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Short Communication

Do television food advertisements portray advertised foods in a 'healthy' food context?

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Abstract

Exposure to food promotion influences food preferences and diet. As food advertisements tend to promote 'less healthy' products, food advertising probably plays some role in the 'obesity epidemic'. Amid calls for increased regulation, food manufacturers are beginning to engage in a variety of health-promoting marketing initiatives. Positioning products in the context of a 'healthy', balanced diet in television advertisements is one such initiative. We explored whether the wider food context in which foods are advertised on television are 'healthier' than the advertised foods themselves. All foods shown in food advertisements broadcast during 1 week on one commercial UK channel were identified and classified as 'primary' (i.e. the focus of advertisements) or 'incidental'. The nutritional content of all foods was determined and that of primary and incidental foods were compared. Almost two-thirds of food advertisements did not include any incidental foods. When a wider food context was present, this tended to be 'healthier' than the primary foods that were the focus of food advertisements – particularly in terms of the food groups represented. It is not yet clear what effect this may have on consumers' perceptions and behaviour, and whether or not this practice should be encouraged or discouraged from a public health perspective.

Key words: Diet: Media: Promotion: Marketing

There is substantial evidence that exposure to food promotion influences food preferences and diet of children^(1,2), and some evidence that the same is true in adults also⁽³⁾. As food advertisements tend to be strongly biased towards products high in fat, salt and sugar and low in fibre and fruit and vegetables^(2,4), it is likely that food advertising plays some role in the 'obesity epidemic'^(1,5).

There are increasing calls for the regulation of food advertisements, particularly those aimed at children⁽⁶⁾. In the UK, and some other territories, regulations exist limiting the types of foods that can be advertised on television which is likely to be viewed by children, and the marketing methods that can be used (e.g. use of celebrities likely to be known to children)^(7,8). In the UK, regulations prohibit the advertisement of high-fat, -salt and -sugar foods during and around programmes 'of particular appeal to children'. Foods are identified as being high in fat, salt and sugar using a nutrient profiling model⁽⁹⁾, and programmes 'of particular appeal to children' are defined as both those on specialist children's channels and those where the proportion of children watching the programme

is more than 120% of the proportion of children in the population⁽⁸⁾.

Amid this climate of increased regulation, food manufacturers are beginning to engage in a variety of health-promoting initiatives linked to marketing. For instance, the 'Be treatwise' campaign⁽¹⁰⁾, supported by some of the world's largest confectionery manufacturers, claims to reinforce the concept of a balanced diet⁽¹¹⁾. Food manufacturers have also claimed that they increasingly position their products in the context of a 'healthy', balanced diet in television advertisements. For example, Cadbury's (Bournville, Birmingham, UK) marketing code of practice states that 'our advertising will reflect moderation in consumption and portion sizes'⁽¹²⁾.

One method of 'reflecting moderation in consumption and portion size' and reinforcing the importance of a balanced diet in food advertisements is to position advertised foods in a wider food context. However, to date, no evidence describing the food context in which foods are advertised has been published. Manufacturers' claims that their marketing positions their products in a 'healthy' context cannot, therefore, be confirmed or refuted.

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We sought to answer the question: is the wider food context in which foods are advertised on television ‘healthier’ than the advertised foods themselves?

Methods

We studied television food advertising over 1 week (7–13 July 2008) on the commercial station with the highest overall viewing figures in the UK (ITV1) and compared the nutritional content of advertised products with that of incidental food products shown in food advertisements.

Broadcast data and food products shown

During the study week, we recorded all programmes and advertisements broadcast (24 h/d, 168 h in total) on ITV1 in the North East region of England. Although there is some regional variation in programmes and advertisements shown on this channel (particularly local news programmes and advertisements for local services), there is very little regional variation in advertisements for products such as food, which tend to be manufactured and advertised by large national and multinational companies. Recordings were watched in order to identify all food advertisements and programme sponsorship slots (shown immediately before and after programming segments, between programming and advertising slots) – collectively termed ‘food advertisements’ in the present study.

All identifiable food and drink products (collectively termed ‘foods’ in the present study) shown in food advertisements were noted, along with approximate volumes in either household measures (e.g. one glass of milk) or manufacturers’ standard sizes (e.g. one standard Mars Bar). Where household measures or manufacturers’ standard sizes were not applicable (e.g. a bowl of Shreddies), information on standard portion size⁽¹³⁾ was used. All identifiable foods shown were taken into account. Thus, if a child was shown drinking a glass of orange juice with a carton of orange juice on the table beside them, both the glass and the carton were included.

Foods shown were divided into ‘primary’ and ‘incidental’ foods. Primary foods were those branded foods that were actively being promoted (e.g. Kellogg’s Coco Pops; Warrington, UK), while incidental foods were all other, non-branded, foods (e.g. milk, fruit juice and tea). If an advertisement showed the component ingredients of primary products (e.g. olive oil and eggs in an advertisement for Hellmann’s Mayonnaise), these components were classified as incidental foods.

Nutritional data

Information on the nutritional content of primary foods was obtained from the package, manufacturers’ websites and via telephone helplines as far as possible, supplemented with standard food table data⁽¹⁴⁾ where necessary. Information on the nutritional content of incidental foods was obtained from standard food tables⁽¹⁴⁾. This information was used to calculate energy density (in kJ/100 g), percentage of energy derived from carbohydrate, sugars, protein, fat and saturated fat, as well as the fibre and Na density (both in g/MJ) of all primary and incidental foods. No attempt was made to separate intrinsic and extrinsic sugars. All primary and incidental foods were also categorised into one of eight food groups, based on the five groups in the Food Standards Agency’s ‘Eatwell Plate’ plus three additional groups (see Table 1)⁽¹⁵⁾.

Analyses

Analyses were performed at two levels – one where individual foods were the unit of analysis, and a second where food advertisements were the unit of analysis. For the analysis at the individual food level, the proportion of all primary and incidental products that were and were not in each food group was compared using the χ^2 test for differences in proportion. The mean nutritional composition of primary and incidental products was then compared using the Wilcoxon rank-sum test. All foods shown in all food advertisements were included in the present analysis.

Table 1. Proportion of primary and incidental foods in each food category* (Numbers and percentages)

Food category	Primary foods (n 1007)		Incidental foods (n 960)		Test of difference in proportions	
	n	%	n	%	χ^2 (df = 1)	P
Alcoholic beverages	29	3	25	3	0.14	0.71
Bread, rice, potatoes and pasta	204	20	73	8	65.04	<0.001
Diet soft drinks and sweeteners	16	2	21	2	0.95	0.33
Foods and drinks high in fat and/or sugar	413	41	131	14	183.97	<0.001
Fruit and vegetables	40	4	422	44	437.27	<0.001
Meals, combination foods, soups and sauces	198	20	72	8	61.39	<0.001
Meat, fish, eggs and beans	3	0	125	13	130.76	<0.001
Milk and dairy foods	104	10	91	10	0.40	0.53

* All analyses at the individual food level.

Table 2. Mean nutritional content of advertised foods (Medians and interquartile ranges (IQR))

Nutritional metric	All primary foods (<i>n</i> 1007)*			All incidental foods (<i>n</i> 960)*			Wilcoxon rank-sum test*			Weighted average of primary foods (<i>n</i> 250)†			Weighted average of incidental foods (<i>n</i> 250)†			Wilcoxon matched-pairs signed-rank test‡			WHO/FAO ranges ⁽¹⁶⁾
	Median	IQR	Median	IQR	Median	IQR	<i>z</i>	<i>P</i>	Median	IQR	Median	IQR	Median	IQR	<i>z</i>	<i>P</i>			
Energy density (kJ/100 g)	1381	502–1645	199	109–772	–20.99	<0.001	1390	665–1679	427	120–920	–12.02	<0.001	–	–	–	–			
Energy (%)																			
Carbohydrate	65.3	41.4–78.6	61.7	10.8–86.3	–1.38	0.17	47.4	9.6–76.5	53.7	30.8–75.8	3.15	0.002	55–75						
Sugar	21.9	5.5–40.6	38.6	1.5–83.0	5.49	<0.001	10.2	1.7–27.3	38.4	7.4–61.7	8.75	<0.001	<10						
Fat	18.5	5.4–44.3	14.4	2.5–34.2	–4.12	<0.001	22.2	5.9–65.5	20.3	9.1–39.2	–5.63	<0.001	15–30						
Saturated fat	4.4	1.3–15.6	3.5	0–12.1	–7.51	<0.001	8.4	1.2–11.3	6.5	0.3–13.0	–2.11	0.035	<10						
Protein	7.8	5.4–13.8	14.2	5.6–29.4	9.60	<0.001	7.1	1.1–12.8	16.2	8.0–26.5	7.54	<0.001	10–15						
Fibre density (g/MJ)	1.9	0.5–3.5	1.5	0–9.7	–0.20	0.84	1.3	0–2.8	1.6	0.2–2.8	0.59	0.55	>3.0‡						
Na density (g/MJ)	0.2	0–0.4	0.6	0.2–2.2	32.33	<0.001	0.2	0.2–0.6	0.9	0.7–2.2	9.56	<0.001	<0.2§						

* Analysis at the individual food level.

† Analysis at the food advertisement level.

‡ Based on a 8.4 MJ/d (2000 kcal/d) diet and a recommended daily fibre intake of >25 g/d.

§ Based on a 8.4 MJ/d (2000 kcal/d) diet and a recommended daily Na intake of <2 g/d.

The analysis at the food advertisement level was conducted in order to allow the relative volume of different foods shown in advertisements to be taken into account. Here, the mean nutritional content of all primary foods shown in each advertisement, weighted according to the relative volume of the different primary foods shown, was calculated. The same procedure was used to calculate the weighted-mean nutritional content of all incidental foods shown in each advertisement. The weighted-mean nutritional content of all primary foods shown in each advertisement was then compared with that of all incidental foods shown in each advertisement, using the Wilcoxon matched-pairs signed-rank test. This analysis was restricted to advertisements that showed at least one primary and one incidental product.

Results

A total of 652 food advertisements, broadcast over 168 h, showing 1007 primary and 960 incidental foods were included in the analysis. There was a maximum of six primary and eleven incidental products in the advertisements. The most frequent combination of products was one primary product and no incidental products (*n* 217, 33%). In sixty-four (10%) advertisements, no primary or incidental foods were shown. These advertisements featured a brand logo for a food range, without any specific foods being shown. Other combinations that accounted for 5%, or more, of food advertisements were three primary products and no incidental products (*n* 48, 7%), one primary and two incidental products (*n* 45, 7%), one primary and one incidental product (*n* 42, 6%) and one primary and three incidental products (*n* 32, 5%).

The proportion of all primary and incidental foods in each food group is shown in Table 1 (analysis at the individual food level). The most common food group represented among primary foods was ‘foods and drinks high in fat and/or sugar’ (41%, e.g. chocolate, cakes and full-sugar, carbonated soft drinks), and the least common was ‘meat, fish, eggs and beans’ (0.3%). Among incidental foods, the most frequently represented food group was ‘fruit and vegetables’ (44%) and the least frequently represented was ‘diet soft drinks and sweeteners’ (2%). Incidental foods were significantly less likely to be categorised as ‘bread, rice, potatoes and pasta’, ‘foods and drinks high in fat and/or sugar’ and ‘meals, combination foods, soups and sauces’ than primary foods, but were significantly more likely to be categorised as ‘fruit and vegetables’ or ‘meat, fish, eggs and beans’.

The mean nutritional content of all primary and incidental foods is shown in the first four data columns of Table 2 (analysis at the individual food level). For comparison, population nutrient intakes suggested by the WHO/FAO⁽¹⁶⁾ in order to prevent diet-related diseases are shown in the final data column. Compared with this suggested diet, primary foods tended to be high in sugar

(more than twice the recommended upper limit), low in protein (about 78% of the recommended lower limit) and low in fibre (about 63% of the recommended lower limit). Incidental foods tended to be very high in sugar (almost four times the recommended upper limit), low in fibre (50% of the recommended lower limit) and very high in Na (about three times the recommended upper limit). The fifth and sixth data columns in Table 2 show the results of Wilcoxon rank-sum tests comparing the nutrient content in all primary and incidental foods. Compared with primary foods, incidental foods had a significantly lower energy density (median energy density in incidental foods was 14% of that in primary foods), fat (78%) and saturated fat content (80%), and a significantly higher sugar (median percentage of energy from sugar in incidental foods was 176% of that in primary foods), protein (182%) and Na (300%) content.

For those advertisements where any incidental foods were shown (n 250, 38%), the weighted-mean nutritional content of all primary and incidental foods is shown in data columns 7–10 of Table 2 (analysis at the food advertisement level). Compared with the WHO/FAO suggested diet, primary foods in this instance tended to have a lower carbohydrate (86% of the recommended lower limit), saturated fat (84% of the recommended lower limit), protein (71% of the recommended lower limit) and fibre content (43% of the recommended lower limit) than suggested. Incidental foods in this instance tended to have a higher sugar (almost four times the recommended upper limit) and Na content (4.5 times the upper recommended limit) than suggested, and a lower saturated fat (68% of the recommended lower limit) and fibre content (53% of the recommended lower limit) than suggested. Wilcoxon matched-pairs signed-rank tests comparing the nutrient content of weighted-mean primary and incidental foods in advertisements showing any incidental foods are shown in data columns 11 and 12 of Table 2. Compared with the weighted-mean nutritional content of primary foods in these advertisements, incidental foods had a significantly lower energy density (median energy density in incidental foods was 31% of that in primary foods), fat (91%) and saturated fat (77%) content, and a significantly higher carbohydrate (median percentage of energy from carbohydrate in incidental foods was 113% of that in primary foods), sugar (376%), protein (228%) and Na content (450%).

Discussion

This is the first study to investigate the wider food context in which foods are advertised on television. Almost two-thirds of food advertisements in the present sample did not include any incidental foods and thus had no wider food context, as defined in the present study. However, when a wider food context was present, this tended to be 'healthier' than the branded foods that were the focus

of food advertisements. This trend was particularly seen in terms of food groups represented with a more mixed picture seen in relation to the nutritional content. The trend was also seen both at the individual food level and the food advertisement level, where the relative volume of different foods shown in an advertisement was taken into account. As previously reported^(1,2,4), food advertisements tended to advertise 'less healthy' foods that were frequently categorised as 'foods and drinks high in fat and/or sugar', that were higher in sugar and lower in fibre, than a diet recommended to avoid diet-related diseases.

In order to identify all food products shown in each food advertisement, we had to view all advertisements. This was a laborious process and often involved reviewing individual advertisements a number of times. Although other content analyses of television food advertisements have been conducted, e.g. Henderson & Kelly⁽¹⁷⁾ and Lewis & Hill⁽¹⁸⁾, we believe that the present study may be one of the most detailed such studies to date. While viewing advertisements is likely to be the only accurate method of collecting the data we required, it did mean that we were limited both in the number of channels and length of period that we could realistically study. A number of previous studies have been restricted to a single week of television^(19,20). The present study week did not contain any major sporting events and was not during local school holidays. However, it is possible that a single week on a single channel is not representative of all UK television⁽²¹⁾.

We necessarily restricted our analyses to identifiable food products. However, there were occasions when foods were shown in advertisements that were unidentifiable. For instance, in a general kitchen scene, a stocked refrigerator is opened, but the specific contents are very difficult to identify. Although it is likely that if we could not identify the foods, viewers would also be unlikely to identify them⁽²²⁾; this does not mean that such general shots do not influence the viewer.

We estimated the approximate volume of foods shown in advertisements. While this was straightforward when branded foods were shown in packaging, it was sometimes harder to estimate the volume of incidental products shown and this process may be prone to error. We did not have any 'gold standard' to validate our method of estimating the volume of products shown against. One individual (R. T.) coded all advertisements. We did not make any attempts to validate her estimated volumes against a second coder. However, substantial literature is available on the estimation of portion size, e.g. Foster *et al.*⁽²³⁾ and Lucas *et al.*⁽²⁴⁾, and this could be drawn on for future work. One alternative, but very resource-intensive, method of estimating the volume of foods shown, that could be used in the future, would be to calculate the proportion of the screen foods take up and their time on the screen in order to determine the proportion of an advertisement they account for.

Our approach assumes that all advertisements, and foods shown, are equal in terms of their impact on the viewer. This may not be the case with all incidental foods contributing to a general perception of the context of the advertisement but not, individually, having the same impact on the viewer as advertised products. It is also possible that the impact of different foods shown varies both between advertisements and between viewers.

Our findings indicate that when foods are advertised in a wider food context, that context is generally, although not universally, 'healthier' than primary foods being actively advertised. For instance, while incidental foods had a lower energy density and fat and saturated fat content than primary foods, they also had a higher sugar and Na content. One possible explanation for the higher sugar content in incidental foods is the higher prevalence of 'fruit and vegetables' among incidental foods, and the increased sugar content in this group of foods may be primarily related to fruit sugars. As we did not attempt to explore different types of sugars, we were not able to confirm this.

Despite the tendency for incidental products to be 'healthier' than primary products, in almost two-thirds of advertisements, no incidental products were shown. Advertisers do appear to be positioning at least some foods in the context of a more balanced diet. It is likely that there are systematic differences in the sort of products that are and are not advertised in a wider food context. For example, primary products that were advertised without any incidental products in this sample had a significantly higher sugar, saturated fat and Na content and a significantly lower fibre content than those advertised with incidental products (data not shown).

Furthermore, it is not clear what effect the wider food context shown in advertisements has on viewers' perceptions of the foods being advertised. It is possible that positioning 'less healthy' foods in a 'healthier' food context reinforces the importance of a balanced diet, lends advertised foods an unjustified aura of 'healthiness' or a combination of these. Further work will be required to determine the impact of incidental foods on viewers' perceptions of the primary foods advertised.

Perceptions of the 'healthiness' of advertised foods are also likely to be influenced by a wide variety of other factors, including non-television marketing and promotion⁽²⁵⁾. For instance, the 'Be treatwise' initiative encourages consumers to 'get to know your guideline daily amounts'⁽¹⁰⁾. While there is evidence that concepts such as guideline daily amounts are poorly understood by consumers⁽²⁶⁾, merely making reference to the concept of a balanced diet may be enough to improve the perceived healthiness of a product. Again, this is a researchable question that warrants further investigation.

Television food advertising is strongly biased towards 'less healthy' products^(2,4). We have found evidence that the wider food context in which foods are advertised on

television tends to be 'healthier' than advertised foods themselves – particularly in terms of food groups represented. However, it is not yet clear what effect this may have on consumers' perceptions and behaviour, and whether or not this practice should be encouraged or discouraged from a public health perspective.

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References

1. McGinnis J, Goolman J & Kraak V (2006) *Food Marketing to Children and Youth: Threat or Opportunity?* Washington, DC: The National Academies Press.
2. Cairns G, Angus K & Hastings G (2009) *The Extent, Nature and Effects of Food Promotion to Children: A Review of the Evidence to December 2008. Prepared for the World Health Organization.* Geneva, Milton Keynes: Institute for Social Marketing, University of Stirling and The Open University.
3. Harris J, Bargh J & Brownell K (2009) Priming effects of television food advertising on eating behavior. *Health Psychol* **28**, 404–413.
4. Powell L, Szczypka G, Chaloupka F, *et al.* (2007) Nutritional content of television food advertisements seen by children and adolescents in the United States. *Pediatrics* **120**, 576–583.
5. Butland B, Jebb S, Kopelman P, *et al.* (2007) *Foresight Tackling Obesity: Future Choices – Project Report.* London: Government Office for Science.
6. Nestle M (2006) Food marketing and childhood obesity – a matter of policy. *N Engl J Med* **354**, 2527–2529.
7. Caraher M, Landon J & Dalmeny K (2006) Television advertising and children: lessons from policy development. *Public Health Nutr* **9**, 596–605.
8. OfCom (2007) *Television Advertising of Food and Drink Products to Children – Final Statement.* London: Ofcom.
9. Rayner M, Scarborough P, Boxer A, *et al.* (2005) *Development of Final Model. Final Report for the Food Standards Agency.* Oxford: British Heart Foundation Health Promotion Research Group, Department of Public Health, University of Oxford.
10. Be treatwise: get to know your GDAs. <http://www.betreatwise.co.uk/> (accessed 24 November 2009).

11. Cadbury (2009) Be Treatwise: Cadbury in the UK to use packs to invite consumers to know more about the role of treats in their diet. <http://www.cadbury.com/ourresponsibilities/consumer/todaystopics/Pages/betreatwise.aspx> (accessed 24 November 2009).
12. Cadbury (2009) Marketing code of practice. <http://www.cadbury.com/SiteCollectionDocuments/Our%20Marketing%20Code.pdf> (accessed 24 November 2009).
13. Crawley H (1988) *Food Portion Sizes*, 3rd ed. London: Her Majesty's Stationery Office.
14. Food Standards Agency (2002) *McCance and Widdowson's The Composition of Foods Integrated Dataset (CoF IDS)*. London: Crown Copyright.
15. Food Standards Agency (2009) Eat well, be well: The Eatwell Plate. <http://www.eatwell.gov.uk/healthydiet/eatwellplate/> (accessed 24 November 2009).
16. World Health Organisation (2003) *Diet, Nutrition and the Prevention of Chronic Diseases: Report of a Joint WHO/FAO Expert Consultation*. WHO Technical Report Series no. 916. Geneva: WHO.
17. Henderson VR & Kelly B (2005) Food advertising in the age of obesity: content analysis of food advertising on general market and African American television. *J Nutr Educ Behav* **37**, 191–196.
18. Lewis MK & Hill AJ (1998) Food advertising on British children's television: a content analysis and experimental study with nine-year olds. *Int J Obes Relat Metab Disord* **22**, 206–214.
19. Adams J, Hennessy-Priest J, Ingimarsdóttir S, *et al.* (2009) Changes in food advertisements during 'prime-time' television from 1991 to 2006: a UK–Canada comparison. *Br J Nutr* **102**, 584–593.
20. Adams J, Hennessy-Priest K, Ingimarsdóttir S, *et al.* (2009) Food advertising during children's television in Canada and the UK. *Arch Dis Child* **94**, 658–662.
21. Østbye T, Pomerleau J, White M, *et al.* (1993) Food and nutrition in Canadian "prime time" television commercials. *Can J Public Health* **84**, 370–374.
22. Verma T, Adams J & White M (2007) Portrayal of health-related behaviours in popular UK television soap operas. *J Epidemiol Commun Health* **61**, 575–577.
23. Foster E, Adamson AJ, Anderson AS, *et al.* (2009) Estimation of portion size in children's dietary assessment: lessons learnt. *Eur J Clin Nutr* **63**, S45–S49.
24. Lucas F, Niravong M, Villemainot S, *et al.* (1995) Estimation of food portion size using photographs: validity, strengths, weaknesses and recommendations. *J Human Nutr Diet* **8**, 65–74.
25. Carels RA, Konrad K & Harper J (2007) Individual differences in food perceptions and calorie estimation: an examination of dieting status, weight, and gender. *Appetite* **49**, 450–458.
26. Lobstein T, Landon J, Lincoln P, *et al.* (2007) *Misconceptions and Misinformation: The Problems with Guideline Daily Amounts (GDAs): A Review of GDAs and their Use for Signaling Nutritional Information on Food and Drink Labels*. London: National Heart Forum.