



A Comprehensive Systematic Review of Health Claims, Food Marketing and Food Advertising via Television for Children: Using the Nutrient Profile Model

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Abstract

Background: Good nutrition is essential to prevent Non-Communicable Diseases (NCDs) like diabetes and heart disease. NCDs account for a large Global Burden of Disease (GBD). There are different guidelines for a healthy diet to avoid obesity and NCDs and reduce GBD. World Health Organization has published recommendations named Nutrient Profile Model (NPM) to categorize foods as healthy and unhealthy.

Methods: First, the keywords Nutrient Profile Model and Child were searched in Web of Science, Scopus, Google Scholar, and PubMed databases, then articles in the English language until October 6, 2023 were selected and entered into the Endnote X8 resource management software. Duplicated and unrelated articles with the main purpose of this project were excluded from the study. Finally, 23 studies out of 542 entered the full evaluation stage according inclusion criteria.

Results: Various studies investigated NP models' application to food advertisements. The results revealed that most foods and beverages advertised on TV are not healthy, according to NPM. Also, the unhealthiness of foods like sweet beverages was illustrated, and studies recommended not be marketed to children. NPM is recommended as a tool to help governments to regulate marketing rules for food and legislate food advertisement.

Conclusion: NPM can be a guideline for labeling health claims and warning labels on food packages and advertng. More strict regulations are recommended for labeling health claims. Articles recommended using the Nutrient Profile Model as a tool for checking the criteria of foods before allowing producers to label them with health claims and advertise on TV.

Keywords: Advertising, Child, Healthy food, Nutrients

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Received: 9 Aug 2023

Accepted: 6 Nov 2023

Citation to this article

Dehghani A, Sadrykia F, Aghapour B, Sobouti B, Iravani O, Abbasalizad-Farhangi M. A Comprehensive Systematic Review of Health Claims, Food Marketing and Food Advertising via Television for Children: Using the Nutrient Profile Model. *J Iran Med Counc.* 2024;7(2):223-37.

Introduction

Food nutrition is key to a healthy life. Healthy nutrition can prevent Non-Communicable Diseases (NCD) like heart disease, stroke, and diabetes (1). Many people around the world are affected by non-communicable diseases. Communities face disease burden. Countries are affected by NCDs Global Burden of Disease (GBD) (2). For example, a study that assessed the burden of diabetes in 195 countries over 28 years (from 1990 to 2017) showed a significant increase in the economic burden of the disease in the world. Lin's study used the Death and Disability Adjusted Life Years (DALYs) index to estimate the burden of disease. This study predicts that the global burden of diabetes in 2025 will reach 79.3 million dollars. These results show the priority of policy-making in preventing diabetes (3). Considering the fact that preventing NCDs will decrease GBD (4) and the prevalence of obesity increased worldwide, reducing Nutrition-Related Non-Communicable Diseases (NR-NCDs) is urgent (5). Childhood obesity is a public health issue that affects millions of children worldwide (6). There are different guidelines for a healthy diet to avoid obesity and NCDs (1). WHO has published intake recommendations for sugar, salt, and fat to avoid the negative impact of these food ingredients on health (7-9). WHO also has suggestions for marketing foods to children (10). One of the main contributors to children's negative dietary patterns is marketing unhealthy products to them (11). Various studies demonstrated that processed food consumption is associated with diabetes, hypertension, weight gain, and obesity (12-15). One of the tools to facilitate governments' regulatory strategies to prevent obesity is the WHO/Europe Nutrient Profile Model (WHO/Europe-NPM) (16). By NPM, food products are classified as healthy and unhealthy. The Nutrient Profile Model is a tool to assess the quality of food (17). The nutritional content of foods (salt, total sugars, added sugars, total fat, and saturated fat) determines if the food is qualified to have permission to be sold to children or not (16). NPM has recommendations like marketing restrictions on foods to children and labeling guides to help governments implement policies to reduce unhealthy food consumption (17). NPM can help improve the nutritional quality of the foods labeled

with health-related claims (18). NPM also can be used as a tool to regulate food advertisement and determine foods that should not be advertised to children (19-21). WHO has published NPMs for different regions like Eastern Mediterranean Region (22), Africa (23) and western Pacific Region (24). Many NP models have been validated (25). For different purposes, there are different NPMs (21). One of the purposes of NPMs is to categorize foods to 'healthy' and 'less healthy' to determine their healthiness to be marketed to children (26). The aim of this study is to evaluate the application of nutrient profile models in different regions. By using this study, the policies needed to improve the quality of community nutrition are understood and it is helpful to propose and implement appropriate policies.

Materials and Methods

This study was conducted according to the statement of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)(27), (Supplementary table 1). It was approved and registered by the Research Vice-Chancellor of Tabriz University of Medical Sciences, Tabriz, Iran (ethical code: IR.TBZMED.REC.1401.214 with grant number:68876).

Search strategy

A comprehensive literature search was conducted using the online databases PubMed, Scopus, and Web of Science and Google Scholar up to October 6, 2023, to identify studies that examined NPM in food advertising to children. The key terms and phrases used for searching studies on NPM were ("Nutrient profile model" AND child*). Two reviewers independently executed the literature search, and disagreements were obviated by consensus. In addition to the systematic database search, a manual search was also done. Supplementary table 2 shows the strategy of search.

Study screening and selection

Searching was unrestricted during the publication period. All the English publications performed about NPM in children's food ads *via* TV upto 2023 were eligible to include. The purpose of not having a time limit on this search was to ensure that the findings

better and fully reflect the state of NPM. All the cross-sectional observational studies that reported the use of NPM in television food and beverage advertising to children were eligible for inclusion in the current systematic review. Two independent reviewers screened and assessed all the found articles for criteria and eligibility. First, the titles and abstracts of all the retrieved articles were entered and reviewed in Endnote software. In the next step, the full text of all the articles was evaluated to ensure the suitability of the study for inclusion in the systematic review. Names of the authors, titles of the articles, name of the journal, year of publication, country, type of NPM used, type of advertised food, results, and policy recommendation were extracted from the selected articles.

Evaluation of the methodological quality

The methodological quality of the included studies was evaluated using the JBI Critical Appraisal Tools (28). This tool evaluates the quality of included

studies and summarizes their results through 8 questions. This validated tool is often used to appraise the quality of cross-sectional studies. Each question has 4 options, namely “Yes”, “No”, “Unclear”, and “Not applicable”.

Results

Figure 1 demonstrated the PRISMA flow diagram. Initially, 876 articles were attained of searching electronic databases [Scopus (n=218), Web of Sciences (n=248), PubMed (n=391), and Google Scholar (n=19)]. The remaining 529 articles were totally screened by title and abstract after deleting the duplicates. Among those, the full-text of 44 articles was evaluated and 21 articles were removed since they had no necessary information for including into the current study. Finally, 23 studies were included in the present systematic review.

Table 1 provides an overview of the characteristics of the qualified articles in the present study. All the included studies were published until 6 October, 2023.

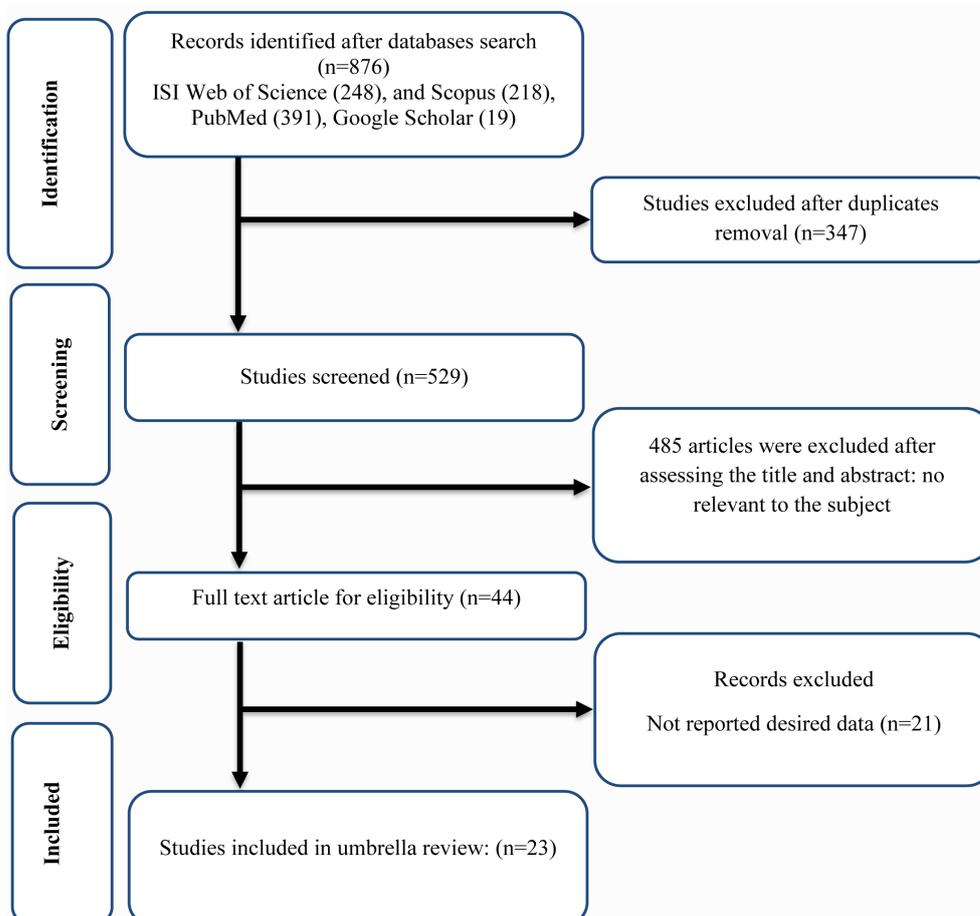


Figure 1. Flow chart of study selection for inclusion studies in the systematic review.

Table 1. Studies on applying the Nutrient Profile Model, characteristics, main results, and policy recommendations

Authors	Title	Journal/ Year/Country	Models	Food	Result	Policy recommendation
Gabrielle Jenkin, Nick Wilson, and Nicole Hermanson	Identifying 'unhealthy' food advertising on television: a case study applying the UK Nutrient Profile Model	Public Health Nutrition-2009- New Zealand	UK Nutrient Profile Model	TV food advertisements	66% of commercials about food were advertising HFSS foods, and 53% of them were 'mixed meal' items. None of the ads were about fresh fruit or vegetables	Food advertising to children needs to be regulated. The nutrient Profile model can be a tool (20)
Mar Romero-Ferna'ndez, Miguel Angel Royo-Bordonada and Fernando Rodr'iguez-Artalejo	Evaluation of food and beverage television advertising during children's viewing time in Spain using the UK nutrient profile model	Public Health Nutrition-2013- Spain	UK nutrient profile model (UKNPM)	Products advertised on TV	74.1% of advertised foods were less healthy, 80% of advertised soft drinks and all (100%) of advertised breakfast cereals were less healthy	By regulating food advertising by UKNPM standards, most food commercials would be withdrawn from TV advertisements (19)
Živa Korošec, Igor Pravst	Television food advertising to children in Slovenia: analyses using a large 12-month advertising dataset	International Journal of Public Health-2016- Slovenia	UK nutrient profile model	Food-related advertisements broadcast	Chocolate and confectionery ads accounted for 37% of food ads in all viewing times and 77% in the 4-9 year olds' viewing hours. 96% of food advertisements during these hours did not pass the criteria of the allowed advertisements according to the profile model of the World Health Organization	In the absence of regulatory marketing restrictions, food advertising to children is almost exclusively associated with energy-dense foods. An appropriate and applicable nutrient profile model needs to be modified according to the specific national context and national food-based dietary guidelines to ensure the application of food marketing restrictions (42)
M. A. Royo-Bordonada, K. Leon-Flandez, J. Damian, M.J. Bosqued-Estefani'a, M. A. Moya-Geromini, L. Lopez-Jurado	The extent and nature of food advertising to children on Spanish television in 2012 using an international food-based coding system and the UK nutrient profiling model	Public Health-2016- Spain	UK nutrient profiling model (UKNPM)	Food advertised to children	64.0% of advertisements were for HFSS (foods high in fat, salt, or sugar). 67.8% of ads on children's and teenagers' channels were for HFSS	It is recommended children's exposure to advertisements for HFSS products be limited (39)

Contd. table 1.

Royo-Bordonada, M. T. Bosqued-Estefanía, M. J. Damián, J. López-Jurado, L. Moya-Geromini, M. T.	Nutrition and health claims in products directed at children <i>via</i> television in Spain in 2012	Gaceta Sanitaria-2016-Spain	UK nutrient profiling model (UKNPM)	Products directed at children <i>via</i> television	In general, 53.3% of advertised products contain nutrition claims, 26.6% have health claims, and 62.2% have less health claims. Low-fat dairy products had the highest percentage of health and nutrition claims in food groups	Most products marketed on television have nutrition or health claims that are less healthy, which can mislead consumers. Nutrient profiles such as the UKNPM should be used to avoid the potentially harmful effects of nutrition and health claims and to identify products that meet minimum nutritional criteria on children's eating habits (43)
Wicks, M. Wright, H. Wentzel-Viljoen, E.	Restricting the marketing of foods and non-alcoholic beverages to children in South Africa: are all nutrient profiling models the same?	Br J Nutr-2016-South Africa	South African NP model (SANPM)	Child-directed food marketing	It varied from 6 to 45 percent of the advertised foods according to different NP models	Further research is needed to assess the validity of the SANPM and to develop an evidence-based framework to help eliminate some highly processed foods such as energy drinks with non-nutritive sweeteners due to their limited nutritional value (44)
Sofía Rincón-Gallardo Patiño, Lizbeth Tolentino-Mayo, Eric Alejandro Flores Monterrubio, Jennifer L Harris, Stefanie Vandevijvere, Juan A Rivera and Simón Barquera	Nutritional quality of foods and non-alcoholic beverages advertised on Mexican television according to three nutrient profile models	BMC Public Health-2016-Mexico	Mexican nutrient profile model, World Health Organization (WHO) nutrient profile model, European and the United Kingdom nutrient profile model (UKNPM)	Foods and non-alcoholic beverages advertised on TV	During cartoon programs, foods with high sugar and energy content were advertised. During sports programs, foods with high sodium and fat were advertised. 60% of advertised foods meet none of the NPM standards. 64.3%, 78.7% and 83.1% did not meet Mexican, Europe and UKNPM, and WHO standards, respectively	The majority of advertised food and beverages do not meet nutritional standards, and marketing them to children should be restricted (21)
Vandevijvere, S. Soupen, A. Swinburn, B.	Unhealthy food advertising directed to children on New Zealand television: extent, nature, impact and policy implications	Public Health Nutr-2017-New Zealand	WHO nutrient profiling model	Unhealthy food advertising	68.5% of television food advertisements were not allowed to be marketed to children according to the WHO Nutrient Profile Model. TV commercials during peak viewing time for children were about 88% of unhealthy foods	To limit unhealthy food advertising to children, especially during peak visits, it is best to use the WHO Nutrient Profile Model (45)

Contd. table 1

Vilaro, M. J. Barnett, T. E. Watson, A. M. Merten, J. W. Mathews, A. E.	Weekday and weekend food advertising varies on children's television in the USA, but persuasive techniques and unhealthy items still dominate.	Public Health-2017-USA	UK Nutrition Profiling System	Child-directed food and beverage advertisements	-	In order to improve nutrition and also to reduce or prevent weight gain among children, extensive and comprehensive changes in policy and examination of effective alternatives are necessary (46)
Kent, M. P. Smith, J. R. Pauzé, E. L'Abbé, M.	The effectiveness of the food and beverage industry's self-established uniform nutrition criteria at improving the healthfulness of food advertising viewed by Canadian children on television	International Journal of Behavioral Nutrition and Physical Activity-2018-Canada	Pan-American Health Organization (PAHO) and UK Nutrient Profile Models (NPM)	food and beverage advertising	In a comparison between May 2013 and May 2016, 99-100% of food product ads that featured CAI were excessive in fat (total, saturated, trans), sodium, or free sugars, according to NPM and PAHO	The health of most advertising products is weak in programs that have the largest number of viewers of children. Therefore, mandatory regulations are needed (47)
León-Flández, K. Royo-Bordonada, M. A. Moya-Geromini, M. A. Bosqued-Estefanía, M. J. López-Jurado, L. Damián, J.	Marketing techniques in television advertisements of food and drinks directed at children in Spain, 2012	International Journal of Public Health-2018-Spain	UK nutrient profile model	Advertisements of food and drinks (AFDs)	Taste and fun were the main attractions used in advertisements. More than two-thirds of the ads that used these persuasive techniques were related to unhealthy products, which is 96.2% of the ads with premium offers and gifts	Marketing techniques in TV AFDs for children in Spain are frequently used and most of the advertised products are unhealthy, so stronger government regulations are needed (48)
Nasreddine, L. Taktouk, M. Dabbous, M. Melki, J.	The extent, nature, and nutritional quality of foods advertised to children in Lebanon: the first study to use the WHO nutrient profile model for the Eastern Mediterranean Region	Food Nutr Res-2019-Lebanon	Regional nutrient profile model (WHO EMR)	Foods advertised to children	Food advertisements in children's programs are the highest compared to other programs (43%). Almost 8 out of 10 food advertisements were for products that did not meet the standards of the WHO EMR model	The use of the WHO EMR model should be considered as a baseline model for the expansion of TV-advertised food marketing policies in Lebanon, which carries a high burden of childhood obesity, with the aim of reducing children's exposure (49)

Contd. table 1.

Zamora-Corrales, I. Jensen, M. L. Vandevijvere, S. Ramírez-Zea, M. Kroker-Lobos, M. F.	Television food and beverage marketing to children in Costa Rica: current state and policy implications	Public Health Nutr-2019-Costa Rica	WHO-EU nutrient profile model	Food and beverage advertisements (F&B ads)	The highest number of F&B ads were during peak viewing hours for children. 91.1% of F&B ads classified by the nutrient profile model were not intended to be marketed to children. The most frequently advertised foods were convenience foods, chocolates/sweets/desserts, breakfast cereals, beverages, edible ices, and salty snacks. Unauthorized F&B advertising mostly uses promotional personas, brand advantage claims, and nutrition and health claims	Costa Rican children are daily exposed to a large number of unhealthy F&B advertisements while watching TV channels. Therefore, the need for regulatory oversight by national authorities helps to mitigate this (50)
Landwehr, S. C. Hartmann, M.	Industry self-regulation of food advertisement to children: Compliance versus effectiveness of the EU Pledge	Food Policy-2020-German	The EU Pledge and the UK OFCOM nutrient profile model	Child-targeted food and beverage advertising (CFBA)	Child-targeted food and beverage advertising (CFBA) in most children's programs do not meet OFCOM's nutritional criteria	The use of a science-based nutrient specification plan as a standard and the implementation of an independent control system are required (51)
Lavriša, Ž Hristov, H. Kelly, B. Pravst, I.	Regulating children's exposure to food marketing on television: are the restrictions during children's programmes enough?	Appetite-2020-Slovenian	The WHO Regional Office for Europe Nutrient Profile Model, modified for Slovenia	Food ads	The average total frequency of not allowed (unhealthy) food advertising <i>per/hr</i> was 2.90 ± 3.22 (2016), 2.66 ± 3.55 (2017), or 2.13 ± 3.04 (2018) ads/h/channel. New food marketing regulations in Slovenia have reduced unhealthy food advertising during children's programs and prime time	Future policy interventions are needed to cover the most popular children's programs during peak children's viewing time (52)
Gallus, S. Borroni, E. Stival, C. Kaur, S. Davoli, S. Lugo, A. Effertz, T. Garattini, S. Scaglioni, S.	Food advertising during children's television programmes in Italy	Public Health Nutr-2021-Italy	WHO-ENPM and the EU-PNC	Food product advertised	90 ads out of a total of 810 ads were related to food products, of which 84.5% did not comply with WHO-ENPM and 55.6% with EU-PNC guidelines. Advertisements promoting sweet and salty snacks had higher non-compliance with WHO-ENPM	There is an urgent need to define independent, readable and practical guidelines for food advertising targeting children. Create guidelines for a complete ban on food advertising targeting children and implemented by all television programs (53)

Contd. table 1.

Velasquez, A. Mora-Plazas, M. Gómez, L. F. Taillie, L. S. Carpentier, F. R. D.	Extent and nutritional quality of foods and beverages to which children are exposed in Colombian TV food advertising	Public Health Nutrition-2021-Colombia	Pan American Health Organization (PAHO) Nutrient Profile Model	Foods and beverages advertised	89.3% of TV commercial samples were related to unhealthy products. And a higher proportion of boys and girls, and especially children with medium and high socio-economic status, are more exposed to unhealthy product advertisements	There is an urgent need to implement legal measures to reduce children's exposure to unhealthy food advertisements and less exposure to television advertisements of unhealthy foods in order to reduce food consumption and obesity among children (29)
Lei, N. Liu, Z. Xiang, L. Ye, L. Zhang, J.	The extent and nature of television food and non-alcoholic beverage advertising to children during chinese New Year in Beijing, China	BMC Public Health-2022-China	The International Network for Food and Obesity/ non-communicable diseases Research, Monitoring and Action Support (INFORMAS), WHO-WPRO and the Guidelines on Snacks for Chinese Children and Adolescents (GSCCA)	F&B ads: food and non-alcoholic beverage advertisements	42.9% of the total advertisements were related to F&B. More than 55% of F&B ads were unhealthy for children according to the three nutrient profile models, and these unhealthy F&B ads used more brand benefit claims, advertising personalities, and health claims than other permitted ads	More stringent regulations are needed to protect children in the Chinese government from foods and beverages advertised to promote health (54)
Shen, S. Mackay, S. Lee, A. Mhurchu, C. N. Sherif, A. Eyles, H.	Impact of a voluntary industry code for advertising food to children and young people: an analysis of New Zealand television data	Public Health Nutrition-2022-New Zealand	WHO-Europe nutrient profiling model	Advertising food on children	The percentage of advertisements related to unhealthy food items is still high (63-7% on weekdays and 65-9% on weekends). The highest amount of advertising is during the peak hours of children's viewing	The need for government regulation and regular oversight of food advertising should reflect the evolving environment of healthy food marketing to children (55)
Kent, M. P. Guimaraes, J. S. Pritchard, M. Remedios, L. Pauzé, E. L'Abbé, M. Mulligan, C. Vergeer, L. Weippert, M.	Differences in child and adolescent exposure to unhealthy food and beverage advertising on television in a self-regulatory environment	BMC Public Health-2023-Canada	Health Canada's Nutrient Profile Model	Food advertisements	Children are highly exposed to advertisements for restaurants, candy and chocolate, snacks, and breakfast foods, and the healthiness of most advertised products was considered poor	Children are exposed to unhealthy food advertisements and powerful marketing techniques. There is a need to develop government policies to protect the dangers of food and beverage advertising and prevent developmental vulnerabilities among children (56)

Contd. table 1

Kontsevaya, A. V. Imaeva, A. E. Balanova, Y. A. Breda, J. Wickramasinghe, K. Jewell, J. M. Abdrakhmanova, S. Polupanov, A. G. Bagci Bosi, A. T. Ergüder, T. Drapkina, O. M. Boyland, E.	Children's exposure to television advertising of unhealthy foods and beverages across 4 countries of WHO European region	Public Health Nutrition-2023-Russia, Turkey, Kazakhstan, and Kyrgyzstan	WHO Nutrient Profile Model, Europe Nutrient Profile Model	Food advertisements	Children in the four surveyed countries are exposed to a high volume of food and drink advertisements, especially sugary products, through television	There is a need to formulate regulations by policy makers to limit marketing in children's media (57)
Morales-Juárez, A. Monterrubio, E. Cosenza-Quintana, E. L. Zamora, I. Jensen, M. L. Vandevijvere, S. Ramírez-Zea, M. Kroker-Lobos, M. F.	Unhealthy food advertising on Costa Rican and Guatemalan television: a comparative study	Health Promot Int-2023-Costa Rica	Pan American Health Organization (PAHO) Nutrient Profile (NP) Model	Food ads	Persuasive marketing techniques were categorized as using advertising characters (eg, Batman), giving prizes (e.g., toys), profit claims (e.g., tasty), and health-related claims (e.g., nutritious). Guatemalan and Costa Rican children have been shown to be exposed to high levels of junk food advertising on television	It is necessary to implement and create national policies to reduce children's exposure to illegal food (58)
Potvin Kent, M. Guimaraes, J. S. Bagnato, M. Remedios, L. Pauzé, E. Pritchard, M. Wu, D. L'Abbé, M. Mulligan, C. Vergeer, L. Weippert, M.	Broadcast television is not dead: exposure of children to unhealthy food and beverage advertising on television in two policy environments (Ontario and Quebec). An observational study	Journal of Nutrition-2023-Ontario and Quebec	Health Canada's proposed nutrient profile model	Food and beverage advertising on television to children	Children are exposed to 3.7 to 4.4 ads of unhealthy food and beverage and fast food per day. These products were classified as unhealthy according to classification (712.3 ads per year)	It appears that consumer protection legislation and federal regulation are needed to limit unhealthy advertising to children (59)

The included studies were all conducted in different countries like New Zealand, Spain, Slovenia, South Africa, Mexico, USA, Canada, Lebanon, Costa Rica, Germany, Italy, Colombia, China, Russia, Turkey, Kazakhstan, Kyrgyzstan, Ontario, Quebec. In all the studies, child-directed food and beverage advertising through television has been evaluated. Establishing rules related to broadcasting food and beverages on TV, removing some advertisements from TV and limiting children's exposure to unhealthy foods, especially during peak visits, and avoiding the potentially harmful effects of nutrition and health claims are among the suggestions and controlling policies presented in the articles are according to NPM.

The methodological quality of the selected and included studies was evaluated with the help of the JBI tool (Table 2).

Discussion

Various studies investigated the application of NP models in food advertising. According to NPM report, the results revealed that most of the foods and beverages advertised on TV are not healthy. Also, foods like sugary drinks have been shown to be unhealthy and studies have recommended that they not be marketed to children. NPM is recommended as a tool to help governments regulate food marketing and food advertising legislation.

Children's exposure to television advertisements of

Table 2. Results of assessment of the methodological quality of included studies according JBI checklist

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Jenkin <i>et al</i> , 2009	Yes	Yes	Yes	Yes	Unclear	Not applicable	Yes	Yes
Romero-Fernández <i>et al</i> , 2013	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes
Korosec Z. <i>et al</i> , 2016	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Patiño, S. R. G. <i>et al</i> , 2016	Yes	Yes	Yes	Yes	Unclear	Not applicable	Yes	Yes
Royo-Bordonada <i>et al</i> , 2016	Yes	Yes	Yes	Yes	Unclear	NO	Yes	Yes
Royo-Bordonada <i>et al</i> , 2016	Yes	Yes	Yes	Yes	NO	NO	Yes	Yes
Wicks, M. <i>et al</i> , 2016	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vandevijvere, S. <i>et al</i> , 2017	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes
Vilaro, MJ. <i>et al</i> , 2017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kent, MP. <i>et al</i> , 2018	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
León-Flández K. <i>et al</i> , 2018	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nasreddine L. <i>et al</i> , 2019	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Zamora-Corrales I. <i>et al</i> , 2019	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes
Landwehr SC. <i>et al</i> , 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lavriša Ž <i>et al</i> , 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gallus S. <i>et al</i> , 2021	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Velasquez A. <i>et al</i> , 2021	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes
Lei N. <i>et al</i> , 2022	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shen S. <i>et al</i> , 2022	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kent MP. <i>et al</i> 2023	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear
Kontsevaya AV. <i>et al</i> , 2023	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Morales-Juárez A. <i>et al</i> , 2023	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Potvin Kent M. <i>et al</i> , 2023	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

foods and beverages affects their diet, however, few studies have examined the nutritional information of advertised products according to the ratings of television audiences and children's exposure to unhealthy foods and beverages' advertisements (29). Previous studies have reported that children are exposed to higher levels of "excess" sugar products, especially beverages, bread and bakery products, and dairy products. These three food categories have the highest number of TV commercials and the highest number of weekly shows among the products (29).

In a study, the amount of salt, sugar, and fat was investigated in ready-to-eat cereals (RTECs) special for children and non-children. It found that the mean amount of sugar and salt in "child-targeted food" was high. Based on the WHO/Europe nutrient profile model recommendation, 87.3% of "child-targeted" RTECs and 73.5% of the total RTECs would not be permitted to supply in the market, and their advertising would restrict (30). Also, the consumption of RTECs, mainly fiber-rich or whole grain RTECs, has practical nutritional and health-promoting consequences. But the total sugar consumption is high, which is a cause for concern due to the frequent consumption of RTECs (31). In another study in Portugal, the compliance of ready-to-eat cereals to the European nutrient profile model was investigated. They understood that the sugar content of RTECs was higher than the European-Nutrient Profile model recommendation in 84.6% of the products. Children's RTECs contain 26% more sugar and 5% more calories compared with "non-children's" RTECs. Nutrient profiling can be used for food selection and identifying the restrictions needed for marketing food to children (32). A study in Malta realized that 36% of the baby foods met the standards of NPM. Most products had a high content of salt and sugar. Then most infants' and young children's foods should comply with NPM to be appropriate for babies under 36 months (33). In one study, the focus was on the type of brand. The total amount of sugar in the store brand is higher, and although they are tastier and in high demand by consumers, they are poor in nutrition and harmful (34). Advertising on high-energy and high-sugar foods was broadcast during the children's program and high-fat and high-sodium foods during the athletic program. Most advertised food products and beverages failed to adapt to nutritional standards;

therefore, advertising these unhealthy products for children should be stopped (21). Considering that children may be particularly exposed and influenced by advertisements due to their cognitive development level, the need to consider all children and create measures to reduce exposure to unhealthy food and beverage marketing is emphasized (35-37).

According to the UKNPM standards, advertising unhealthy and nutritionally poor quality food should be stopped during the broadcast of the child's program (19). A study of child-oriented products using the Nutrition Profiling Model (NPM) showed that packaged snacks for children were classified in the "healthy" food (15.8%) and "less healthy" (84.2%) groups, as well as "healthy" (65.7%) and "less healthy" (34.3%) groups for beverages (38). Since the majority of food advertised was "unhealthy" high-fat, high-salt, and, high-sugar (HFSS), it is recommended that children's exposure would be restricted (39). Jenkin *et al* in New Zealand examined TV advertisements about "unhealthy" food using UK Nutrient Profile (NP). They found none of the ads were about fresh fruit or vegetables. Hence, NP model would be used to formulate children's foods advertisements (20). Food products subject to these rules and using both are as follows: Pan American Health Organization (PAHO) and Chilean food labeling and advertising Law (Chilean model). Most of the meats (97.3% PAHO model; 87.5% Chilean model), sweets (95.6% PAHO), and snacks (Chilean model) had more warning labels. Then front of package warning labeling is recommended for most packaged foods (40).

Health-Related Claims (HRCs) are classified into nutrition and health claims. Nutrition claims illustrate the nutritional quality of food, and health claims show the health consequence of consuming the food. They are assertion set up on food packets. According to EU regulations, these claims should only exist on food packages with a specific Nutrient Profile (NP). European Committee suggested but did not accept the NP model. The Preventable Risk Integrated Model (PRIME) was obtained by determining the effect of HRCs on food choices, the prevalence of HRCs on prepackaged foods, and the quality of foods with those assertions. Two scenarios are modeled: controlling HRCs with an NP model and formulizing

HRC-carrying foods. In the first scenario, only foods that pass the model can carry HRCs claims. The first scenario formulizes foods that carry claims but do not pass the model. Regulating HRCs might cause negative health outcomes; however, a larger health outcome assessment is essential (41). The consequences of studies illustrate the need for stricter arrangements for health claims usage and to improve the quality of foods labeled with the health-related assertion (18).

Conclusion

NPM can be used to regulate food and beverage advertising and determine which foods should not be advertised to children. This tool can also improve food quality and labeling regulations. Its use can be effective in the long-term goal of preventing non-communicable diseases. By using this tool, policymakers can design useful policies and implement them more accurately.

Strength and limitations

To our knowledge, this is the first systematic review

on the application of NPM in television food and beverage advertising to children. The nature of this study is one of the benefits of collecting and reviewing several studies that have helped to understand the subject better. And it allows policymakers to understand the valuable policies ahead. This study has the limitations of an observational research design. This means that it is not practicable to get a causal relationship from the results.

Acknowledgements

This study's protocol was approved and registered by the Research Vice-Chancellor of Tabriz University of Medical Sciences, Tabriz, Iran (IR.TBZMED.REC.1401.214). We gratefully acknowledge the financial support of the Nutrition Research Center of Tabriz University of Medical Sciences, Tabriz, Iran (Grant number: 68876).

Conflict of Interest

The authors declare that they have no competing interests.

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