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ORIGINAL ARTICLE

Healthfulness of Commonly Eaten Foods in the Indian Diet: Comparison Using 5 Nutrient Profiling Models

Srishti Mediratta[1], Pulkit Mathur[2]

[1]Ph.D. Scholar, [2]Associate Professor, Lady Irwin College, University of Delhi, India

ABSTRACT

Context: There is an increase in consumption of foods that are high in fats, sugar, salt and low in nutrients, which has resulted in increased prevalence of obesity and non-communicable diseases.

Aim: This study is an attempt to categorize food items commonly eaten in India according to healthfulness using selected nutrient profiling models.

Methods and Material: It is an exploratory study with purposive sampling. Two major supermarkets and three quick service restaurants from each geographical zone of Delhi were surveyed for packaged ultra-processed food items and freshly prepared food. The cooked dishes and packaged products were profiled using selected nutrient profiling models. The models selected were-Food Standards Australia New Zealand (FSANZ), Pan American Health Organization (PAHO), Choices Programme, Traffic light scheme, WHO model for South-East Asia Region (WHO-SEARO).

Results: Majority food products across all codex categories were high in fat, sugar and/or salt according to all nutrient profiling models. Bakery and confectionery items, ready to eat foods and desserts had high proportion of products exceeding fat cut-offs across all the models. Majority of beverages and desserts exceeded sugar cut-offs. Ready to eat savouries and prepared food had higher percentage of products exceeding the salt threshold. Across all the categories, WHO-SEARO model has the most stringent threshold as maximum food products across all categories exceeded cut-off limits.

Conclusions: An urgent intervention is needed through government policies to control production and sale of high fat, sugar and salt foods. Awareness generation among consumers is also required to promote healthier food choices.

Keywords: Nutrient profiling, Healthfulness, High fat, High sugar, High salt

Address for correspondence: Srishti Mediratta, Senior Research Fellow, Ph.D. Scholar, University of Delhi, India. E-mail: srishti31@gmail.com

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INTRODUCTION

Overconsumption of energy dense diets which are low in other nutrients, is one of the biggest concerns in urban India. This has resulted in increased prevalence of obesity and related non communicable diseases [1]. Dietary guidelines across countries highlight food categories that should be consumed less like salt, sugar and fat rich foods or eat more like fruit, vegetables and wholegrain cereal foods [2]. Dietary Guidelines for Indians [3] recommends to consume home cooked food, and avoid snacks as meal replacement and limit consumption of processed food. It further states that regular consumption of processed food rich in fats, salt and sugar can cause health problems.

A study reported that 45% adults buy ultra-processed foods once weekly and one fifth buy them every day in Delhi. The study showed that 40% checked the nutritional information on the food label before buying these foods [4]. Indian households have shifted preference from home cooked food towards food which is conveniently available for consumption [5]. In India the average daily consumption of processed foods like fried snacks and sweets is 19 g/d and 12 g/d group among urban population [3].

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Studies have shown that consumers claim to understand the concept of healthy and unhealthy diet, but find it difficult to put it into practice for foods [6]. Policy makers have started developing nutrient profiling tools that define nutritional quality of the food and help consumers make healthier choices. Nutrient profiling is defined as categorization of foods according to the nutritional composition [7]. Many nutrient profiling models have been developed, each with a different approach and purpose. It is difficult to compare the models launched over the years as there is no gold standard for comparison. Nutrients and other food components to be included in the model and the cut off limits to be adopted are important points to consider [8]. This study is an attempt to categorize food items commonly eaten in India according to healthfulness using selected nutrient profiling models and to compare the different models.

MATERIALS AND METHODS

The study was conducted in New Delhi, India. The list of markets from each geographical zone was identified and large supermarkets which are popular and frequently visited by consumers were selected [9]. Two major supermarkets from each geographical zone of Delhi (North, South, East and West) were surveyed for packaged ultra-processed food items. Ultra-processed food is made from products derived by processing of whole foods [10]. Permission for collecting nutritional information on the products was taken from the supermarket store manager.

Three popular quick service restaurants were also surveyed from each geographical zone. Menu cards from each outlet were collected. The cashier was asked about the sweet, bakery and savoury dishes which sold the most in that food outlet. In addition, android food delivery applications such as 'Zomato', 'Swiggy' and 'Food Panda' were used to gather menu cards. The food items selected do not represent the entire food supply chain, but those that are popular snacks or meals consumed by people based on the data provided by food outlets as well as food consumer surveys [11, 12, 13]. Both packaged and prepared foods were selected for nutrient profiling as they both are commonly consumed. The cooked dishes and packaged products were categorized into 8 Codex food categories [14] namely; bakery and confectionery, bread, breakfast cereals, ready-to-eat savories, beverages, desserts, prepared foods, pasta and noodle like products. Nutrient content was taken from food labels of packaged products and from available nutrient databases of dishes [15, 16, 17]. All nutritional information available on the food label was recorded.

Out of all models currently used across the world, five models were selected purposively based on the inclusion criteria. Models which were available in public domain in English were included. The selected models had a scoring method or well defined cut offs/threshold to be able to categorise foods into healthy and unhealthy category. Models which were developed by commercial organisations or food industry were not included in the present study. The models selected were—Food Standards Australia New Zealand (FSANZ), Pan American Health Organization (PAHO), Choices Programme, Traffic light scheme, WHO model for South-East Asia Region **(**WHO-SEARO**)**. Each model has been briefly described here. Traffic Light scheme was designed by the UK, Food Safety Authority. The model supports the development and communication of front of pack (FoP) nutrition labels that are compliant with the UK Health Ministry recommendation on the use of colour coding. Traffic light scheme involves ranking levels of total fat, saturated fat, sugar and salt as either high, medium or low and assigns a red, amber or green colour-code to them respectively [18]. Food Standards Australia New Zealand (FSANZ) model developed in 2007 is a threshold model used in regulation of food claims. The FSANZ has made it mandatory that the total amount of all trans-fats present in the food be shown on the label. The threshold for categorising food as unhealthy is 4 points and for beverages it is 1 point. Firstly, baseline points are calculated which are the sum of points for energy content, saturated fatty acids, total sugars and sodium. Then final score is calculated which is equal to baseline points minus fruits and vegetable points (V) minus protein points (P) minus fibre (F) points [19]. Choices International model has food product categories within which the nutrition criteria is applied. These categories more closely align with how individuals select foods in a retail setting. The categories are divided into basic and non-basic product groups. For example, the product category "main course, sandwiches, mixed salads and small meals" allows individuals to understand how a pizza compares to a pasta [20].

WHO-SEARO (South-East Asia Region) nutrient profile model helps classify foods to according to the guidelines for marketing of food and beverages to children. The food categories in this model are similar to the category system used by the Codex. The nutrients for which the thresholds have been set are total fat, saturated fat, total sugars, added sugars and sodium [21]. The Pan American Health Organization (PAHO) Nutrient Profile Model is a tool to classify food and drink products on the basis of sugars, salt, total fat, saturated fat and trans fatty acids. This model assists the implementation process of the strategies for preventing non communicable diseases. The nutrients and cut-off criteria were defined by an expert consultation group that included globally recognized experts in public health nutrition [22]. The study received approval from the Institutional Ethics

Committee (IEC). Data was entered in MS Excel-2013. Average serving size of the product in each codex category was calculated. Products exceeding the cut off limits were noted for each nutrient profiling model.

RESULTS AND DISCUSSION

Codex categories were used to classify 401 food products, out of which 322 were packaged food items and 79 were prepared dishes. The nutritional composition of packaged food items with average serving size ranging from 21 g-69 g. Total calories are expressed in terms of kJ and total fat, sugar and salt are expressed as 'g' per 100 g/100 ml product. The nutritional composition of the packaged food products (n = 322) showed that mean calories range from (276-2130)kJ per product category. The mean ranges of total fat were 2-28 g, 4-33 g for sugar and 0.4-1.8 g for salt per product category (Table 1).

Food products were divided according to Codex categories and profiled (Table 2). Food items were profiled using 'per 100 g' or 'per Kcals' as base. The number of samples shown in each food category is different for different nutrients depending on whether the nutrient was mentioned on the label of the product or whether the values were available in the nutrient databases. In the case of salt, some nutrient profile models give the threshold in terms amount of salt while others give in terms of amount of sodium. Ready to eat savouries and prepared food had higher percentage of products exceeding the threshold. Fewer products in bread and breakfast cereals category exceeded sodium cut offs. Across all the categories, WHO-SEARO and Choices model resulted in maximum products being categorized as unhealthy. Some food items that were high in salt were *chole bhature* (spicy chick peas with fried refined flour bread), *chowmien* (stir fried noodles), manchurian fried rice, cup noodle vegetable manchow, pasta, banana chips, *chakoli* (fried snack of rice and bengal gram), potato chips. These were classified as unhealthy by all models.

In the case of sugar, some nutrient profile models employ the threshold for added sugar while other give it for total sugar. Choices model provides total sugar threshold for beverages. All of the fruit based beverages were 'unhealthy' as per the Choices model. Across all nutrient profile models, beverages and desserts exceeded sugar cut offs. Food items that were high in sugar included chocolate bars, fruit juices specially flavours like (guava, lichi, apple, mango), fruit and vitamin drinks, aerated drinks, *kheer* (rice pudding), brownie, cake, orange slice cake, strawberry cake, vanilla centre-filled cake, choco-chip cake. These were classified as 'unhealthy' by all models.

In the case of fat, some nutrient profile models give threshold for fat, saturated fat and trans fat. Bakery and confectionery items, ready to eat foods and desserts had a high proportion of products exceeding cut offs across all the models. Desserts, bakery and confectionary and ready to eat foods had a high saturated fat content in them. WHO-SEARO resulted in maximum products getting classified as unhealthy and was the strictest. Some food items that were high in total fat and saturated fat and trans fat were poori aalo (whole wheat fried bread with potato curry), *medu vada* (fried snack of dehusked black gram), vegetable puff, *bhelpuri* (puffed rice), *sarsoon ka saag* (mustard leaves curry), *kachori* (spicy fried snack of gram flour), nachos and cheese, *pao bhaji* (mixed vegetable with bread), *namkeen* (savoury snacks), popcorn, *dal biji* (fried gram savoury), *channa cracker* (bengal gram based savoury snack),

Table 1: Nutritional Composition of Packaged Food Products

Food Categories	Total Number of Product (N)	Average Serving Size (g)	Serving Size Range (g)	Average Calorie Content in kJ		Average Fat Content in g		Total Sugar Content in g		Salt Content in g	
				Mean	SD	Mean	SD	Mean	SD	Mean	SD
Bakery and confectionary	59	33	20-100	2092	146	24	6	21	18	*	-
Bread	16	21	18-30	1130	92	2	1	4	3	1.3	0.5
Ready to eat savouries	54	36	15-80	2130	197	28	11	5	7	1.8	0.7
Breakfast cereal	34	40	28-75	1594	205	8	2	11	8	0.4	0.01
Dessert	85	51	16-120	1527	188	9	2	33	15	0.4	0.1
Pasta	28	69	55-75	1201	623	7	1	4	3	0.9	0.2
Beverages	46	340	65-300	276	192	¶	¶	10	7	¶	¶

Note: *Mentioned on few products, not mentioned on product label.

Table 2: Foods Exceeding the Cut Offs Prescribed by Different Models

Food Categories	Number of Samples	Nutrient	Choices	WHO	PAHO	Traffic Light
			N (%)			
Bakery and confectionery	18	Sodium	2(11)	*	1(7)	1(6)
	58	Sugar	32(55)	38(64)	8(14)	24(41)
	59	Total fat	*	58(98)	56(94)	49(83)
	59	Saturated fat	37(63)	*	29(49)	39(66)
	58	Trans fat	8(14)	*	0(0)	*
Bread	16	Sodium	1(6)	2(13)	2(13)	2(13)
	15	Sugar	3(20)	3(20)	2(13)	0(0)
	16	Total fat	*	0(0)	0(0)	0(0)
	16	Saturated fat	0(0)	*	¶	0(0)
	16	Trans fat	¶	*	¶	*
Ready to eat savouries	15	Sodium	13(86)	13(86)	6(40)	10(66)
	50	Sugar	17(34)	*	4(8)	3(6)
	52	Total fat	*	49(94)	48(92)	44(84)
	50	Saturated fat	43(86)	*	41(82)	39(78)
	43	Trans fat	1(2)	*	1(2)	*
Breakfast cereal	24	Sodium	5(21)	5(21)	5(21)	5(21)
	34	Sugar	9(26)	21(61)	12(35)	7(20)
	34	Total fat	*	7(20)	5(14)	0(0)
	34	Saturated fat	14(41)	*	10(29)	6(18)
	33	Trans fat	3(9)	*	1(2)	*
Dessert	23	Sodium	3(13)	6(26)	3(13)	1(4)
	60	Sugar	35(58)	54(90)	43(72)	26(43)
	59	Total fat	*	51(86)	49(83)	14(23)
	37	Saturated fat	23(62)	*	29(78)	13(35)
	35	Trans fat	9(25)	*	10(28)	*
Prepared foods	26	Sodium	21(81)	25(96)	*	6(23)
	26	Sugar	0(0)	0(0)	*	0(0)
	78	Total fat	*	33(42)	*	8(10)
	78	Saturated fat	41(53)	23(30)	*	10(13)
	0	Trans fat	¶	*	*	*

Table 2 (Cont.)

Pasta	12	Sodium	3(25)	3(25)	3(25)	3(25)
	17	Sugar	4(24)	*	2(12)	0(0)
	28	Total fat	*	14(50)	12(42)	7(25)
	28	Saturated fat	9(32)	*	10(36)	6(21)
	13	Trans fat	0(0)	*	0(0)	*
Beverages milk based	0	Sodium	[b]	*	¶	¶
	10	Sugar	9(90)	*	8(80)	1(10)
	0	Total fat	¶	¶	¶	¶
	0	Saturated fat	¶	*	¶	¶
	0	Trans fat	¶	*	¶	¶
Beverages fruit based	0	Sodium	¶	*	¶	¶
	36	Sugar	36(100)	27(75)	36(100)	15(41)
	0	Total fat	¶	¶	¶	¶
	0	Saturated fat	¶	*	¶	¶
	0	Trans fat	¶	*	¶	*

Note: * Not defined by model, ¶ Not mentioned on product label.

moong dal (fried split green gram savoury snack), *boondi* (fried chickpea flour) and classified as unhealthy by all models.

Since the information required to calculate NPSC (Nutrient Profile Scoring Criteria) was not available on most of the Indian products; only a few products could be profiled. Almost all food products profiled were unhealthy according to the FSANZ model (Table 3). Choices gives cut offs for added and total sugar for most categories. In the ready to eat savoury category Choices was the strictest followed by PAHO model and Traffic light model on classifying foods by total sugar content. In the breakfast cereal category, WHO-SEARO model was the strictest followed by PAHO model for classifying foods on the basis of total sugar content. WHO-SEARO model gives a cut off at 9 g/100 g product while traffic light scheme shows leniency in setting the cut off at 22.5 g/100 g of the product. PAHO model accounts for free sugar and gives a detailed method for deriving free sugar from the total sugar declared on the packet. In the dessert category, WHO-SEARO model was the strictest followed by PAHO model and Choices model. Threshold limits for desserts category are 12 g/100 g, 20 g/100 g, 22.5 g/100 g and 10% of total energy from sugar according to WHO SEARO, Choices, Traffic light and PAHO models respectively. All fruit based beverages (n=36) exceeded sugar cut off according to Choices model because of the strict sugar threshold placed at 2.5 g/100 g.

Across all the categories, PAHO gives threshold as less than 10% total energy from saturated fat. For bakery and confectionary, dessert categories Choices sets the threshold at 6 g/100 g product, whereas traffic light scheme sets it at 5 g/100 g product. For pasta, ready to eat food, prepared food, breakfast cereal and desserts, Choices model gave the strictest cut off and maximum products were categorized as unhealthy. Many products didn't declare trans-fats values on their labels. They were mentioned on some of the bakery items, ready to eat food, desserts. Models such as WHO-SEARO and Traffic light scheme don't provide with trans-fat thresholds. In the dessert category, PAHO model categorized more products as unhealthy in comparison to Choices for trans-fat cut off. In the case of total fats, WHO-SEARO is stricter (3 g-12 g/100 g product) than Traffic light scheme (17.5 g/100 g product). Choices model doesn't provide total fat cut off limits. PAHO model classified more products as unhealthy in comparison to Traffic light scheme. Inclusion of nutrients in PAHO model is based on the WHO Population Nutrient Intake Goals to prevent obesity and non-communicable diseases.

Traffic light scheme is also a 'front of pack' nutrition labelling scheme that educates and helps consumers make a healthier food choice. The colour coded (red, amber and green) labels on the front of pack show the consumers at a glance if the food they are buying has high, medium or low amounts of fat, saturated fat, sugars and salt. If the product has red code,

Table 3: Percentage of Unhealthy Food Categories Using FSANZ (NPSC Score)

Food Category	Total Number*	Number (%) Exceeding NPSC Score
Breakfast cereals	34	34(100)
Bakery and confectionary	17	17(100)
Ready to eat savouries	15	15(100)
Prepared foods	23	19(83)
Pasta and noodles	15	15(100)
Beverages	7	7(100)
Desserts	5	5(100)

Note: *Total number which could be profiled by FSANZ model.

it doesn't mean that the product should not be purchased at all. However, the consumer should reduce the intake of that product. The green colour on the symbol means a healthier choice as compared to the amber. When choosing between similar products there will be a mixture of all three colours on the front of pack label, choosing more green and amber than red colour will mean healthier choices. A study measuring nutrient profile scores, showed that introduction of the coloured nutrition label with a communication leaflet was associated with purchase of biscuits having better nutritional quality [23]. In another study, Traffic light labelling helped consumers to select low sodium products [24]. A study in the United Kingdom showed that the introduction of traffic-light labelling led to a reduction in consumption of sandwiches and increase in home cooked food share. In this study, six ready to eat meals and 12 sandwiches were labelled with traffic light scheme and price of the product wasn't mentioned [25].

FSANZ model follows a continuous system of scoring food products. Due to lack of available nutrient information like sodium, fibre and protein content on all food products, only a small number could be classified. All the products were unhealthy as per FSANZ scoring method. In a study food products in New Zealand were profiled using FSANZ model for healthiness and participants who looked at the label before purchasing food products bought healthier food products than those who did not look at the food label [26]. FSANZ collaborates with food industry to ensure food regulations and labelling of products assists consumers to make informed and healthier food choices. FSANZ takes into account a number of food categories and nutrients. For the product to be classified as healthy the baseline points should not cross 2 points in the category for energy content, saturated fats, total sugar and sodium. These ranges are lesser than the WHO cut offs for specific categories.

WHO-SEARO and Choices are 'category specific' models. Traffic light scheme and PAHO model are 'across the board' models. PAHO has more stringent cut offs as compared to Traffic light scheme. PAHO model uses 'per KCal' as the reference base, while Traffic light scheme utilizes 'per 100 g' as the reference base. All these models have threshold limits which help classify a product as healthy and unhealthy. WHO-SEARO model has the most stringent threshold as maximum food products across all categories exceeded cut-off limits. Its thresholds are based on the WHO Population Nutrient Intake Goals for preventing diet related non communicable diseases. WHO-SEARO model is based on two assumptions, the first being that average 2000 Kcal is used as the energy intake and 25% energy requirement should come from each meal and 10-12% from snacks [21]. The Choices model was developed by the scientific committee to evaluate food products by setting thresholds using the latest information available. This model also has a logo which makes it easier for consumers to choose healthy food from the market shelf. While comparing 'across the board' models with 'category specific' models, the latter has more stringent thresholds. A study suggested that nutrient profiling models should be category specific as they are similar to the population food based dietary guidelines [27]. This would better enable the consumers to choose healthier food options from each food category.

Consumption of high fat, sugar and salt food has contributed to rise in diet related non communicable diseases [28]. A study showed that 20% adults buy ultra-processed foods every day in Delhi [4]. In a study on eating habits of school children it was found that around 60-70% consumed chips 2-3 times per week [13]. The rise in availability of energy dense, low cost, attractive processed food is an added factor [29]. Countries such as Peru and Costa Rica excluded high fat, sugar and salt foods from public schools in 2012 while Mexico charged a tax on sugary drinks amounting to 0.042 USD (one

peso) per litre of sugar [30]. Portugal has imposed tax on salt products and Hungary has imposed tax on food high in fat [31]. In India, a 'fat tax' (14.5%) has been imposed on HFSS foods sold in restaurants in the state of Kerala to curb unhealthy food eating habits [32, 33].

A study in Santiago showed a reduction in the availability of food products exceeding cut offs from 90.4% in 2014 to 15% in 2016 when there was a ban on sales in schools of all packaged foods exceeding prescribed cut offs. The law also led to reduction in the fat (–5.6 g/100 g), sugar (–21 g/100 g) and salt (–173 g/100 g) content in the food available across public schools [34]. Another study showed reduction in sugar intake (10 g) from morning snacks after vending machines were banned in secondary schools in France [35]. Processed foods that fail to meet the criterion need reformulation by food industries. Food technologists and chefs need to take up the challenge of reducing levels of salt, sugar and fat in different commonly consumed food products.

CONCLUSION

Majority of food products across all profiling models and food categories were high in total fat, sugar and salt. Out of all food categories, products belonging to bakery and confectionery, ready to eat foods and desserts were high in fats; beverages and desserts were high in sugar; and, prepared food, ready to eat food were high in salt content. This highlights the need for the food industry, food service establishment and chefs to work on reformulation of recipes and focus on production of food items which have lower fat, salt and sugar. The threshold limits of fat, sugar and salt were most stringent in the WHO-SEARO model. Since, the model clearly defines thresholds for specific food categories it can be easily implemented. Changes in eating behaviour will be seen only when consumers read and understand nutrition labels and are aware of the consequences of consuming high fat, salt and sugar foods. A nutrient profile model that has a logo on 'front of pack' can make it easier for consumers to make better and healthier choices. At the policy level, imposing additional tax on purchase of commodities with high fat, sugar and salt can help in reducing the intake of HFSS foods. Additional research should focus on the understanding of nutrient profiling and the need to create awareness to eat healthy among consumers.

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Author Contributions

The first author (S.M.) was involved in conducting literature review, data collection, analysis and interpretation of the data and drafting of the work to be published. The second author (P.M.) was involved in providing critical suggestions for design of the study, interpretation of data and reviewing the paper. All authors have read and agreed to the published version of the manuscript.

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