Review Paper

# Content analysis of advertisements related to oral health in children: a systematic review and meta-analysis

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ABSTRACT

Objectives: The evidence about the content of TV advertisements broadcast during children's viewing times with an emphasis on the number of food advertisements and the number of cariogenic food advertisements was systematically reviewed and meta-analyzed.

Study design: A systematic review and meta-analysis.

Methods: Articles published up until October 2017 in PubMed, Scopus, Embase, Web of Science, Cochrane Library, and Persian databases such as Magiran, IranDoc, and Iranmedex with the keywords that were related to advertising and oral health in children were searched and screened by two reviewers independently, and the outcomes of interest were extracted. Meta-analysis was performed using the Comprehensive Meta-Analysis, version 2.0.

Results: A total of 480 titles were retrieved and reduced to 256 eligible studies after deletion of duplicates, and finally, after closer assessment of titles and abstracts, five articles were selected for systematic review and meta-analysis. Of the included studies, three were conducted in the UK, one in India, and one in Greece. About 38.0% (95% confidence interval: 19.6–60.6, $P = 0.296$) of advertisements were related to food and also about 70.6% (95% confidence interval: 53.7–83.3, $P < 0.019$) of food advertisements were related to cariogenic foods.

Conclusions: Food advertising during children's programs is dominated by food items that are potentially harmful to oral health. Moreover, the advertisements shifted toward food items that appeared healthy but contain a large amount of hidden sugar.

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## Introduction

Dental caries constitutes a major public health problem in children worldwide,[1] and it continues to be the most common infectious disease of childhood.[2] There is mounting evidence that the cause of dental caries is multifactorial with behavioral and environmental determinants.[3] It has been shown that high-sugar and acidic food consumption is harmful for oral health, and it is related to increased prevalence of dental caries. High numbers of bacteria, such as mutans streptococci and lactobacilli, are associated with dental caries that is the consequence of high sugar intake, and this results in periods of low pH levels in dental plaque and caries development.[4] Moreover, dental caries is related to poor food selection behavior of children.[3] Multiple factors influence food choices of children, including peer pressure, food access, and marketing.[5] Marketing via TV advertisement is a potent source of introducing foods to children. Children are the major target for TV advertisement because of the influence of children on parent's purchases.[6] It was shown that food advertising for children results in preference and purchase of the advertised products.[7–9] Watching TV is the major free-time activity of children. Therefore, they are exposed to different food advertisements.[3] It was shown that advertising of foods and beverages has a negative effect on children's dietary preferences.[9] Assessment of the effects of food advertisements via TV on children's eating behavior showed that exposure to food advertisements increases the food consumption of children by 45%.[10]

Generally, the fat and sugar contents of advertised foods are high, and the fiber and nutrient contents of them are low.[11] For example, about 50% of food advertisements in India and 56% of them in England were high-sugar foods and beverages.[12–15] Repeated exposure to low-nutrient, high-caloric, and sugary food advertisements may increase the craving for these foods. In addition to obesity, dental caries is one of the important negative health effects of consuming foods high in sugar and acid as mentioned. Despite several studies conducted about the content analyzing of children's TV advertisements in relation to oral and dental health, there is no systematic review and meta-analysis to summarize the results of these studies. The purpose of this systematic review and meta-analysis was to evaluate the evidence about the content of TV advertisements broadcast during children's viewing times especially with an emphasis on the number of food advertisements and the number of food advertisements harmful to dental health.

## Methods

### Data sources and search strategy

For this systematic review and meta-analysis, we searched the databases of PubMed, Scopus, Embase, Web of Science, Cochrane library, and Persian databases such as Magiran, IranDoc, and Iranmedex for articles published up until October 2017. Keywords were based on population, indicator, and outcome and included (but not limited to) (i) population: 'child*' or 'pediatric'; (ii) indicator: 'media', 'TV', 'multimedia',

'advertising'; and (iii) outcome: 'oral health', 'health', 'oral', 'dental'. Keywords were combined by Boolean operators. The search strategy is shown in Table S1. The references of eligible articles were also manually searched for further studies not identified. The Iranian Center for Evidence Based Medicine of Tabriz University of Medical Sciences approves the research protocol of the present study. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was used to build and elaborate this systematic review and meta-analysis.[16]

### Study selection

The present systematic review included observational studies that evaluated the nature and content of advertisements related to foods and oral health during children's TV viewing times and published as a journal article or conference paper. The articles were included if they report the total number of advertisements, number of food advertisements, and cariogenic food advertisements in children's viewing time. Editorials, review articles, and articles published in other languages rather than English or Persian were excluded.

### Data extraction

Two reviewers extracted data independently. Initially, one reviewer screened the results to exclude duplicate data and irrelevant articles. Two reviewers independently screened the remaining records to identify which articles met the inclusion/exclusion criteria. For these records, the full text was obtained and was independently evaluated by two reviewers for relevance. For each eligible study, one reviewer extracted the data about the authors, publication date, method, sample size, duration of the study, and participants' characteristics and studied the outcomes, and then, the results were checked by a second reviewer. Any inconsistencies were resolved through discussion and by consulting a third reviewer.

### Quality assessment

Two investigators independently rated the methodological quality of selected studies for two domains of the number of included channels and methods of outcome measurements. Each domain appraised for a quality assessment considering the number of channels reviewed, the recording time of each channel in prime and non-prime time, the number of reviewers, the assessment of the agreement between reviewers, and the clear classification of cariogenic and non-cariogenic food (ranked as low, moderate, or high).

### Statistical analysis

The Comprehensive Meta-Analysis, version 2.0, was used for analyses of data. We extracted the total number of advertisements, the total number of food advertisements, and also the number of cariogenic food advertisements reported in the original articles, and then, the event rates were computed. Q statistic and $I^2$ were used for determination of heterogeneity. In the present meta-analysis, $I^2 > 50\%$ and also a significance level of $P < 0.10$ for Cochran's Q were considered as clinically

important heterogeneity.[17] Based on heterogeneity analysis, fixed or random effects model was used. In two separated analyses, the event rates for food advertisements and cariogenic food advertisements were examined.

## Results

### Search results

A total of 480 titles were retrieved and reduced to 256 titles after deletion of duplicates. The number of articles was reduced to 13 in the first assessment of the titles and abstracts and was further reduced to five on closer assessment of the abstract and full text (Fig. 1). Thus, eventually five articles, including a total of 15,368 advertisements (ranged between 950 and 9151 ads), met our predefined inclusion criteria. The characteristics of the studies are presented in Table 1.

### Sample characteristics

Of the included studies, three were conducted in the UK,[13,18,19] one in India,[14] and one in Greece.[20] The years during which data were collected ranged between 2000 and 2014. The period of collecting data was between 16 days and 12 months. The source of the advertisement in all studies was TV. All studies used the direct viewing of channels (after video recording) as a data collecting method.

Chestnutt and Ashraf,[18] by examining the content and duration of advertisements broadcast for children, identified the potential risk of food advertisement related to oral health in the UK. They totally analyzed 237 h and 42 h of children's viewing time and evening viewing time, respectively. A total of 3236 commercials were recorded, of which 2345 were broadcast during children's viewing time and 891 in prime time. About 62.5% of broadcasts during children's TV time were for foodstuffs. About 73.4% of food advertised during children's TV time was estimated to have the potential to damage oral health.

Rodd and Patel,[13] in a 2-month observational study in the UK, showed that the majority (about 62.5%) of advertisements were related to non-food/drink products such as a toy. Only one-third of advertisements were related to food and drinks. Of the 342 food and/or drink advertisements, 95.3% of them were related to foods high in sugar and/or acid, and 38.6% (132 ads) of food/drink advertisements were related to products
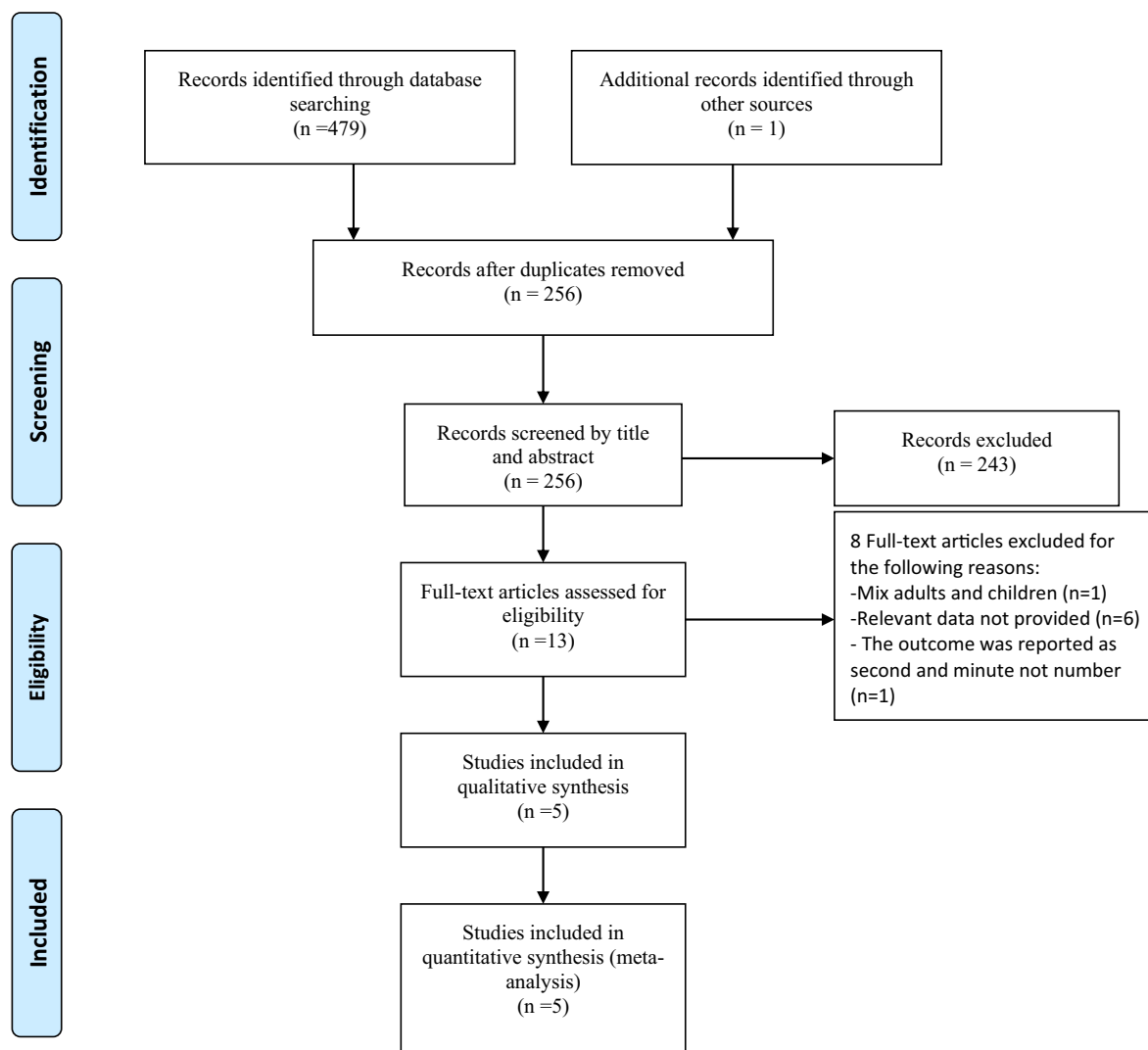


Fig. 1 — **Flow diagram of studies for inclusion in the present study.**

**Table 1 – Characteristics of the included studies in the systematic review and meta-analysis.**

| Author (date) | Country | Target population | Total number of advertisements | Number of food advertisements | Number of cariogenic food advertisements | Data collection method | Data collection duration | No. of channels |
|---|---|---|---|---|---|---|---|---|
| Chestnutt and Ashraf (2002)[18] | UK | Children TV advertising | 2345 | 1394 | 1023 | Direct viewing of channels (after video recording) | 2 months | One channel |
| Rodd and Patel (2005)[13] | UK | Children TV advertising | 984 | 342 | 326 | Direct viewing of channels (after video recording) | 2 months | One channel |
| Sukumaran et al. (2012)[14] | India | Children TV advertising | 1938 | 1078 | 907 | Direct viewing of channels (after video recording) | 16 days | Two channels |
| Gatou et al. (2014)[20] | Greece | Children TV advertising | 950 | 289 | 211 | Direct viewing of channels (after video recording) | 2 months | Six channels |
| Al-Mazyad et al. (2017)[19] | UK | Children TV advertising | 9151 | 1532 | 934 | Direct viewing of channels (after video recording) | 12 months | One channel |

high in both acid and sugar. They reported that the most advertised food or drinks were sugary breakfast cereals (26.3%), confectionery products (23.7%), non-carbonated soft drinks (18.1%), fast foods (16.7%), and flavored milk drinks (4.1%).

Sukumaran et al.,[14] by analyzing the content of advertisements in India, demonstrated that of 1938 advertisements telecasted for children, 55.6% were based on food, of which 46.8% focused on sugar-rich foods.

Gatou et al.[20] investigated the nature and extent of food advertising in a cross-sectional sample of six channels of Greek TV programs during children's viewing times. They demonstrated that of 289 foods advertised, 73.01% (211 ads) were related to high-sugar and/or acid foods, and advertisement of harmful foods to teeth was almost three times as likely to be shown during children's programs. The most advertised food items for children were confectionery products (27.7%), yoghurt desserts (18.7%), bottled water (10.4%), fruit-flavored drinks (9.3%), and breakfast cereals with added sugar (9%).

Al-Mazyad et al.[19] quantified the prevalence of food advertising harmful to dental health in a cross-sectional study. The biggest commercial channel of UK TV was recorded from January to December of 2012 (one weekday and weekend day every month). They demonstrated that 16.7% of advertisements were related to food, and 61% of food advertisements were harmful to dental health. During peak time of viewing, 65.9% of food advertisements were for food harmful to dental health.

### Quality assessment

Quality of selected studies was assessed for two domains of risks of selection bias and outcome measurements (Table 2). In terms of risk of selection bias, four studies were categorized as having moderate risk of selection bias. These studies included only a limited number of channels (one or two channels), and the length of recording for each day was short. One study was categorized as having low risk of selection bias. It included appropriate number of channels (six channels) and also the length of recording for each day was appropriate.

In terms of risk of outcome measurement, one study was categorized as having high risk of bias. Although the classification of food and non-food advertisements was clear, the number of reviewers, information about the process of analyzing recorded programs, and intraoperator agreements were not provided. Three studies were classified as having moderate risk of bias. Studies in this category did not provide the intraoperator agreement, or the outcome was only assessed by one reviewer. Finally, one study was categorized as having low risk of bias. This study had good classification of food and non-food advertisements. The team of dentists was involved in analyzing the outcome, and the intraoperator agreement was also analyzed.

### Meta-analysis results

Five studies were identified as eligible for meta-analysis. The publication bias was observed in the event rate of total food advertisements (Egger test: P = 0.19, one tailed). Publication

| Table 2 — Risk of selection and outcome measurement bias and justification for ratings. | | |
|---|---|---|
| Study | Risk of selection bias | Risk of outcome measurement bias |
| Chestnutt and Ashraf (2002)[18] | Moderate: one channel was included in this study. The programs of this channel were video recorded for 8 weeks on weekdays (1.5 h/day [15.35—17.05]) and Saturdays (4 h/day [7—11]) and Sundays (3 h/day [7—10]).The authors selected only one channel, and the length of recording for each day was short. So we considered moderate risk of bias | High: the classification of food and non-food advertisements was clear. But the number of reviewers who extracted the data was not clear. The information about the process of analyzing recorded programs and also intra-operator agreements was not provided. So, we considered high risk of outcome measurement bias. |
| Rodd and Patel (2005)[13] | Moderate: this study included the advertisements broadcast in one British commercial and one terrestrial channel for 2 months in weekdays (2 h/day [15.15—17.15]) and weekend (3 h and 10 min/day [9.20—12.30]). The authors included only one channel and also the short length of recording for each day. So we considered moderate risk of bias | Moderate: clear classification of food and non-food and also clear subclassification of food group were used. However, the recorded channels were only analyzed by one investigator without reanalyzing by the second author. The intra-operator agreement was also analyzed 1 week later with the excellent kappa coefficient of 1.0 |
| Sukumaran et al. (2012)[14] | Moderate: This study included the advertisements broadcast in two main children channels in India for 16 days in prime (2 h/day [19—21]) and non-prime (2 h/day [17—19]) times. Although the authors selected two main channels, the length of recording was short (only 16 days and each day for 4 h). So, we considered moderate risk of bias. | Moderate: clear classification of food and non-food items and also clear subclassification of food group were used. However, the recorded channels were only analyzed by one investigator, and 5.5% of recorded programs were reanalyzed by the second reviewer, and the agreement rate was 89.5%. Moreover, intra-operator agreement was also analyzed 1 week later with the excellent kappa coefficient of 1.0 |
| Gatou et al. (2014)[20] | Low: This study included the advertisements broadcast in six channels in Greece for 2 months in weekdays (4 h/channel [15—17 and 21—23]) and weekend (8 h/day [9—13, 15—17, and 21—23]) times. The authors selected six different channels and also the selected length of recording was appropriate. So we considered low risk of bias | Low: Clear classification of food and non-food items and also clear subclassification of food group were used. The recorded channels were analyzed and classified into food subgroup by the team of dentists and non-food subgroup by one of the authors. Moreover intra-operator agreement was also analyzed 10 days later with the excellent kappa coefficient of 0.95—0.97 |
| Al-Mazyad (2017)[19] | Moderate: The biggest commercial TV channel in the UK was included in this study. The programs of this channel were video recorded for 12 months on one weekday (16 h/month [6 AM—10 PM]) and one weekend day (16 h/month [6 AM—10 PM]). The authors selected only one channel so the generalizability of data was poor, but the length of recording for each day was appropriate. So, we considered moderate risk of bias | Moderate: Clear classification of peak time TV viewing for children and for food and non-food items and clear subclassification of food group were used. The recorded channels were analyzed and classified into food subgroup by the team of dentists and non-food subgroup by one of the authors without any reanalyzing. So we considered moderate risk of bias |

bias was also seen for the event rate of cariogenic food advertisements (Egger test: $P = 0.11$, one tailed). Considering the presence of heterogeneity in total food advertising ($I^2 = 99.81$, $Q = 2115.11$, $df = 4$, $P < 0.001$) and also in cariogenic food advertising ($I^2 = 99.15$, $Q = 471.14$, $df = 4$, $P < 0.001$), the random effects model was used.

About 38.0% (95% confidence interval [CI]: 19.6 to 60.6, $P = 0.296$) of all advertisements were related to food, and (Fig. 2) 70.6% (95% CI: 53.7.0 to 83.3, $P < 0.019$) of food advertisements were related to cariogenic food (Fig. 3). We could not do subgroup analysis owing to the limited number of studies conducted in this topic.
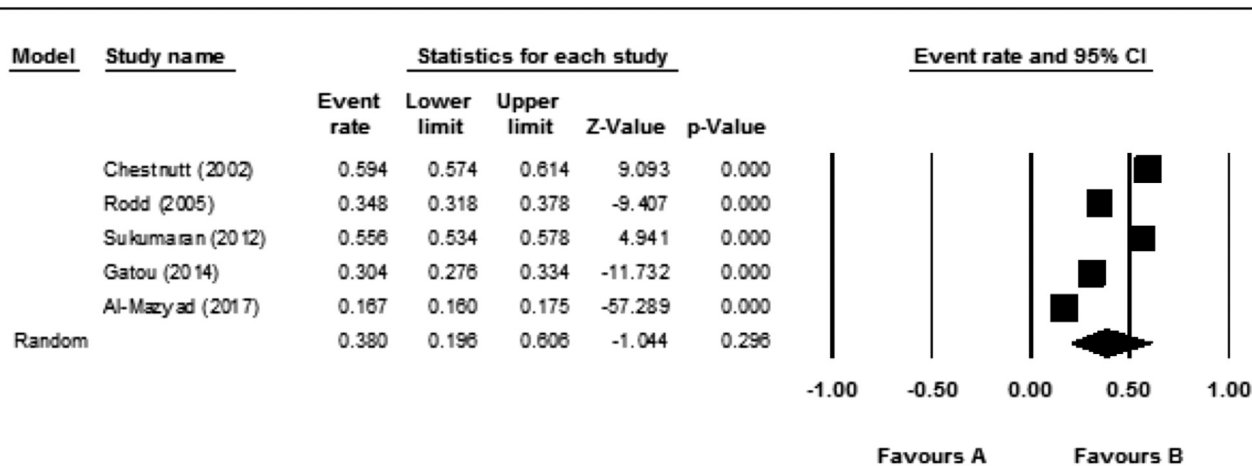
## Discussion

This systematic review identified five observational studies that have investigated the content of TV advertisements related to oral health in children. The results indicated that about 38% of the advertisements telecasted for children were based on food. Two of five studies[14,18] found that more than 50% of advertisements telecasted for children were based on food and drinks. Two of the included studies compared the content of the advertisements broadcast during children's viewing times and prime time.[18,20] Chestnutt and Ashraf[18] showed that about 62.5% of advertisements broadcast during children's TV time were devoted to food; however, this percent in prime time was 18.4%. Gatou et al.[20] also showed that food advertisements accounted for of 30.4% of all advertisements during children programs and 25.9% of advertisements during other programs.
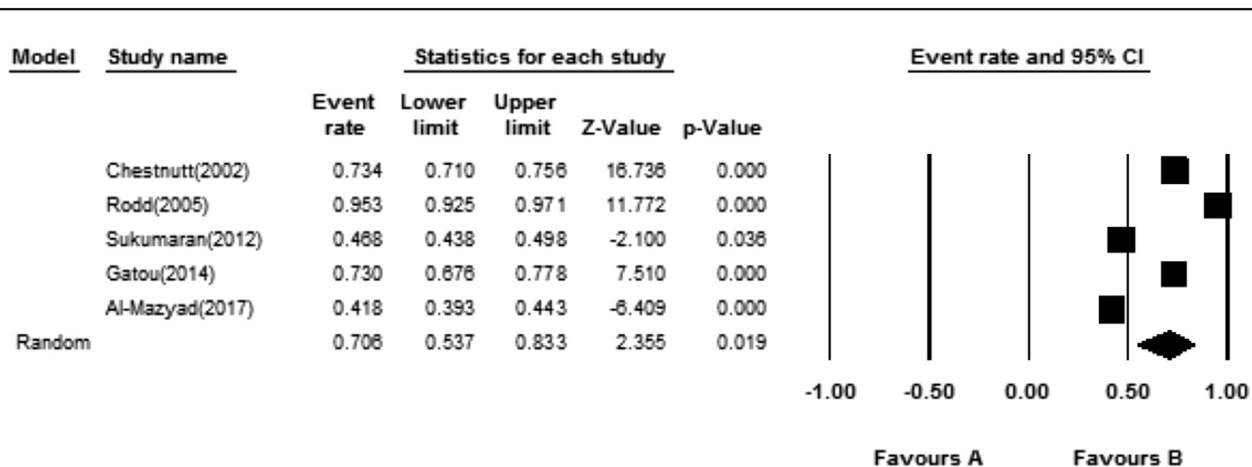
These results indicated that children are a good target group for marketers because of their power to influence parent's purchases and also they are the future adult consumers.[5,6]

According to the results of meta-analysis, we also showed that about 70.6% (95% CI: 53.7—83.3, $P = 0.019$) of food

| Model | Study name | Statistics for each study | | | | | Event rate and 95% CI |
|---|---|---|---|---|---|---|---|
| | | Event rate | Lower limit | Upper limit | Z-Value | p-Value | |
| | Chestnutt (2002) | 0.594 | 0.574 | 0.614 | 9.093 | 0.000 | |
| | Rodd (2005) | 0.348 | 0.318 | 0.378 | -9.407 | 0.000 | |
| | Sukumaran (2012) | 0.556 | 0.534 | 0.578 | 4.941 | 0.000 | |
| | Gatou (2014) | 0.304 | 0.276 | 0.334 | -11.732 | 0.000 | |
| | Al-Mazyad (2017) | 0.167 | 0.160 | 0.175 | -57.289 | 0.000 | |
| Random | | 0.380 | 0.196 | 0.606 | -1.044 | 0.296 | |



Meta Analysis

Fig. 2 – Forest plot showing the weighted event rate for food advertisements. CI, confidence interval.

| Model | Study name | Statistics for each study | | | | | Event rate and 95% CI |
|---|---|---|---|---|---|---|---|
| | | Event rate | Lower limit | Upper limit | Z-Value | p-Value | |
| | Chestnutt(2002) | 0.734 | 0.710 | 0.756 | 16.736 | 0.000 | |
| | Rodd(2005) | 0.953 | 0.925 | 0.971 | 11.772 | 0.000 | |
| | Sukumaran(2012) | 0.468 | 0.438 | 0.498 | -2.100 | 0.036 | |
| | Gatou(2014) | 0.730 | 0.676 | 0.778 | 7.510 | 0.000 | |
| | Al-Mazyad(2017) | 0.418 | 0.393 | 0.443 | -6.409 | 0.000 | |
| Random | | 0.706 | 0.537 | 0.833 | 2.355 | 0.019 | |



Meta Analysis

Fig. 3 – Forest plot showing the weighted event rate for cariogenic food advertisements. CI, confidence interval.

advertisements were related to cariogenic foods. Four of five studies showed that more than 60% of advertised food and drinks were of high sugar content and acidic, which are harmful for oral and dental health.[13,18–20] Sukumaran et al.[14] categorized only the sugar-rich foods and beverages as cariogenic; therefore, they reported the lower rate of cariogenic food advertisements (less than 50% of food advertisements). Two studies[18,20] compared the content of advertisements broadcast during children's viewing time with those transmitted during evening and night time (the adult's time), and both showed that there is a significant difference in broadcasting oral health–harming foods in children's programs and other programs. These observations are of particular concern because they reveal that marketers of food that are potentially harmful to teeth select children as a target group, and children are being bombarded with sugar-rich product advertisements.

Psychological research has demonstrated that young children (younger than 8 years) were not fully conscious about the aim of food marketing and tended to trust advertisements.[21,22] On the other hand, older children, in spite of understanding the intent of advertising, could not interpret these messages critically.[21]

By reviewing the content of cariogenic food items advertised for children, it was observed that most highly advertised food categories for children were confectioneries, sugared dairy products, and sugared cereals. In the study in the UK, Morgan et al. showed that sugared cereals and sweetened dairy products were the most food items advertised during children's viewing time.[3] Unfortunately, as these results reveal, the advertisements shifted toward advertising the items that appear healthy; however, they contain a large amount of hidden sugar. Most parents and also children

consider these products as safe and may replace the non-sugary items with their sugared alternative without being aware of their deleterious effects. Three studies which have investigated the portion of non-cariogenic food and drink items reported the lack of these item's advertisements such as dairy products, water, fruits, and vegetables.[13,18,20]

Three studies were conducted in the UK,[13,18,19] of which one was conducted in 2012 after full implementation of Ofcom's food advertising regulation.[19] The comparison of the results of these studies showed that although there is a good adherence to these regulations, children are still targeted by marketers in different ways, such as advertising harmful foods during attractive programs to children such as entertainment and game shows.

Similar to any systematic review, this study also has limitations due to the type of the studies selected (observational studies), the differences in the sample size of studies, the heterogeneity of the results found, and the distinct variations in different countries' advertising regulations. These limitations certainly introduced some bias in this meta-analysis, as analytical and measurement bias.

### Conclusion

In conclusion, the systematic review and meta-analysis of the observational studies showed that the most advertised foods during children's programs are food items that are potentially harmful to dental health. Moreover, the advertisements shifted toward food items that appeared healthy but contain a large amount of hidden sugar. The findings showed that food marketers are counting on children as vulnerable targets to advertisements. Considering these findings, it seems that it is necessary for policymakers and decision makers to review and revise the regulations of child-targeted food advertisements and also to apply a stricter restriction in regions with previously implemented regulations such as the UK to reduce the exposure of children with such unhealthy advertisement.

## Author statements

### Ethical approval

None sought.

### Competing interests

None declared.

### Authors' contribution

FPN, MG, and HMA developed the concept; FS and MM extracted the data; MG and SHE did the meta-analysis; FPN, MG, and ZN interpreted the data; and ZN and HMA prepared the manuscript, and all authors approved the final manuscript.

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## Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.puhe.2017.12.012.