10 YEARS ON

NEW EVIDENCE ON TV MARKETING AND JUNK FOOD CONSUMPTION AMONGST 11-19 YEAR OLDS 10 YEARS AFTER BROADCAST REGULATIONS

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CANCER RESEARCH UK

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The authors are solely responsible for the content of the report.

CANCER RESEARCH UK

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LIST OF ACRONYMS

High in fat, salt or sugar	HFSS
Cancer Research UK	CRUK
Policy Research Centre for Cancer Prevention	PRCP

FOREWORD

I am delighted to introduce the first report from the Youth Obesity Policy Survey run by Cancer Research UK. The survey benchmarks young people's exposure to junk food marketing, and helps us understand any link this has to their diet and weight.

This report examines the association between television marketing and diet. Specifically, it tests whether commercial television is linked to consumption of a range of unhealthy foods and drinks – in turn, helping to quantify the role that television marketing may be playing the UK's youth obesity epidemic.

This is a public health topic of the upmost importance. Obesity is responsible for around 5% of all cancers in the UK, at substantial cost to the NHS. Further, an obese child is around five times more likely to be an obese adult. Results from this year's National Childhood Measurement Programme, run by Public Health England, showed that obesity rates amongst 11 year olds remain alarmingly high. It is important that we better understand, and address, the factors that sustain the UK's youth obesity epidemic.

In the 2000s, a range of evidence showed that junk food marketing increases children and young people's total calorie intake. In answer to this, the UK introduced regulations on junk food broadcast marketing in 2008. These regulations prevent junk food marketing on children's television programming. However, their introduction was a decade ago and they may now be out of date. One concern is that they have not kept up with changing viewing habits. Ofcom's own figures show children currently watch the most TV between 7-8pm, when 'family entertainment' programming is commonly on. This is generally unregulated and may constitute a source of continued high exposure to junk food marketing amongst children and young people.

This report tests current regulations and our concerns about their effectiveness. More specifically, it ascertains whether the impact of junk food marketing on young people is at an acceptably low level; explores whether new viewing habits need better regulation, and evidences policy recommendations to ensure the UK's approach to junk food marketing is fit for purpose.

This is the first of several reports to be released using data from the Youth Obesity Policy Survey. Future reports will focus on marketing more broadly; test for a link between marketing and weight; examine common arguments against regulation through our data and explore the link between junk food marketing and health inequalities. In sum, this series will add to an already extensive evidence base, and I encourage UK policy makers to use it as an opportunity for action.

Professor Jason Halford
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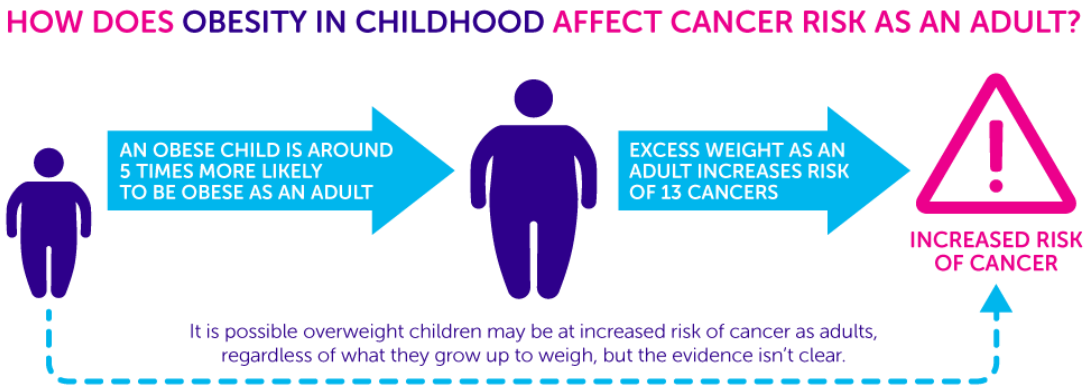
EXECUTIVE SUMMARY



Obesity is the biggest preventable cause of cancer after smoking and is linked to 18,100 cancer cases a year in the UK (5.5% of all cancer cases)[1], with the largest number of weight-linked cases in the UK being breast, bowel and womb[1,2]. Between 1998 and 2008, obesity in England more than doubled[3] and modelling studies estimate that if current trends of overweight and obesity continue, it could lead to a further 670,000 cancer cases by 2035[4]. The cost of this rise in obesity to the NHS would be an extra £2.5 billion/year[4].

Children's obesity constitutes a specific problem. As Public Health England's National Childhood Measurement Programme trends analysis report recently showed, obesity rates are holding steady at an alarmingly high level[5]. An obese child is five times more likely to become an obese adult[6]. In the long-term, this increases health and cancer risk, and in the short-term can cause physiological and psychological harm[7]. There is no one reason that explains the rise in levels of obesity amongst young people. Research has pointed to factors as diverse as genetics, increased food and drink consumption and lower levels of exercise[3,8-11]. However, factors which increase food and drink consumption and calorie intake have been shown to be the more powerful explanations[8,10,12].

The link between junk food marketing and the consumption of products high in fat, salt or sugar (HFSS) is clear in the research literature[13-16]. The weight of the evidence led the UK government to introduce regulations in 2008 preventing all junk food marketing on children's programming. A decade on, these regulations may now be out of date. One particular concern is that they have not kept up with changing viewing habits. Ofcom figures show young people watch the most television (TV) between 7:00 and 8:00pm, when family entertainment shows are more common, where junk food regulations remain generally lighter[17], and HFSS adverts are most regularly aired[18].

This research is designed to test current broadcast regulations and explore whether they remain fit for purpose ten years on. Through a UK-wide and representative study of 11-19 year old's diet, weight, marketing exposure and screen time, we explored whether the impact of junk food marketing on young people is acceptably low. We also examined whether new viewing habits, such as online on-demand streaming, need to be considered. This adds to the evidence base and provide an opportunity for UK policy makers to act.

KEY FINDINGS

Our analysis of the data collected as part of the Youth Obesity Policy Survey indicate that urgent action on junk food television marketing is needed.

TV MARKETING WAS MOSTLY SEEN ON FAMILY SHOWS

Young people were asked to select genres of TV shows where they felt they saw the most junk food adverts. The top four results were 1) entertainment, 2) reality TV, 3) sports and 4) daytime TV. These genres are generally made up by 'family viewing shows', seen on evenings and weekends, and often exempt from junk food regulations. This source of exposure supports our fear that current viewing habits mean existing, decade-old regulations are unfit for purpose.

TV MARKETING IS A RISK FACTOR FOR HIGH HFSS CONSUMPTION IN 11-19 YEAR OLDS

Our study used commercial TV viewing at high (3 hours a day or more) and moderate (0.5 - 3 hours per day) levels as a proxy for TV advertising exposure. High exposure was associated with increased risk of high consumption for 10 of the 12 HFSS product types tested – a tellingly consistent link.

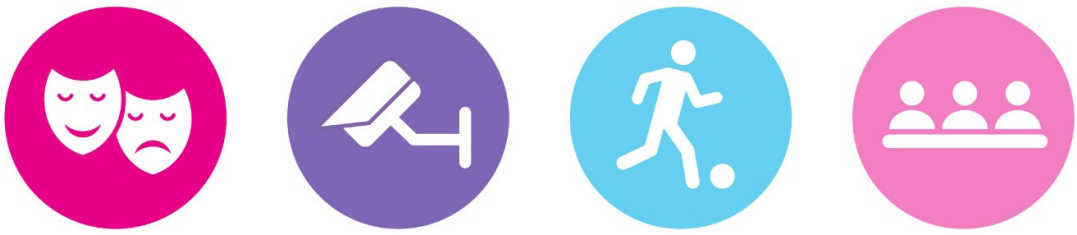
Highlights from the model are that young people with high TV exposure were associated with being:

- ***1.9 times more likely to consume 2 or more sugary drinks per week.***
- ***1.8 times more likely to consume 1 or more takeaways per week***
- ***1.7 times more likely to consume fried potato products 1 or more times per week.***

TV MARKETING WAS ASSOCIATED WITH HIGH RISK OF CONSUMING A WIDE RANGE OF PRODUCTS

The study tested several quite different product types – including healthy items, low price and accessible unhealthy items and high price, less accessible items. Significant effects across diverse products would offer stronger evidence that TV marketing influences energy intake. TV marketing was associated with similar increases in risk of high consumption across each of these categories – except healthy eating, where it was associated with decreased eating. ***This association is a strong indication of marketing's power.***

DURING WHICH TYPES OF TV SHOWS DO YOUNG PEOPLE TEND TO SEE UNHEALTHY FOOD/DRINK ADVERTS?



TV MARKETING WAS A RISK FACTOR FOR HIGHER JUNK FOOD EATING

We also tested for a link for total junk food consumption. In this model, the correlated risks were as follows:

- ***People with high advert exposure were around 2.7 times more likely to have high total HFSS consumption.***
- ***People with low exposure (< 0.5 hours/day) were around 2.6 times more likely to have low total HFSS consumption.***

The difference between being a high consumer and a low consumer was at least 520 junk food products/year. This means advert exposure may have a substantial impact on a population level.

STREAMING WAS A RISK FACTOR FOR HIGH JUNK FOOD CONSUMPTION

On-demand streaming services with adverts were associated with increased risk of unhealthy eating/drinking. For example, in terms of fizzy drinks, this meant, high TV marketing exposure was associated with being:

- ***2.5 times more likely to consume one energy drink or more per week.***
- ***2.1 times more likely to consume 2-4 or more diet drinks per week.***
- ***1.5 times more likely to consume sugar sweetened fizzy drinks 2-4 times per week or more.***

This is the first UK study we are aware of to test the association between on-demand television and risk of HFSS consumption on this scale. It shows the need to account for TV advertising holistically in any regulations by considering new, online ways of watching commercial content.

POLICY IMPLICATIONS

The study finds that junk food marketing is a clear, consistent and cumulative risk factor for high junk food consumption.

Genres watched by family audiences on evenings and weekends were perceived by participants to be the main source of exposure to junk food marketing. Restrictions that focus on these programmes – often shown at evenings and weekends – would improve the effectiveness of the regulations. A 9pm watershed on TV would clearly be the most effective mechanism, but scheduling restrictions or revisions to the audience index are alternative options.

Our study also found that streaming had a similar association with HFSS eating to TV. This popular new way of watching television 'on-demand' should be proactively regulated through inclusion in any regulation of TV content.

Whilst there will not be a single solution to obesity in the UK, our findings show that junk food advert restrictions constitute a simple and pragmatic way for policy makers to make a sustainable impact on the UK's childhood obesity epidemic.

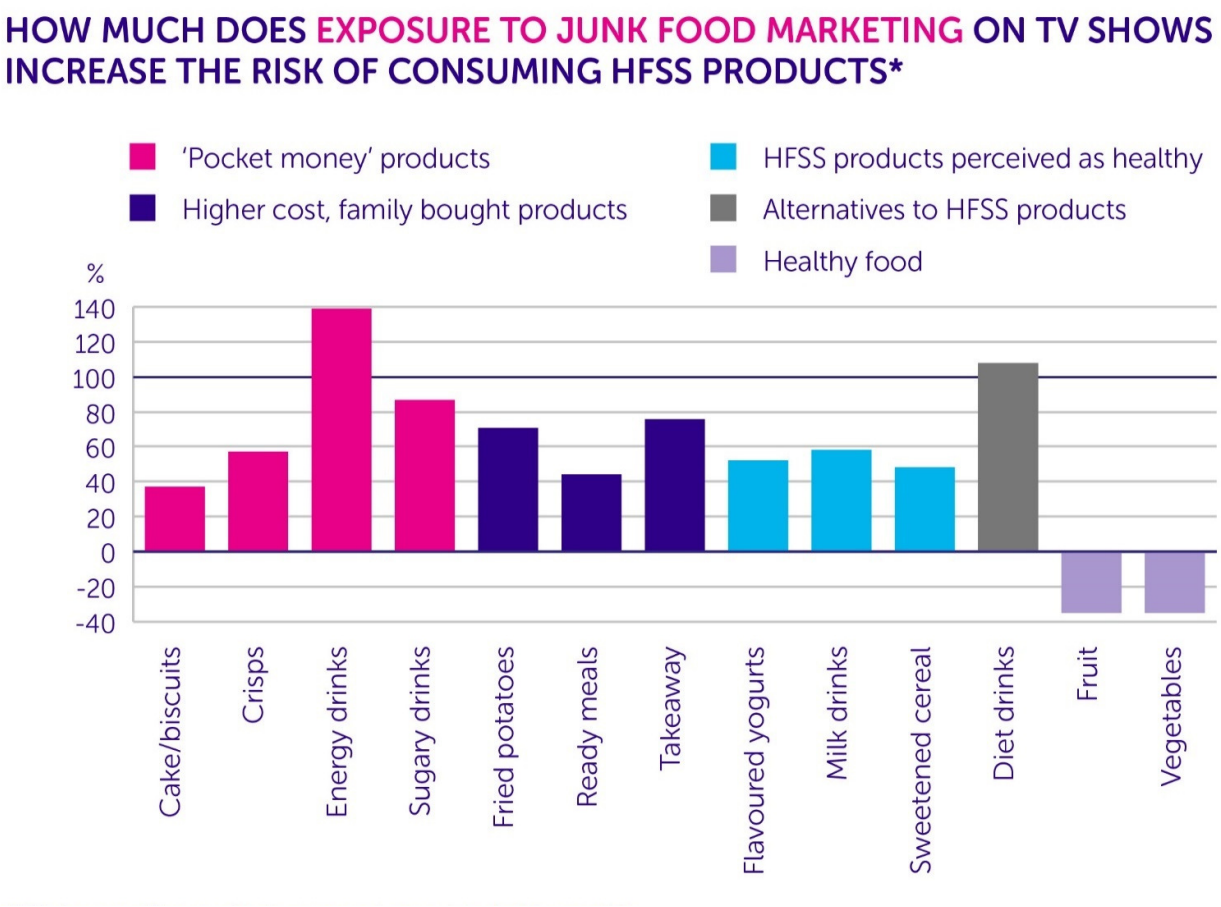


Figure 1: The percentage increased likelihood of consuming high amounts of a given food associated with each significant junk food category. This figure shows the maximum increased risk associated with high exposure to either on-demand or traditional TV content.

*Non-broadcast mediums had no consistent association with dietary choices in our tests.

INTRODUCTION

Obesity is the biggest preventable cause of cancer after smoking and is linked to around 18,100 cancer cases a year in the UK (5.5% of all cancer cases)[1], with the largest number of weight-linked cases in the UK being breast, bowel and womb[1] (*Figure 2*). Between 1998 and 2008, obesity in England almost doubled[3] and modelling studies estimate that if current trends of overweight and obesity continue, it could lead to a further 670,000 cancer cases by 2035[4]. The cost of this rise in obesity to the NHS would be an extra £2.5 billion/year[4].

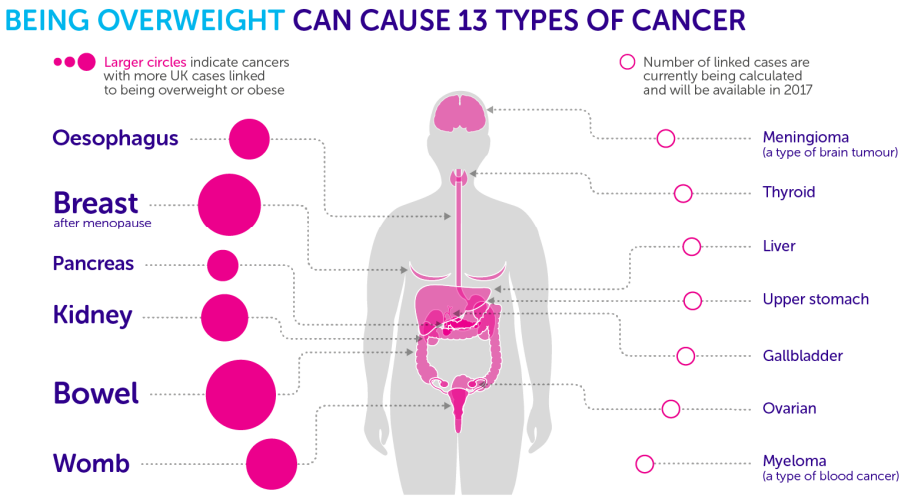


Figure 2: Obesity can cause 13 types of cancer, including breast, bowel and kidney cancer.

Children's obesity is a specific problem. Incidence is holding steady at a very high level amongst primary school leavers[5] and an obese child is five times more likely to become an obese adult[6]. This increases cancer and other health risks in the long term[19] and also risks psychological harm to the child[7]. There is no one reason that explains the rise in levels of obesity amongst young people. Research has pointed to numerous factors as diverse as genetics, increased consumption and lower levels of exercise[3,9-11,20]. However, factors which increase (unhealthy) food/drink consumption are the best explanations for the sharp rise in obesity rates over a short space of time.[8,10,12]

The link between television advertising of high fat, salt or sugar (HFSS) items and worse diet is clear. This is established by a body of research, including evidence reviews and meta-analyses, such as that undertaken by Boyland et al in 2015[21] and 2016[22]. Both concluded that health policy action on marketing was justified, with the more recent concluding that 'acute exposure to food advertising increases food intake in children…'. Equally, a large Australian survey by the National Secondary Students' Diet and Activity survey study team, showed a consistent link between marketing and diet amongst Australian adolescents[23]. From a global policy perspective, the World Health Assembly officially advocated for restrictions to the marketing of HFSS food and drink as a key policy in protecting children's health as recently as 2016[24].

In 2008, the UK reacted to this evidence by introducing broadcast regulations to prevent HFSS marketing during children's programming. A decade on, these regulations may be out of date.

One particular concern is that they do not account for current viewing habits: Ofcom figures show young people watch the most TV between 7:00-8:00pm, when family entertainment shows are common, regulation generally lightest[17], and the most HFSS adverts aired[18].

A comprehensive evidence base is needed to inform any changes to UK marketing policy and this report attempts to contribute to that. Firstly, we provide novel and new intelligence – no study we know of is based on a UK-wide survey of this scale. Secondly, there have been relatively few UK wide studies since final implementation of HFSS marketing regulations came into effect in 2008. Those that do exist have covered limit geographies[25] or used experimental designs harder to apply back to the UK's specific policy context[13,26-28]. These have high value in their own right – which will be all the stronger for the contextualised evidence offered here. Thirdly, though several studies have explored primary school age young people[13,28-35], less is known about how HFSS marketing effects adolescents above the age of 11. Finally, the role of streaming *and* television have not been fully assessed in any single study we know of. Evidence on these topics will enable better informed action to be taken.

RESEARCH AIMS

We aim to provide evidence to help explore:

- Whether marketing is linked to diet
- The extent and direction of that link
- An evidence base to support health policy across the UK

Our general hypothesis is that HFSS TV marketing is a clear and consistent risk factor for HFSS eating/drinking.

METHODOLOGY

The inspiration for the 'Youth Obesity Policy Survey' was derived from the Youth Tobacco Policy Survey. This is a repeat cross-sectional analysis which has been run by the Institute of Social Marketing, University of Stirling since 1999[36]. The tool monitors youth perceptions of tobacco over time, providing up to date intelligence to inform health policy and helping identify emerging trends. Our intention here is to benchmark diet and obesity in the UK, evaluate existing policies and use the repeat surveys to evaluate the effect of any new policies over time.

SCOPING STUDY

To establish the hypotheses for this study, a scoping study was commissioned by the Policy Research Centre for Cancer Prevention (PRCP). The scoping study used eight focus groups to explore the perceptions of marketing held by 11-19 year olds in England, Scotland and Wales. The results of the scoping study suggested that young people saw a high amount of advertising (particularly on television), found that advertising engaging, and perceived it as having a role in their food and drink preferences. Their descriptions of how advertising worked to influence their preferences – and which mediums were important – provided information needed to generate hypotheses for the current study.

SURVEY DEVELOPMENT

The survey was developed to cover six themes: exercise levels, consumption, screen time, recalled marketing exposure, perceptions of marketing and demographic factors. The survey was designed to be long enough to secure a rich dataset, but short enough to avoid problems arising from the attention span of our participants. The survey was delivered online, reducing the potential of social acceptability bias impacting answers.

In this study, diet and consumption, demographic factors and screen time were the focus. To help the accuracy of the survey instrument, validated questions were adapted and used wherever possible. Questions were adapted for our instrument from the following surveys: FLASHE[37] (family life activity sun health and eating study), the last three iterations of the Youth Tobacco Policy Survey, the National Secondary Students' Diet and Activity survey[38,39] (NASSDA) run in Australia, the National Diet and Nutrition Survey[40] (NDNS) run by Public Health England (PHE) and the University of Stirling's survey on brand engagement amongst young people[41]. Each of these was adapted in some way during cognitive interviews, or otherwise to ensure policy relevance, age appropriateness and cultural validity. The most relevant sources for this report were FLASHE (consumption questions) and NASSDA (screen time questions).

DATA COLLECTION

Data was collected using YouGov's in-house panel. To ensure that the study was representative of the UK, the sample was collected with reference to the UK's demographic makeup. Factors considered were geography, nationality, ethnicity, deprivation and age – and the make-up of the survey's sample is outlined in **Appendix 1**. The sample size for the survey was n = 3348. This offered sufficient numbers to produce analysis on some of the individual demographics included in the analysis.

DATA CODING

The survey asked consumption questions – covering healthy foods (fruit, vegetables) and unhealthy foods/drinks (12 items). Diet drinks were also included which, whilst not necessarily healthy, cannot be categorised as high in fat, salt or sugar. Unhealthy foods were considered any high in fat, salt or sugar, which is a definition used by Ofcom as the basis of broadcast regulations.

Dependent Variables: Consumption Habits

The variables were chosen in collaboration with policy experts, with reference to the research literature on unhealthy products and also with reference to the categories included by Public Health England in their sugar reduction programme[42]. A wide range of products were included in the model to ensure each added value. As such, foods and drinks were included from five different groups (*Table 1)*. These each offered different tests of our hypothesis, and are discussed individually in the results and discussion chapters of this report.

'Pocket money' products	**Higher price or family bought products**	**HFSS product perceived as healthy**	**Non-HFSS products**	
			Healthy options	**Alternatives to HFSS products**
Confectionery	Desserts	Flavoured Yogurts	Fruit	Diet carbonated drinks
Cakes/Biscuits	Takeaways	Milk drinks	Vegetable	
Sugary drinks	Ready Meals	Sugar Sweetened Cereals		
Energy drinks	Fried Potato Products			
Crisps				

Table 1: Variations in food and drink consumption items included in our survey sample

Food and drink consumption questions were asked using Likert scales, ranging from more than once a day to never. These were converted to binary variables. In similar studies that also use binary logistic regression, high and low were defined as consuming a given unhealthy item once a week or more (high) or less than once a week (low)[23]. However, based on the number of items tested, and the distribution of the results, products were split across two coding groups. The coding was based on the consumption distribution seen in data, consultation with academic and policy experts regarding 'high' or 'risky' consumption, and the total calorific content in each food. The final split is outlined in *Table 2* – with coding group 1 using 2+ portions consumed per week as high and coding group 2 using 1+ portion consumed per week as high.

Coding Group 1	Coding Group 2
Sugar Sweetened Drinks	Takeaways
Flavoured Yogurts	Ready Meals
Confectionery[1]	Energy Drinks
Cakes and/or biscuits	Fried Potato products
Fruit	Milk Drinks/milk shakes
Vegetables	Sugar sweetened cereals
Diet drinks	
Crisps	
Desserts	

Table 2: Categorisation of high and low consumption by food/drink product.

Independent Variable: Commercial Screen Time as a Proxy for Marketing Exposure

The independent variable was television marketing exposure. However, given the age group, it is difficult for a self-reported survey to obtain an accurate measure of number of adverts seen. As per previous studies, 'commercial TV time' was used as a proxy[23,43,44]. Participants were asked to list both the hours spent watching TV on the BBC (weekend and daytime) and on commercial channels (weekend and daytime). This study then focused in on the effect of commercial television, whilst using the 'non-commercial TV' variable to ensure factors such as the sedentary nature of television were controlled for in any model. However, after extensive testing, non-commercial-TV was not significant in any models and was subsequently removed from the final analysis.

On-demand streaming is a growing way for young people to watch TV, as seen in Ofcom's analysis of viewing figures[45]. It was considered important to explore the impact this had. The above method was used to distinguish advertised streaming from non-advertised streaming services. Again, non-advertised streaming was not significantly associated with risk of high HFSS consumption after extensive testing and was subsequently removed from the final analysis.

This left two independent variables – advert exposure (streaming) and advert exposure (live television). Coding was based on the distributions of the data and other research on the subject. Weekend and weekday viewing of television/streaming were weighted and turned into a weekly measure for each participant. This was then split into three categories: low (< 0.5 hours per day) medium (0.5 - 3 hours per day) and high (3 hours or more per day). A similar method has been successfully employed in an Australian study of screen time and diet[23].

Control Variables

Controls were selected based on theoretical importance to the model, to avoid any introduction of researcher bias and ensure our models were comparable. To establish theoretical importance, the literature was rapidly reviewed[14,16,39,44,46-51]. Age, gender, health awareness, devolved or not devolved nation, ethnicity and deprivation were chosen.

[1] Defined as chocolate and 'sweets' in this study.

DATA ANALYSIS

Descriptive analysis was undertaken to explore how much TV content young people saw. This allowed identification of whether HFSS marketing exposure was at potentially problematic levels. Television content was defined as a television show seen on TV or on streaming services. This was split by commercial and non-commercial content to allow comparison of the two, and better understanding of the role of advertising vs. sedentary activity.

Commercial screen time was calculated for average time spent streaming TV, average time spent watching TV and a combined average for both. This was further broken down by BMI - self-reported and coded as obese, overweight, healthy weight and underweight (as per IOTF coding guidelines) – to investigate the difference in the number of adverts being seen in different weight groups. A chi-squared test was used to establish any significant differences ($P < 0.05$) in commercial screen time between BMI groups.

To establish where HFSS adverts were, the survey included an item on the genres of television show young people saw them. The question allowed young people to tick the genres they felt most often carried HFSS marketing in their own experience. Admittedly, this relies on young people self-reporting, and does not control for the hours spent watching each genre respectively. However, the value of interest is where young people do see adverts – particularly, the adverts they remember later. As such, this question helps establish the causal mechanism by which adverts might impact on dietary choices, and help policy target the most problematic areas of marketing.

A binomial logistic regression model was developed to test for an association between screen time and dietary behaviours. This was run as 15 models - one for each dependent variable. Logistic regression was the most appropriate mode of analysis because the distribution of each consumption question often varied and conversion of these variables to a binary variable consistently corrected for skew. Equally, the study is specifically concerned with harmful levels of consumption, and this mode of analysis meant the model could best be aligned to the hypotheses the research was designed to test. Assumption testing further confirmed the suitability of this test.

To ensure that any positive results were not confounded by adverts leading a young person to consume one HFSS product *in place of another* (i.e. substituting HFSS products, with a net neutral effect on energy intake), a total HFSS consumption variable was also created. This used the ten significant dependent variables found through the individual models (above). This was converted to a binary variable based on the high and low consumption threshold of 1 item per week or less and 2 items per week or more. Over ten products, this equalled 10 items per week or less and 20 items per week or more – or at least 10 HFSS items extra each week. Tests were run for whether low TV advert consumers were more likely to eat a low amount of HFSS products and for whether high TV advert consumers were more likely to eat a high amount of HFSS products. This further allowed comparison of risk of high consumption between the two.

Scotland have recently begun development of a diet and obesity strategy. To provide policy context to that strategy, Scottish and English models were developed. This allowed comparisons and discussion of HFSS marketing in the two nations. The method for the models was the same as for the all-UK data analysis. Whilst sample sizes were sufficient for individual Wales and Northern Ireland models, their small sample sizes meant they lacked sufficient power for comparison to the English and Scottish models.

ETHICS

Ethical approval was granted in January 2017 for the study by the General University Ethics Panel (GUEP) at the University of Stirling. This covered both cognitive testing of the questionnaires and the online surveys. YouGov's in-house team also included a lead for ethical and quality assurance, to ensure coherence to best practice throughout testing and data collection. This included ensuring informed consent was obtained, post-survey signposting to support organisations and confidentiality of personal information.

RESULTS

1. COMMERCIAL SCREEN TIME AND LOCATION OF HFSS ADS

Splitting commercial TV seen by weight group (where commercial TV = hours/week streaming with adverts + hours/week watching commercial television) showed a downward gradient. Obese participants recorded 26 hours of screen time on average, which was significantly higher than that recorded by overweight (21 hours) and healthy weight (20 hours) participants ($p<0.001$) (*Figure 3*). This establishes that obese adolescents - on average –watch more commercial television and, thus, probably see more HFSS adverts[2]

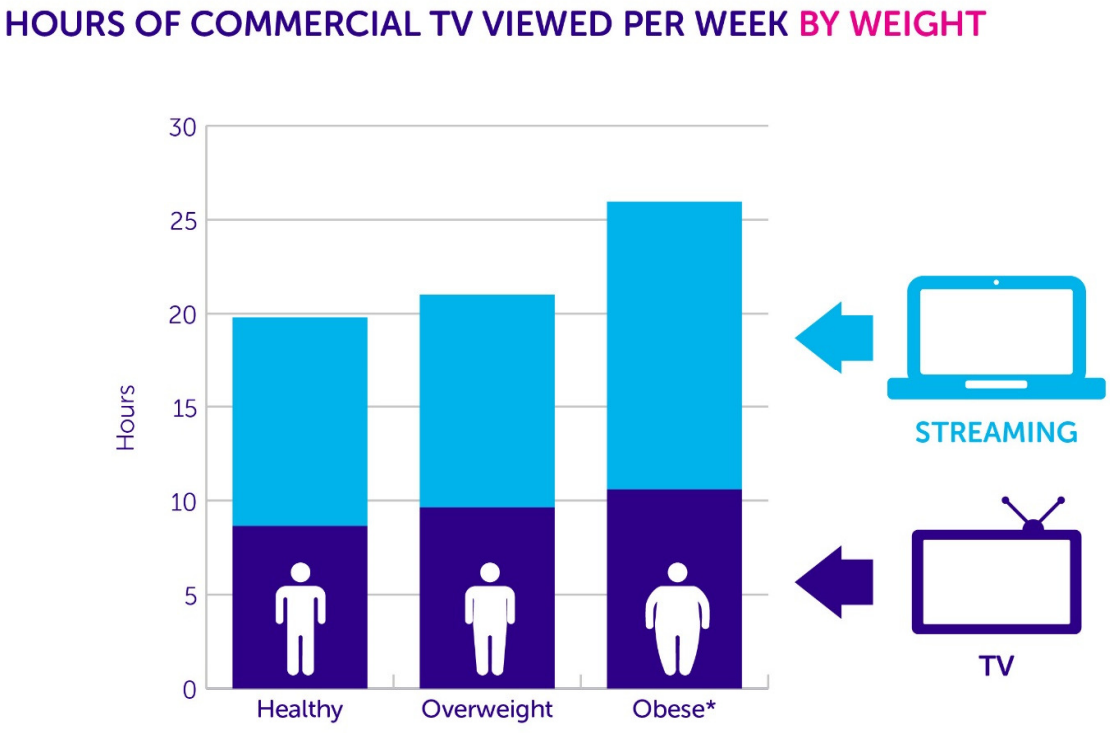


*Figure 3: Commercial TV Time per week by weight. * significant to P < 0.05*

[2] This was established as a suitable proxy for junk food marketing exposure by also testing for a link between non-commercial TV and unhealthy diet. There was no link, which ensures any effect here is not just due to TV being a sedentary activity. See the methodology chapter (above) for further detail and justification.

The survey tested associations between HFSS marketing and different genres of television shows to where HFSS marketing is being seen (*Figure 4).*

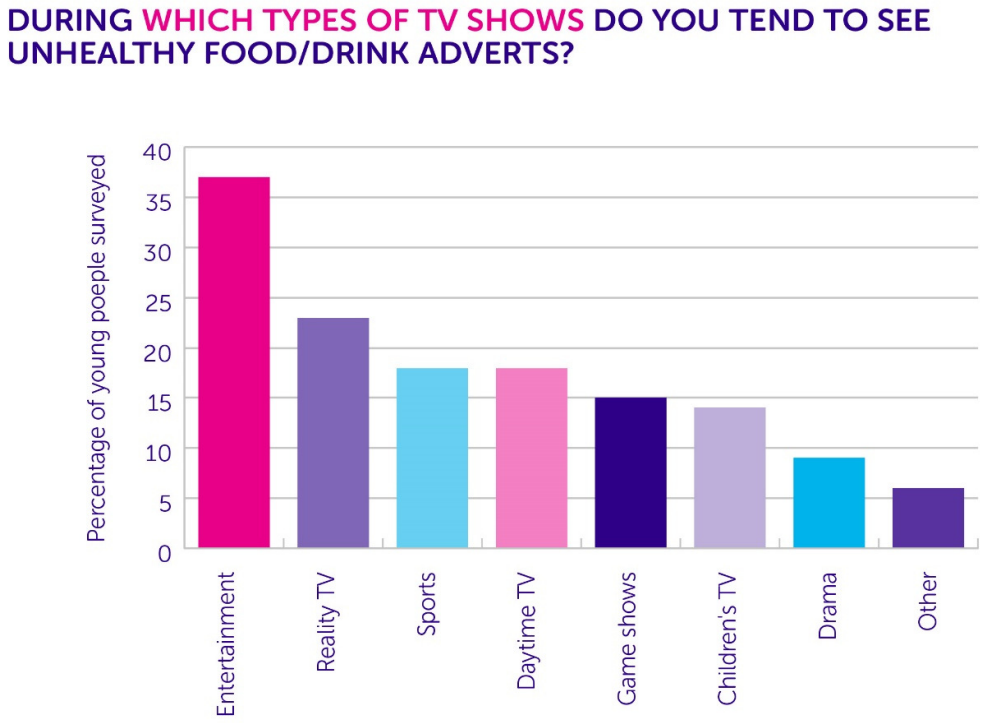


Figure 4: Responses from the question 'What genres of TV shows do you most often see junk food marketing on'.

Entertainment was the TV genre most often associated with junk food marketing – with 37% of young people giving it as their answer. Other evening, weekend or family viewing channels – such as Reality TV (23%), Sports (18%) and Daytime TV (18%) – were also associated by participants with junk food TV advertising.

2. MARKETING EXPOSURE AS A RISK FACTOR FOR HFSS CONSUMPTION

The results of the logistic regression show that increased marketing exposure is significantly associated with increased consumption of HFSS products (*table 3*). In *table 3* percentages represent the extra chance of eating a high amount of junk food compared to the low marketing exposure group. For example, high marketing exposure was associated with an 44% increased risk of high ready meal consumption (OR: 1.44, p = 0.013). Medium levels of marketing exposure was associated with an increased risk of 26% (OR: 1.26, p = 0.016)

Product	% Increased Risk Associated with Medium Marketing Exposure (Odds Ratio)	% Increased Risk Associated with High Marketing Exposure (Odds Ratio)
Cake/Biscuits	**+38%** (1.38)	**+37%** (1.37)
Fried Potatoes	**+73%** (1.73)	**+71%** (1.71)
Sugary Drinks	**+39%** (1.39)	**+87%** (1.87)
Crisps	**+64%** (1.64)	**+57%** (1.57)
Desserts	**+35%** (1.35)	*NS*
Diet Drinks	**+30%** (1.30)	**+75%** (1.75)
Energy Drinks	*NS*	**+94%** (1.94)
Flavoured Yogurts	**+49%** (1.49)	**+52%** (1.52)
Fruit	*NS*	**-27%** (0.73)
Milk Drinks	**+31%** (1.31)	**+58%** (1.58)
Ready Meals	**+26%** (1.26)	**+44%** (1.44)
Cereal	**+30%** (1.30)	**+48%** (1.48)
Confectionery	**+36%** (1.36)	*NS*
Takeaway	**+32%** (1.32)	**+76%** (1.76)
Vegetables	*NS*	*NS*

Table 3: The impact of medium and high television marketing exposure on risk of high consumption of 15 foods and drinks. NS indicates variables that were not significantly correlated to marketing (P < 0.05). Numbers in brackets are odds ratios.

These results show a consistent link between commercial television viewing – that is, both high and moderate HFSS advertising exposure – and the risk of unhealthy eating. The products in Table 3 can also be thought of in terms of five different types. These are lower price, more accessible 'pocket money' products; higher price, less accessible products; healthy products; alternatives to HFSS products (Diet drinks) and HFSS products often perceived to be healthy. Using a wide range of products – including healthy products – allowed for a better test of our hypothesis, and the results for each category are outlined in turn below. Results for total HFSS eating is also reported.

a. 'Pocket Money' Products

High television viewing was associated with increased risk of consumption of four of the five cheap, accessible product types. These were cakes and biscuits, sugary drinks, crisps and energy drinks. In this instance, confectionery was not significantly correlated. Odds ratios ranged from 1.37 (cakes/biscuits, $p = 0.029$) to 1.94 (energy drinks, $p = 0.016$). Compared to low television viewing, medium television viewing was associated with increased risk of consumption of four of the five product types. These were cakes and biscuits, crisps, sugary drinks and confectionary. Odds ratios ranged from 1.36 (confectionary, $p = 0.001$) to 1.64 (crisps, $p < 0.001$).

b. Higher cost or family bought products

High consumption of these items was consistently associated with medium and high television use. Medium television use was associated with all four items tested, with odds ratios of 1.26 (ready meals $p = 0.013$) to 1.73 (fried potato products, $p < 0.000$). High television use was associated with three of the four items tested, with odds ratios of 1.44 (ready meals, $p = 0.016$) to 1.76 (takeaways, $p < 0.001$).

c. HFSS products often perceived to be healthy

Both medium and high levels of exposure to marketing were associated with increased risk of high consumption of products that might be perceived to be healthy despite their generally high fat, salt or sugar content. Odds ratios ranged from 1.30 (sweetened cereal, $p = 0.007$) to 1.49 (flavoured yogurts, $p < 0.001$) for the moderate advert exposure and 1.48 (cereal, $p = 0.008$) to 1.58 (Milk drinks, $p = 0.004$) for high advert exposure.

d. Healthy products and alternatives to HFSS products

High levels of marketing exposure were associated with a decreased chance of being a high fruit consumer (OR: 0.73, $p = 0.045$). Diet drinks were associated with an increased chance of consumption of 1.3 (medium advert exposure, $p = 0.009$) and 1.7 (high advert exposure $p < 0.000$) respectively.

e. Total consumption of HFSS products

Two total junk food consumption models were also run. One explored whether low TV viewers were associated with a greater chance of being in the low consumption group and the second explored whether high TV viewers were associated with a greater chance of being in the high consumption group. People with high advert exposure were around 2.7 times more likely to have high total HFSS consumption ($p < 0.000$). People with low exposure were around 2.6 times more likely to have low total HFSS consumption ($p < 0.000$). The difference between being a high consumer and a low consumer was at least 520 junk food products/year, which means advert exposure may have a substantial impact on a population level.

3. TELEVISION MARKETING: ENGLAND AND SCOTLAND

In England, high television marketing exposure was associated with an increased risk of high consumption of 7 out of 12 unhealthy food and drinks. These were fried potatoes, sugary drinks, crisps, energy drinks, milk drinks, ready meals and takeaways. Medium exposure was associated with 8 product types (*Table 4):*

Product	% Increased Risk Associated with Medium Marketing Exposure (Odds Ratio)	% Increased Risk Associated with High Marketing Exposure (Odds Ratio)
Cake/Biscuits	**+33%** (1.33)	NS
Fried Potatoes	**+63%** (1.63)	**+80%** (1.80)
Sugary Drinks	**+32%** (1.32)	**+84%** (1.84)
Crisps	**+60%** (1.60)	**+52%** (1.52)
Desserts	**+34%** (1.34)	NS
Diet Drinks	**+37%** (*1.37*)	**+70%** (1.70)
Energy Drinks	NS	**+118%** (2.18)
Flavored Yogurts	**+37%** (1.37)	NS
Fruit	*NS*	**-31%** (0.69)
Milk Drinks	**+32%** (*1.32*)	**+54%** (1.54)
Ready Meals	NS	**+40%** (1.40)
Cereal	NS	NS
Confectionery	**+27%** (*1.27*)	NS
Takeaway	NS	**+83%** (1.83)
Vegetables	NS	NS

Table 4: The risk of high consumption at different levels of TV marketing exposure in England only. NS indicates variables that were not significantly correlated to marketing (P < 0.05). Percentages show increased risk associated with that level of advertising exposure. Number in brackets are odds ratios.

In Scotland, marketing exposure was significantly associated with increased risk of high consumption for 6 food groups: cakes/biscuits, fried potatoes, flavoured yogurts, crisps, desserts and confectionary (*Table 5*). The Scottish odds ratios were much higher than those seen in England, indicating a higher risk of increased consumption of HFSS products. For example, the risk of flavoured yogurt consumption associated with high television marketing exposure in Scotland was 4.27 (p = 0.003) whilst in England it was not significant. At medium exposure levels, the Scottish odds ratio was 2.06 (p = 0.029) and the English odds ratio 1.37 (p = 0.015). Other odds ratios were consistently over 2.0 in Scotland, but generally under 2.0 in England.

Product	% Increased Risk Associated with Medium Marketing Exposure (Odds Ratio)	% Increased Risk Associated with High Marketing Exposure (Odds Ratio)
Cake/Biscuits	**+112%** (2.12)	NS
Fried Potatoes	**+121%** (2.21)	NS
Sugary Drinks	NS	NS
Crisps	**+84%** (1.84)	NS
Desserts	**+87%** (1.87)	NS
Diet Drinks	NS	NS
Energy Drinks	NS	NS
Flavored Yogurts	**+106%** (2.06)	**+327%** (4.27)
Fruit	NS	NS
Milk Drinks	NS	NS
Ready Meals	NS	NS
Cereal	NS	NS
Confectionery	**+88%** (1.88)	NS
Takeaway	NS	NS
Vegetables	NS	NS

Table 5: The effect of marketing exposure on consumption, using Scotland only data. NS indicates variables that were not significantly correlated to marketing ($P < 0.05$). Percentages show increased risk associated with that level of advertising exposure. Number in brackets are odds ratios.

4. STREAMING TELEVISION SHOWS 'ON-DEMAND'

Medium or high streaming use was associated with 6 of the 12 unhealthy foods and drinks tested in this analysis (*Table 6)*. These were fried potatoes, sugary drinks, energy drinks, milk drinks, ready meals and takeaways (high only). There was also an association between high marketing exposure through these mediums and a decreased chance of high fruit and vegetable consumption (0.65, p = 0.001; 0.65, p = 0.014 respectively).

Product	% Increased Risk Associated with Medium Marketing Exposure (Odds Ratio)	% Increased Risk Associated with High Marketing Exposure (Odds Ratio)
Cake/Biscuits	NS	NS
Fried Potatoes	**+27%** (1.27)	**+41%** (1.41)
Sugary Drinks	**+25%** *(1.25)*	**+55%** (1.55)
Crisps	NS	NS
Desserts	NS	NS
Diet Drinks	**+54%** (1.54)	**+108%** (2.08)
Energy Drinks	**+89%** (1.89)	**+139%** (2.39)
Flavoured Yogurts	NS	NS
Fruit	NS	**-35%** (0.65)
Milk Drinks	**+40%** (1.40)	**+36%** (1.36)
Ready Meals	**+26%** (1.26)	**+65%** (1.65)
Cereal	NS	NS
Confectionery	NS	NS
Takeaway	NS	**+50%** (1.50)
Vegetables	NS	**-35%** (0.65)

Table 6: The impact of medium and high exposure to streaming on risk of unhealthy diet. NS indicates variables that were not significantly correlated to marketing (P < 0.05). Percentages show increased risk associated with that level of advertising exposure. Number in brackets are odds ratios.

Streaming was also an element of the Scotland model. The results from England and Scotland models are compared in *table 7* below:

Product	% Increased Risk Associated with Medium Marketing Exposure in **England** (Odds Ratio)	% Increased Risk Associated with Medium Marketing Exposure in **Scotland** (Odds Ratio)	% Increased Risk Associated with High Marketing Exposure in **England** (Odds Ratio)	% Increased Risk Associated with High Marketing Exposure in **Scotland** (Odds Ratio)
Cake/Biscuits	NS	NS	NS	NS
Fried Potatoes	**+63%** (1.63)	NS	**+28%** (1.28)	**+156%** (2.56)
Sugary Drinks	**+61%** (1.61)	NS	**+28%** (*1.28*)	NS
Crisps	NS	NS	NS	NS
Desserts	NS	NS	NS	NS
Diet Drinks	**+44%** (1.44)	**+142%** (2.42)	**+111%** (2.11)	**+122%** (2.22)
Energy Drinks	**+127%** (2.27)	NS	**+74%** (1.74)	NS
Flavored Yogurts	NS	NS	NS	NS
Fruit	**-40%** (0.60)	NS	NS	NS
Milk Drinks	**+49%** (1.49)	NS	**+53%** (1.53)	NS
Ready Meals	**+62%** (1.62)	NS	**+29%** (1.29)	NS
Cereal	NS	NS	NS	NS
Confectionery	NS	NS	NS	NS
Takeaway	**+62%** (1.62)	NS	NS	NS
Vegetables	**-40%** (0.60)	NS	NS	NS

Table 7: Medium exposure to marketing via television streaming, as compared across England, Scotland and all devolved nations. NS indicates variables that were not significantly correlated to marketing (P < 0.05). Percentages show increased risk associated with that level of advertising exposure. Number in brackets are odds ratios.

Odds ratios in Scotland were higher in general. There was a 156% increased risk of fried potato consumption in Scotland associated with moderate streaming viewing, for example (p = 0.001). This is compared to a 63% associated risk in England (p = 0.001).

The figure below summarises the results run on the UK data by demonstrating the highest amount of risk of high consumption for each product type associated with advert exposure (*Figure 5)*. It includes both 'on-demand' and traditional television models.

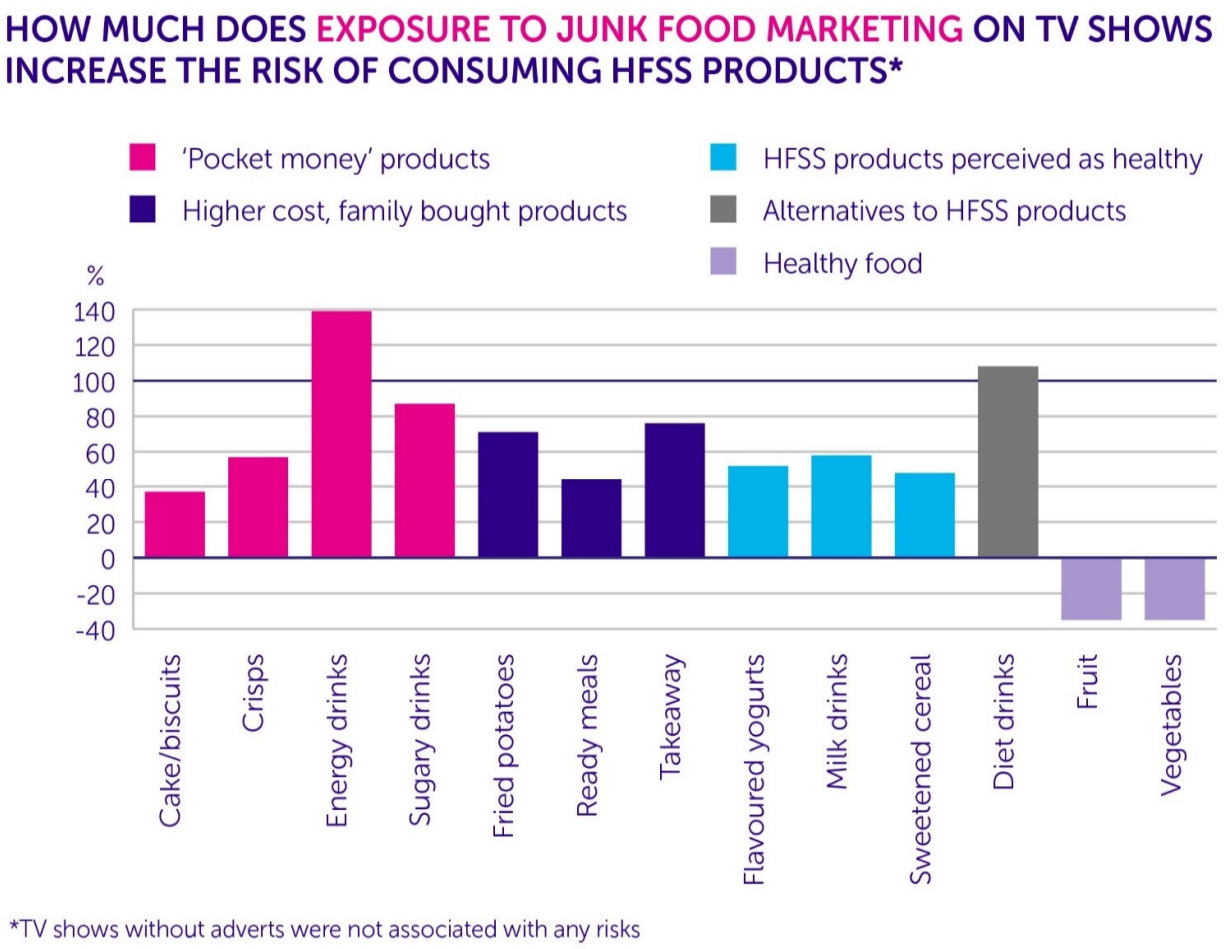


Figure 5: The increased risk associated with high advert exposure on traditional television shows. Only significant variables ($P < 0.05$) are shown. Percentages show increased risk associated with that level of advertising exposure. Number in brackets are odds ratios.

DISCUSSION

This report tests the link between television advertising and consumption of HFSS foods and beverages. Our hypothesis was that commercial television would be associated with poor diet and non-commercial television would not – indicating that HFSS marketing was a risk factor for HFSS eating/drinking. Our results support that hypothesis over a large range of products.

Given UK government policy attempts to control the exposure of children to HFSS marketing on television, it was important to first establish where HFSS marketing is being seen and how extensively. Our results showed commercial viewing time similar to figures reported by Ofcom[17]. Screen time average for all participants was 20 hours/week for healthy weight participants, 21 hours/week for participants with overweight and almost 26 hours/week for participants with obesity. Content analyses on the topic have both shown that HFSS adverts are significantly more common than other food adverts on TV; that HFSS adverts are more common on shows with large youth audiences; and are shown twice an hour on average[52] but up to nine times on shows with peak youth audiences[18]. The levels of commercial television viewed could subsequently represent large amounts of HFSS advertisements.

The existence of broadcast regulations in the UK makes it important to identify where HFSS might be slipping through - both to show where regulations might be ineffective, but also where they could be improved. Predominantly, HFSS ads were associated with family viewing shows, shown at evenings and weekends, such as sports, reality TV and entertainment shows. This is in-line with Ofcom's own viewing figures, which suggest young people watch TV the most between 7-8pm – when these shows are often broadcast[17]. Yet, they often remain outside the scope of junk food marketing broadcast regulations.

It was also notable that 15% of participants self-reported that they saw a high amount of HFSS marketing on children's TV. This is despite strict regulation of this type of programming by Ofcom. This might indicate that Ofcom's definitions of children's programming are narrower than those used/perceived by children – though more research would be necessary to make firm conclusions.

These descriptive figures are more meaningful if an association can be shown between advert exposure and HFSS product consumption. The lowest bar for our hypothesis to pass was a

statistically significant link to low price items, such as confectionery, biscuits, cakes and sugary drinks. There was a consistent association between high and moderate TV exposure and increased risk of high consumption of these items. Yet, there was also surprising consistency in the effect marketing had on higher price, less accessible items, such as takeaways, ready meals or frozen chips. These are products we would expect to be bought by a parent, or at least be less readily available to most of our survey's age range. This could indicate the kind of pester power shown by previous PRCP research[29]. Seemingly healthy but HFSS products were also linked to marketing exposure. Fruit consumption was inversely associated with marketing as consumption decreased with high advert exposure. This may be because fruit is advertised comparatively less than HFSS products, leading to those who see high numbers of adverts substituting it for unhealthy snacks, but more research is needed to reach a firm conclusion. This demonstrates a strong correlation between marketing and increases in consumption across an extraordinary range of HFSS products and supports the original hypothesis.

It could be possible that the increased risk associated with individual HFSS items is due to a 'substitution effect'. Put simply, this is where an advert convinces someone to replace one HFSS product with another – increasing consumption of that kind of product, but not overall calorific intake. A total HFSS consumption variable was created to test this further. It showed both that low TV viewers were less likely to eat HFSS food and that high TV viewers were more likely to eat HFSS food. This also allows comparison of consumption risk across group – substantiating the statement that high exposure groups are associated with higher risk of eating additional HFSS products than low exposure groups.

Two further interesting points emerge from our evidence. Firstly, moderate exposure to adverts were almost as extensive a risk factor as high exposure to adverts. This reiterates the need for strict scheduling restrictions to suitably protect young people. Secondly, adverts from 'on-demand' services were a clear and consistent risk for poor diet. This is a medium with a growing user base – especially amongst young people – and this heightens concerns about the impact marketing on television content might have on obesity overall.

Comparison of analyses of Scottish and England data also raises some interesting points. In England, there were generally more significant associations between HFSS product types and marketing exposure. However, the odds ratios in Scotland tended to be larger. To some extent, this is to be expected given Scotland had a smaller sample size, which is likely to increase p-values. Equally, it may show the more concentrated effect marketing has on a smaller, homogenous population. Further research would be useful to more fully account for the different impact junk food marketing has in the devolved nations.

The existing research on the link between obesity and foods consumed helps contextualise our findings – and show exactly what is at stake. High consumption of individual foods – including takeaways[53-55], sugary drinks[56,57] and confectionery items[58] - have been linked to increase BMI amongst children and young adults elsewhere. Other HFSS food types have not been studied. However, Public Health England have stated that they estimate adults are consuming 200-300 excess calories/day and that children are following suit. This shows that moderate energy increases can underpin weight gain. Should the policy goal remain reducing that consistent over eating, this research shows that marketing restrictions would be a pragmatic and effective way forward for UK government.

POLICY RECOMMENDATIONS

Our evidence shows problems with the stated intentions of current broadcast media regulations. Based on these problems, we feel several policy recommendations should be urgently adopted throughout the UK.

1. **HFSS marketing regulations are a decade old, out of date and should be tightened as soon as possible.** The most effective mechanism for this change would be a 9pm watershed, addressing the problem of family viewing on evenings and weekends. Less impactful measures could include strict scheduling restrictions or revisions to the audience index.
2. **Restrictions should apply to online on-demand services**. Streaming was shown to be as much of a risk factor as traditional TV. Where programmes are shown before 9pm, HFSS marketing restrictions should also apply to streaming services.
3. **There would be benefits in ensuring restrictions apply to a wider age-range of children**. Our research, which showed an association between marketing and dietary choices in young people nineteen and younger, suggests including a wider set of age ranges in marketing restrictions.

Data showed the impact in the UK, in England and in Scotland. It is likely true in Wales and Northern Ireland. This gives credence to action in Westminster to help health across the UK.

HFSS marketing restrictions alone will not tackle children's obesity and other measures will be needed. Regulations beyond broadcast media will likely be necessary. Nonetheless, this evidence indicates a pragmatic way forward for government policy to have a large positive impact of children's dietary choices and weight outcomes.

STRENGTHS/LIMITATIONS

This report has many strengths. It is the first report of its size and richness to be run since broadcast regulations were updated in 2008. Moreover, it builds on a large body of experimental literature with a UK-wide and heavily contextually relevant information, which make it uniquely well placed to inform policy.

A limitation is limited by its use of self-reported figures. This could lead to overestimations of screen time and underestimations of food consumption – beyond the problems typical with online survey methodologies. These problems are partially mitigated through the removal of extreme values in analysis and the use of distribution as one of the factors which helped define coding – mitigating any skews.

The cross-sectional nature of the report also means that causation cannot be established – however, the correlations shown are consistent enough to provide a strong addition to the evidence base. Finally, obesity is a complicated issue and influenced by an incredibly large amount of variables. These could not all be tested in this study, any will need to be the focus of future research/policy development on other obesogenic factors beyond marketing.

FURTHER RESEARCH

The Policy Research Centre for Cancer Prevention will be undertaking further research into deprivation, the link between marketing and weight, and the role of marketing engagement in diet. Current plans for reports in 2018 include explorations of:

1. The link between marketing more widely and diet
2. Marketing, obesity and common counter-arguments against regulations.
3. Marketing and health inequalities, build on the preliminary findings given here.

Further evidence exploring the idea of increasing the scope of the definition of child in the regulation to cover 19 year olds and below would be useful. Equally, evidence specific to Wales and Northern Ireland would be useful supplements to the analysis we have presented.

APPENDICES

1. SAMPLE DEMOGRAPHIC

	Variable Level	Percentage included in cohort
Men	Age 11 to 12	11.0%
	13 to 15	16.0%
	16 to 17	12.0%
	18 to 19	12.0%
Women	Age 11 to 12	10.0%
	13 to 15	16.0%
	16 to 17	11.0%
	18 to 19	12.0%
Ethnicity	White	82.0%
	BME	18.0%
IMD	1,2	20.0%
	3,4	20.0%
	5,6	20.0%
	7,8	20.0%
	9,10	20.0%
Region	North East	4.0%
	North West	11.1%
	Yorkshire & Humber	8.5%
	East Midlands	7.3%
	West Midlands	9.3%
	East	9.3%
	London	12.7%
	South East	14.0%
	South West	8.2%
	Wales	4.7%
	Scotland	7.8%
	Northern Ireland	3.1%

Table 8: Demographic makeup of the sample cohort.

2. REGRESSION TABLES

Due to the quantity of regression tables necessary in this research, they have not been included in full. 15 regression tables are available for each different model (all-UK, England, Scotland and devolved). Please email PRCP@cancer.org.uk for access.

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