices	88	2.96	0.02 ± 0.06	0.00–0.30	0.00 ± 0.01	0.00–0.10	10.79 ± 3.85	0.00–28.00	0.00 ± 0.01	0.00–0.10
Flavored waters	14	0.47	0.02 ± 0.04	0.00–0.10	0.02 ± 0.04	0.00–0.10	9.57 ± 9.11	0–31.60	0.23 ± 0.44	0.00–1.30
Milk drinks and milk substitutes	24	0.81	1.77 ± 1.27	0.00–3.60	1.93 ± 2.10	0.00–7.00	5.77 ± 3.87	0.00–14.20	0.07 ± 0.06	0.00–0.20
Ice tea and coffee	20	0.67	0.07 ± 0.22	0.00–0.93	0.07 ± 0.18	0.00–0.60	4.68 ± 2.07	0.00–8.20	0.01 ± 0.04	0.00–0.17
Beverage powder mixes	28	0.94	2.81 ± 6.48	0.80–35.00	2.30 ± 5.83	0.00–31.00	7.00 ± 6.03	0.40–33.50	0.12 ± 0.21	0.00–1.10
Total	2,969	100								

(High) color-coded nutrients; the highest amount of products in the snack foods group with 78.66%, followed by oil, fat, nuts and olive groups with 57.58% and sugar, sweets, and other desserts group with 52.02% (Figure 1 and Supplementary Table 2). According to the products that had a 'Red' (High) score; sugars, sweets, and other desserts group had the highest mean value with 17.49 ± 10.63 g/100 g or ml (Supplementary Table 3).

Total sugars

Similar to the saturated fat content; the sugar, sweets, and other desserts group contained the highest sugar content with 41.32 ± 22.92 g/100 g or ml (Table 4). As expected, the sugar, sweets and other desserts group and snack foods group had the highest proportion of products receiving a 'Red' (High) traffic light with 79.48% and 57.84%, respectively, while the meats and eggs group had the highest proportion of products receiving a 'Green' (Low) traffic light (98.81%) (Figure 1 and Supplementary Table 2). According to the products that had a 'Red' (High) score; the mean value of the sugar, sweets, and other desserts group was 50.04 ± 15.17 g/100 g or ml (Supplementary Table 3).

Total salt

The group with the highest salt content was the sauces, ready-to-consume seasonings, and broths group with 3.98 ± 9.35 g/100 g or ml (Table 4). Additionally, the meats and eggs group was the highest group that had the amount of the 'Red' (High) traffic light products (67.46%) (Figure 1 and Supplementary Table 2). According to the products that had a 'Red' (High) score; the sugars, sweets, and other desserts group had the highest salt content (8.82 ± 12.89 g/100 g or ml), followed by the sauces, ready-to-consume seasonings, broths group with 7.76 ± 12.60 g/100 g or ml) (Supplementary Table 3).

The healthfulness of packaged foods and beverages

According to the examination of the healthfulness of packaged foods and beverages using the traffic light total score method; 1,472 products (49.57%) were found 'unhealthy'. Of the 1,472 products; the highest amount of 'unhealthy' products was found in the sugars, sweets, and other desserts group with 25.00%, followed by the snack foods group with 24.86% and dairy products group with 17.32%. The non-alcoholic beverages group (0.14%) and the sauces, ready-to-consume seasonings, broths group (3.87%) had the lowest amount of 'unhealthy' products (Figure 2).

Additionally, chocolates (18.95%), cheese (11.35%), and biscuits (10.67%) were the subgroups that had higher 'unhealthy' products compared to the others. Soda + energy drinks, fruit juices, flavoured waters, milk drinks and milk substitutes, and ice tea and coffee subgroups did not contain any 'unhealthy' products (Supplementary Table 4).

Discussion

This is the first study to evaluate how the color-coded MTL FOP labeling method would look like if implemented in Turkish packaged foods and beverages. This study showed that packaged foods classified as 'Green' (Low) traffic light were found 31.7% for total fat,

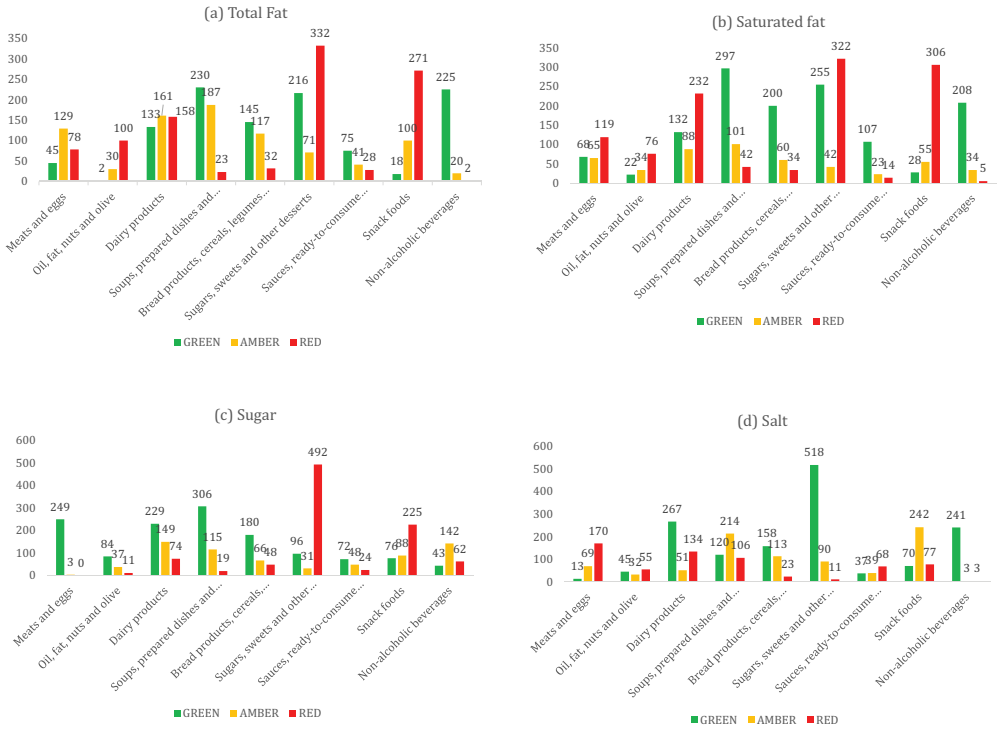

Figure 1. The proportion of products in each main group meeting traffic light criteria: (a) Total fat; (b) saturated fat; (c) total sugars; (d) salt (N = 2,969).

40.7% for saturated fat, 47.5% for sugar and 45.1% for salt, whereas these percentages for packaged beverages were 91.1%, 84.2%, 17.4%, and 97.6%, respectively. 30.7% of packaged foods for total fat, 17.2% for saturated fat, 19.7% for sugar and 31.2% for salt were classified as 'Amber' (Medium) score. The percentages for packaged beverages were 8.1%, 13.8%, 57.5% and 1.2%, respectively. Packaged foods classified as 'Red' (High) traffic light were found 37.6% for total fat, 42.1% for saturated fat, 32.8% for sugar and 23.7% for salt. Additionally, 50.43% of 2969 products were found 'healthy' whereas 49.57% were found 'unhealthy'.

The inclusion of FOP labeling is one of the important public policies that can be implemented to improve consumers ability to identify unhealthy food products (Lima et al. 2019). Consumers do not have the motivation or the time to process nutritional information when they are shopping (Hodgkins et al. 2015). Assuming that consumers interpret red lights on labels to mean 'less healthy', acceptance of health claims and MTL systems in food classification is important to ensure consumer submission (Sacks et al. 2011; Dunford et al. 2017). The present study provided information for the implementation of MTL FOP labeling to help consumers to make healthy food choices.

MTL FOP labeling could both change consumer behavior also give data for manufacturers to reformulate their products (Wartella et al. 2012; Dunford et al. 2017; Temple 2020). A UK study showed that consumers paid more for a change from 'Red' to a 'Green' label, compared from 'Amber' to 'Green' label (Balcombe, Fraser, and Di Falco 2010). In

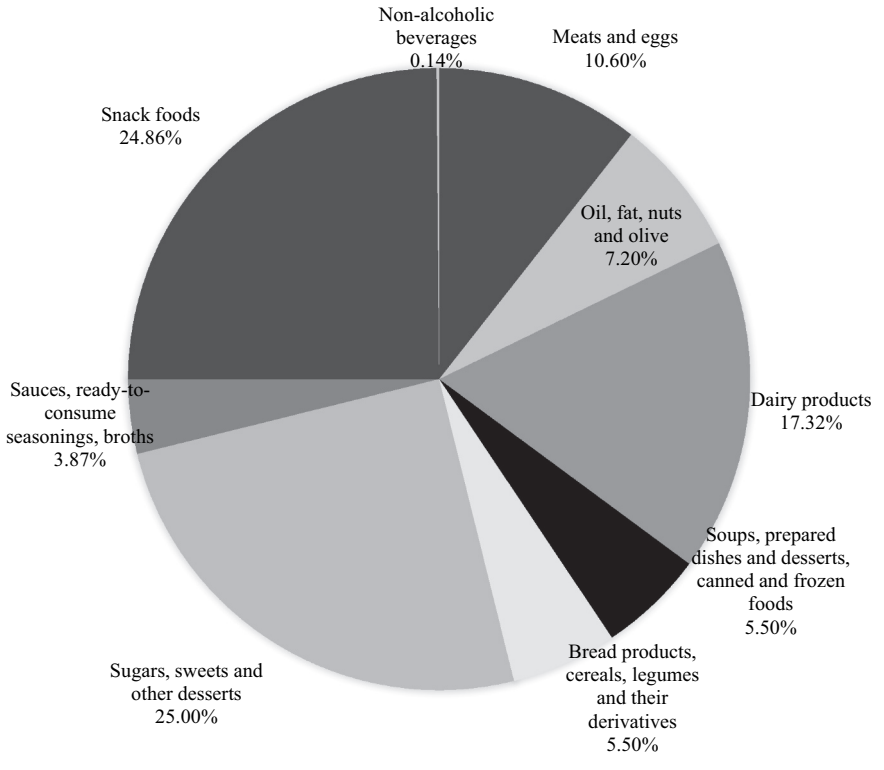

Figure 2. The proportion of products in each main group according to the healthfulness score.

another study, using MTL FOP labeling in cafeteria products, the proportion of sales of 'Red' products reduced from 24% to 20%, and 'Green' products sales increased from 41% to 46% after 24 months (Thorndike et al. 2014). According to a study, children, adolescents, and adult males reported using the information infrequently in MTL; adolescents interested in health and adult women used the MTL the most to select products. Some companies decreased levels of added fat, sugar, or salt in their products, whereas some of them opposed the policy due to the information being misleading in Ecuador (Freire et al. 2017). However, a study conducted in Ecuador showed that the use of MTL was low among the women due to less education, limited nutrition-related health knowledge, and a higher risk of food insecurity (Orozco et al. 2017). In a recent study, it was found that most of the participants were unaware of the MTL, although they began to use MTL 2 years ago in Iran (Roudsari et al. 2021). In this study, products classified as 'Red' (High) traffic light was 37.6% for total fat, 42.1% for saturated fat, 32.8% for sugar and 23.7% for salt. Additionally, we found that 1,472 of all products (49.57%) were classified as 'unhealthy' according to the MTL scoring. Nearly 1 out of every 2 products was 'unhealthy' and not suitable for consumption according to the MTL score. Considering Turkey's high population, we expect the awareness of 'healthy' products will be improved in a short amount of time, leading to a rapid increase in the consumption of 'Green' labeled products. Additionally, considering these studies, especially Turkey's neighbor (Iran) study (Roudsari et al. 2021) – it has a relatively similar culture and structure to our country – it may be more appropriate to switch to this labeling system with various

policies, including educating public with the nutrition-related disease, important of food security, and use of labeling system, to raise public awareness and awareness. Furthermore, these results can prove helpful for manufacturers to reformulate products not only in terms of per 100 g/ml composition but also with the serving sizes they offer consumers.

Generally, people think that low-calorie foods are healthy hence leading consumers to make an effort to increase the consumption of these products in their diets for reducing daily energy intake and losing weight. Additionally, the interest in nutrition labels may differ, depending on the consumer's familiarity with a product. Turkish people showed the greatest interest in nutrition labels for low-calorie products according to a study (Besler, Buyuktuncer, and Uyar 2012). We also found that the low-calorie snacks group had 12.18 ± 13.84 g/100 g or ml total fat; 20.66 ± 21.00 g/100 g or ml sugar and 1.33 ± 1.26 g/100 g or ml salt which means most products in this subgroup classified as 'Amber' (Medium). However, the saturated fat content was 6.02 ± 11.18 g/100 g or ml and classified as 'Red' (High). These results showed that the nutrient values are identified aspects of concern for food groups.

Excess salt intake is a significant leading cause of the development of NCDs (Bayram and Ozturkcan 2021b). In recent years, salt reduction is a major problem of health policies around the world. Turkey is also dealing with this issue for years; however, according to the last report, the daily intake of salt (15 g/day) is still higher than the WHO recommendation (5 g/day) (WHO 2012; GDPH 2017). In Turkey, there is a salt reduction protocol in packaged products. According to this protocol, the salt content in breads was reduced by 25%, in olives by 50%, and in cheese by 35–61% (GDPH 2019b). However, the high salt content of packaged products still provides excessive levels of salt to consumers' diets. In a study conducted in Turkey, 2,975 packaged food and beverage products were analyzed, 60.3% of products contained salt and 53.5% of them contained a sodium-containing food additive. Additionally, a total of 31.8% of the products were classified as having a high sodium content according to the WHO global sodium benchmark targets (Bayram and Ozturkcan 2021b). In the present study, meats products, olive, cheese, ready-to-eat dishes, meal-based sauces, ready-to-eat sauces, crackers, chips, and low-calorie snacks are the groups with the highest products receiving 'Red' (High) traffic light for salt. For the success of salt reformulation, it is among the suggestions that the food chain should be made, determining the salt levels in a wide variety of foods and beverages and regularly renewed targets (GDPH 2019b). Our results could potentially force manufacturers to lower the sodium levels in their products to 'better' traffic light colors, thereby helping to reduce the dietary salt intake of the population.

Similar to salt consumption, it is known that excessive sugar consumption increases the risk of NCDs. For example, childhood obesity in Turkey has shown a dramatic increase in the past few decades (WHO 2017). Additionally, a study observed that consuming sugar-sweetened beverages (soft drinks, juice drinks, etc.) was one of the most common risk factors for childhood obesity in Turkey (Bereket and Atay 2012). In another study conducted in Turkey, 2,514 packaged foods and beverages were analyzed, and 65.5% contained added sugars or non-nutritive sweeteners (Bayram and Ozturkcan 2022). In the present study, packaged foods and beverages classified as 'Red' (High) traffic

lights were found 32.8%, and 25.1% for sugar, respectively. In Turkey, there are no tax policies or warning labels about this issue. Considering negative health effects, it is important to monitor sugar contents used in food and beverage supplies, globally (Bayram and Ozturkcan 2022).

The study has some limitations. First, we collected the nutritional label from supermarkets and web databases from supermarkets. Then, we coded and classified the products in Microsoft Excel 2016. Human error may have occurred. Second, the packaged foods and beverages are selected from supermarkets in Turkey which are commonly found in all supermarkets; nevertheless, they may reflect all samples of packaged foods and beverages.

In conclusion, this study provides a baseline assessment of how the MTL scheme would look like if implemented in packaged products in Turkey. We found that nearly half of the products were classified as 'unhealthy' according to the MTL. We expect such studies to increase in coming years for raising awareness of people since a standardized FOP labeling system would be a useful tool for consumers for making healthy food choices. Additionally, after the implementation of a standardized FOP labeling system, various policies such as promoting and educating to use of the labeling system, educating nutrition-related health that increase public awareness should be developed and the public should be enlightened on this issue. Also, we found a wide variation for food groups according to the traffic light color-coded. These results may be helpful for manufacturers to reformulate their products for 'healthfulness'.

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References

Arrúa, A., L. Machín, M. R. Curutchet, J. Martínez, L. Antúnez, F. Alcaire, A. Giménez, and G. Ares. 2017. "Warnings as a Directive front-of-pack Nutrition Labelling Scheme: Comparison with the Guideline Daily Amount and traffic-light Systems." *Public Health Nutrition* 20 (13): 2308–2317. doi:10.1017/S1368980017000866.

Balcombe, K., I. Fraser, and S. Di Falco. 2010. "Traffic Lights and Food Choice: A Choice Experiment Examining the Relationship between Nutritional Food Labels and Price." *Food Policy* 35 (3): 211–220. doi:10.1016/j.foodpol.2009.12.005.

Bayram, H. M., and A. Ozturkcan. 2021a. "Nutrition Quality of the Turkey Packaged Foods and Beverages: A Comparison of Two Nutrient Profile Models." *Journal of Food Products Marketing* 27 (5): 255–265. doi:10.1080/10454446.2021.1980755.

Bayram, H. M., and A. Ozturkcan. 2021b. "The Presence of Sodium Content and sodium-containing Food Additives in Packaged Foods and Beverages Sold in Turkey." *Journal of Food Composition and Analysis* 102: 104078. doi:10.1016/j.jfca.2021.104078.

Bayram, H. M., and A. Ozturkcan. 2022. "Added Sugars and non-nutritive Sweeteners in the Food Supply: Are They a Threat for Consumers?" *Clinical Nutrition ESPEN* 49: 442–448. doi:10.1016/j.clnesp.2022.03.006.

Bereket, A., and Z. Atay. 2012. "Current Status of Childhood Obesity and Its Associated Morbidities in Turkey." *Journal of Clinical Research in Pediatric Endocrinology* 4 (1): 1–7. doi:10.4274/jcrpe.506.

Besler, H. T., Z. Buyuktuncer, and M. F. Uyar. 2012. "Consumer Understanding and Use of Food and Nutrition Labeling in Turkey." *Journal of Nutrition Education and Behavior* 44 (6): 584–591. doi:10.1016/j.jneb.2012.01.005.

Cecchini, M., and L. Warin. 2016. "Impact of Food Labelling Systems on Food Choices and Eating Behaviours: A Systematic Review and Meta-analysis of Randomized Studies." *Obesity Reviews* 17 (3): 201–210. doi:10.1111/obr.12364.

Chantal, J., and S. Hercberg; World Health Organization. 2017. "Development of a New front-of-pack Nutrition Label in France: The five-colour Nutri-Score." *Public Health Panorama* 3 (4): 712–725.

Cowburn, G., and L. Stockley. 2005. "Consumer Understanding and Use of Nutrition Labelling: A Systematic Review." *Public Health Nutrition* 8: 21–28. doi:10.1079/PHN2005666.

Defago, D., J. F. Geng, O. Molina, and D. Santa María. 2020. "Can Traffic Light Nutritional Labels Induce Healthier Consumer Choices? Experimental Evidence from a Developing Country." *International Journal of Consumer Studies* 44 (2): 151–161. doi:10.1111/ijcs.12554.

Draper, A. K., A. J. Adamson, S. Clegg, S. Malam, M. Rigg, and S. Duncan. 2013. "Front-of-pack Nutrition Labelling: Are Multiple Formats a Problem for Consumers?" *European Journal of Public Health* 23 (3): 517–521. doi:10.1093/eurpub/ckr144.

Dubois, P., P. Albuquerque, O. Allais, C. Bonnet, P. Bertail, P. Combris, S. Lahlou, N. Rigal, B. Ruffieux, and P. Chandon. 2021. "Effects of front-of-pack Labels on the Nutritional Quality of Supermarket Food Purchases: Evidence from a large-scale Randomized Controlled Trial." *Journal of the Academy of Marketing Science* 49: 119–138. doi:10.1007/s11747-020-00723-5.

Dunford, E. K., J. M. Poti, D. Xavier, J. L. Webster, and L. S. Taillie. 2017. "Color-coded front-of-pack Nutrition labels—an Option for US Packaged Foods?" *Nutrients* 9 (5): 480. doi:10.3390/nu9050480.

Egnell, M., Z. Talati, S. Hercberg, S. Pettigrew, and C. Julia. 2018. "Objective Understanding of front-of-package Nutrition Labels: An International Comparative Experimental Study across 12 Countries." *Nutrients* 10 (10): 1542. doi:10.3390/nu10101542.

Emrich, T. E., Y. Qi, W. Y. Lou, and M. R. L'Abbe. 2017. "Traffic-light Labels Could Reduce Population Intakes of Calories, Total Fat, Saturated Fat, and Sodium." *PloS One* 12 (2): e0171188. doi:10.1371/journal.pone.0171188.

Enax, L., Y. Hu, P. Trautner, and B. Weber. 2015. "Nutrition Labels Influence Value Computation of Food Products in the Ventromedial Prefrontal Cortex." *Obesity* 23 (4): 786–792. doi:10.1002/oby.21027.

European Food Information Council. "Global Update on Nutrition Labelling." Accessed December 20 2021. http://www.eufic.org/images/uploads/files/ExecutiveSummary.pdf

Findling, M. T. G., P. M. Werth, A. A. Musicus, M. A. Bragg, D. J. Graham, B. Elbel, and C. A. Roberto. 2018. "Comparing Five front-of-pack Nutrition Labels' Influence on Consumers' Perceptions and Purchase Intentions." *Preventive Medicine* 106: 114–121. doi:10.1016/j.ypmed.2017.10.022.

Freire, W. B., W. F. Waters, G. Rivas-Mariño, T. Nguyen, and P. Rivas. 2017. "A Qualitative Study of Consumer Perceptions and Use of Traffic Light Food Labelling in Ecuador." *Public Health Nutrition* 20 (5): 805–813. doi:10.1017/S1368980016002457.

FSA (Food Standards Agency). "Guide to Creating a Front of Pack (Fop) Nutrition Label for pre-packed Products Sold through Retail Outlets". Department of Health of UK. Accessed December 5 2020. https://www.food.gov.uk/sites/default/files/media/document/fop-guidance_0.pdf

GBD 2016 Mortality Collaborators. 2017. "Global, Regional, and National Under-5 Mortality, Adult Mortality, age-specific Mortality, and Life Expectancy, 1970-2016: A Systematic Analysis for the Global Burden of Disease Study 2016." *Lancet* 390 (10100): 1084–1150. doi:10.1016/S0140-6736(17)31833-0.

GDPH (General Directorate of Public Health). 2010. "Struggle and Control Program of Obesity in Turkey." Republic of Turkey Ministry of Health. Accessed January 10 2021. http://www.istanbulsaglik.gov.tr/w/sb/halksag/belge/mevzuat/turkiye_obezite_mucadele_kontrol_prg.pdf

GDPH (General Directorate of Public Health). 2016. "Reducing Salt Consumption 2017-2021 Program of Turkey." Republic of Turkey Ministry of Health. Accessed January 10 2021. https://bursaism.saglik.gov.tr/Eklenti/8857/0/turkiye-asiri-tuz-tuketiminin-azaltilmasi-programi-2017-2021pdf.pdf

GDPH (General Directorate of Public Health). 2019a. "General Directorate of Public Health. Turkey Health and Nutrition Survey-2017." Republic of Turkey Ministry of Health. Accessed January 10 2021. https://hsgm.saglik.gov.tr/depo/birimler/saglikli-beslenme-hareketli-hayat-db/Yayinlar/kitaplar/TBSA_RAPOR_KITAP_20.08.pdf

GDPH (General Directorate of Public Health). 2019b. "Protocol Implementation and Salt Reduction Guide for the Food and Beverage Industry." Republic of Turkey Ministry of Health. Accessed March 28 2022. https://www.tgdf.org.tr/wp-content/uploads/2020/02/Tuz-Azaltma-Rehberi.pdf

Grunert, K. G., L. Fernández-Celemín, J. M. Wills, S. S. G. Bonsmann, and L. Nureeva. 2010. "Use and Understanding of Nutrition Information on Food Labels in Six European Countries." *Journal of Public Health (Bangkok)* 18 (3): 261–277. doi:10.1007/s10389-009-0307-0.

Hawley, K. L., C. A. Roberto, M. A. Bragg, P. J. Liu, M. B. Schwartz, and K. D. Brownell. 2013. "The Science on front-of-package Food Labels." *Public Health Nutrition* 16: 430–439. doi:10.1017/S1368980012000754.

Hersey, J. C., K. C. Wohlgenant, J. E. Arsenault, K. M. Kosa, and M. K. Muth. 2013. "Effects of front-of-package and Shelf Nutrition Labeling Systems on Consumers." *Nutrition Reviews* 7 (1): 1–14. doi:10.1111/nure.12000.

Hodgkins, C. E., M. M. Raats, C. Fife-Schaw, M. Peacock, A. Gröppel-Kelin, J. Koenigstorfer, G. Wasowicz, et al. 2015. "Guiding Healthier Food Choice: Systematic Comparison of Four front-of-pack Labelling Systems and Their Effect on Judgements of Product Healthiness." *British Journal of Nutrition* 113 (10): 1652–1663. doi:10.1017/S0007114515000264.

Ikonen, I., F. Sotgiu, A. Aydinli, and P. W. J. Verlegh. 2020. "Consumer Effects of front-of-package Nutrition Labeling: An Interdisciplinary meta-analysis." *Journal of the Academy of Marketing Science* 48: 360–383. doi:10.1007/s11747-019-00663-9.

Khandpur, N., P. de Morais Sato, L. A. Mais, A. P. B. Martins, C. G. Spinillo, M. T. Garcia, C. F. U. Rojas, and P. C. Jaime. 2018. "Are front-of-package Warning Labels More Effective at Communicating Nutrition Information than traffic-light Labels? A Randomized Controlled Experiment in A Brazilian Sample." *Nutrients* 10 (6): 688. doi:10.3390/nu10060688.

Lima, M., M. de Alcantara, A. Rosenthal, and R. Deliza. 2019. "Effectiveness of Traffic Light System on Brazilian Consumers Perception of Food Healthfulness." *Food Science and Human Wellness* 8 (4): 368–374. doi:10.1016/j.fshw.2019.10.001.

Malam, S., S. Clegg, S. Kirwan, and S. McGinigal. 2009. *Comprehension and Use of UK Nutrition Signpost Labelling Schemes*. London: Food Standards Agency.

Mandle, J., A. Tugendhaft, J. Michalow, and K. Hofman. 2015. "Nutrition Labelling: A Review of Research on Consumer and Industry Response in the Global South." *Global Health Action* 8: 25912. doi:10.3402/gha.v8.25912.

Mauri, C., L. Grazzini, A. Ulqinaku, and E. Poletti. 2021. "The Effect of Front-of-package Nutrition Labels on the Choice of Low Sugar Products." *Psychology & Marketing* 38 (8): 1323–1339. doi:10.1002/mar.21473.

Miller, L. M. S., and D. L. Cassady. 2015. "The Effects of Nutrition Knowledge on Food Label Use. A Review of the Literature." *Appetite* 92 (92): 207–216. doi:10.1016/j.appet.2015.05.029.

Orozco, F., D. Ochoa, M. Muquinche, M. Padro, and C. L. Melby. 2017. "Awareness, Comprehension, and Use of newly-mandated Nutrition Labels among Mestiza and Indigenous Ecuadorian Women in the Central Andes Region of Ecuador." *Food and Nutrition Bulletin* 38 (1): 37–48. doi:10.1177/0379572116684730.

The Republic of Turkey Ministry of Agriculture and Forestry General Directorate of Food and Control. "Legislation draft-Regulation on Amendment of TGK Food Labeling and Consumer Information Regulation". Republic of Turkey. Accessed January 10 2021. https://www.tarimorman.gov.tr/GKGM/Duyuru/420/Mevzuat-Taslagi-Tgk-Gida-Etiketleme-Ve-Tuketicileri-Bilgilendirme-Yonetmeliginde-Degisiklik-Yapilmasina-Dair-Yonetmelik

Reyes, M., M. L. Garmendia, S. Olivares, C. Aqueveque, I. Zacarías, and C. Corvalán. 2019. "Development of the Chilean front-of-package Food Warning Label." *BMC Public Health* 19: 906. doi:10.1186/s12889-019-7118-1.

Roudsari, A. H., S. F. Abdollah Pouri Hosseini, A. M. Bonab, M. Zahedi-rad, F. M. Nasrabadi, and A. Zargaraan. 2021. "Consumers' Perception of Nutritional Facts Table and Nutritional Traffic Light in Food Products' Labeling: A Qualitative Study." *The International Journal of Health Planning and Management* 36 (3): 628–642. doi:10.1002/hpm.3105.

Sacks, G., M. Rayner, and B. Swinburn. 2009. "Impact of front-of-pack 'traffic-light' Nutrition Labelling on Consumer Food Purchases in the UK." *Health Promotion International* 24 (4): 344–352. doi:10.1093/heapro/dap032.

Sacks, G., K. Tikellis, L. Millar, and B. Swinburn. 2011. "Impact of 'traffic-light' Nutrition Information on Online Food Purchases in Australia." *Australian and New Zealand Journal of Public Health* 5 (2): 122–126. doi:10.1111/j.1753-6405.2011.00684.x.

Sonnenberg, L., E. Gelsomin, D. E. Levy, J. Riis, S. Barraclough, and A. N. Thorndike. 2013. "A Traffic Light Food Labeling Intervention Increases Consumer Awareness of Health and Healthy Choices at the point-of-purchase." *Preventive Medicine* 57: 253–257. doi:10.1016/j.ypmed.2013.07.001.

Temple, N. J., and J. Fraser. 2014. "Food Labels: A Critical Assessment." *Nutrition* 30 (3): 257–260. doi:10.1016/j.nut.2013.06.012.

Temple, N. J. 2020. "Front-of-package Food Labels: A Narrative Review." *Appetite* 144: 104485. doi:10.1016/j.appet.2019.104485.

Thorndike, A. N., L. Sonnenberg, J. Riis, S. Barraclough, and D. E. Levy. 2012. "A 2-phase Labeling and Choice Architecture Intervention to Improve Healthy Food and Beverage Choices." *American Journal of Public Health* 102 (3): 527–533. doi:10.2105/AJPH.2011.300391.

Thorndike, A. N., J. Riis, L. M. Sonnenberg, and D. E. Levy. 2014. "Traffic-light Labels and Choice Architecture: Promoting Healthy Food Choices." *American Journal of Preventive Medicine* 46 (2): 143–149. doi:10.1016/j.amepre.2013.10.002.

Trudel, R., K. B. Murray, S. Kim, and S. Chen. 2015. "The Impact of Traffic Light color-coding on Food Health Perceptions and Choice." *Journal of Experimental Psychology. Applied* 21 (3): 255. doi:10.1037/xap0000049.

van Herpen, E., S. Hieke, and H. C. M. van Trijp. 2014. "Inferring Product Healthfulness from Nutrition Labelling. The Influence of Reference Points." *Appetite* 72: 138–149. doi:10.1016/j.appet.2013.10.012.

Wartella, E. A., A. H. Lichtenstein, A. Yaktine, and R. Nathan, eds. 2012. *Committee on Examination of Front-of-Package Nutrition Rating Systems and Symbols (Phase II) Food and Nutrition Board. Front-of-Package Nutrition Rating Systems and Symbols Promoting Healthier Choices*. Washington, DC: National Academies Press. Dunford et al. 2017; Temple, ed. 2012.

WHO (World Health Organization). 2012. "Sodium Intake for Adults and Children". World Health Organization, Geneva. Accessed January 2 2021. https://apps.who.int/iris/bitstream/handle/10665/77985/9789241504836_eng.pdf?sequence=1

WHO (World Health Organization). 2017. "WHO Contributes to New Plans to Tackle Childhood Obesity in Turkey." World Health Organization, Geneva. Accessed March 28 2022. https://www.euro.who.int/en/countries/turkey/news/news/2018/3/who-contributes-to-new-plans-to-tackle-childhood-obesity-in-turkey

WHO (World Health Organization). 2020. "Obesity and Overweigh" World Health Organization, Geneva". Accessed March 23 2020. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Zhang, X., Y. Liu, Y. Gu, S. Wang, and H. Chen. 2020. "Red for 'Stop': 'traffic-light' Nutrition Labels Decrease Unhealthy Food Choices by Increasing Activity and Connectivity in the Frontal Lobe." *Nutrients* 12 (1): 128. doi:10.3390/nu12010128.