

# A survey of sports drinks consumption among adolescents

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## IN BRIEF

- Quantifies the consumption of sports drinks by high school children.
- Confirms that consumption is high and not always associated with sports activity.
- Taste was viewed as the prime reason for consumption.
- Enhancement of sporting ability was not stated as a reason for use.
- The popularity of these palatable high sugar and acidic drinks has implications for children's oral health.

**Background** Sports drinks intended to improve performance and hydrate athletes taking part in endurance sport are being marketed to children, for whom these products are not intended. Popularity among children has grown exponentially. Wor- ryingly they consume them socially, as well as during physical activity. Sports drinks are high in sugar and are acidic. Product marketing ignores the potential harmful effects of dental caries and erosion. **Objective** To investigate the use of sports drinks by children. **Method** One hundred and eighty-three self-complete questionnaires were distributed to four schools in South Wales. Children in high school years 8 and 9 (aged 12–14) were recruited to take part. Questions focused on use of sports drinks, type consumed, frequency of and reason for consumption and where drinks were purchased. **Results** One hundred and sixty children responded (87% response rate): 89.4% (143) claimed to drink sports drinks, half drinking them at least twice a week. Lucozade Sport™ was the most popular brand. The main reason for consuming the drinks was attributed to the 'nice taste' (90%, 129/143). Most respondents purchased the drinks from local shops (80.4%, 115) or supermarkets (54.5%, 78). More boys claimed to drink sports drinks during physical activity (77.9% *versus* 48.6% girls,  $P < 0.001$ ). Whereas more girls claimed to drink them socially (51.4% *versus* 48.5% boys, NS). **Conclusion** A high proportion of children consumed sports drinks regularly and outside of sporting activity. Dental health professionals should be aware of the popularity of sports drinks with children when giving health education advice or designing health promotion initiatives.

## INTRODUCTION

Sports drinks have become more popular over recent years with the younger generation.<sup>1,2</sup> In the 1970s, marathon runners were discouraged from drinking any fluids as it was thought it would slow the runners down. But, now runners are being encouraged to 'drink ahead of thirst'<sup>3</sup> with the recognition that hydration is associated with performance. Sports drinks are designed to improve performance and hydrate elite adult athletes taking part in endurance and intense sporting events.<sup>4</sup> There is no evidence of beneficial effects in non-elite athletes or children.<sup>3</sup> However, these drinks are being consumed by the general population during physical activity and socially. It is the

latter which is the most cause for concern,<sup>5</sup> particularly among children aged under 16.<sup>3</sup>

The marketing of sports products has become a multibillion-dollar industry.<sup>6</sup> In 2014, the UK sports drinks market was worth £218 million and the core consumers were 15–24-year-olds.<sup>1</sup> However, the marketing campaigns ignore the detrimental impact sports drinks have on teeth and the effects they can have on general health. Certain marketing campaigns have even misled consumers into incorrectly concluding that the drinks contained no carbohydrates or additives.<sup>6</sup> In addition, studies have shown that while certain supplements in sports drinks can potentially improve performance, many have not been proven to be beneficial and some have harmful side-effects.<sup>6</sup>

If consumed socially and in large quantities, sports drinks can lead to serious problems, such as obesity, diabetes, heart disease and gout,<sup>7</sup> as well as poor oral health.<sup>4</sup> Studies in the past have shown that non-athletes are consuming these drinks simply because of their nice taste.<sup>2</sup>

Sports drinks contain both free sugars and acids,<sup>4</sup> hence these drinks have the ability

to cause both dental caries and erosion. There is a strong relationship between eating foods high in 'free' sugars and dental caries.<sup>8–11</sup> The term free sugars refers to all mono and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, fruit juices and syrups.<sup>12</sup> Many sports drinks have a pH below 5.5, the critical pH for the demineralisation of enamel, leading to erosion.<sup>13,14</sup> Dehydration associated with physical activity increases erosion risk, as the buffering capacity is inhibited due to lower salivary flow.<sup>4</sup> Dehydration also reduces clearance of acids and sugars from the tooth surface, affecting both erosion and caries.<sup>4</sup>

The frequency and duration of sports drinks consumption are also important factors impacting on dental health.<sup>15</sup> The general consensus is that the frequency and amount of sugary food and drinks should be reduced and, when consumed, limited to mealtimes.<sup>16</sup> Certain sports drinks, for example, Powerade zero™, are marketed as being sugar free. However, these drinks still have an acid content that can lead to erosion of enamel.<sup>13,14</sup>

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## Refereed Paper

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A study conducted in the dental clinic at the Olympic Park during the London 2012 Olympics assessed the general oral hygiene of 278 participating athletes.<sup>17</sup> The authors reported that 55% of the athletes treated had dental caries and 45% had dental erosion (as measured by the Basic Erosive Wear Examination). This is a much higher prevalence than the experience of 'tooth wear' recorded by the UK Adult Dental Health Survey in 2009<sup>18</sup> for similarly aged adults. While the Olympic athletes came from the five continents<sup>17</sup> the authors reported no significant difference in erosion by continental location or ethnicity. They also reported a link between the frequency of sports drinks use and dental erosion in anterior teeth.<sup>17</sup>

Recent surveys have shown that Wales has higher levels of decayed, missing and filled teeth (DMFT/dmft) when compared with other areas in the UK, especially in children. In 2013, 52% of children aged 12 in Wales had at least one DMFT in their adult teeth compared with 32% in England.<sup>19</sup> Of concern are the wide inequalities in experience, with children from more deprived areas experiencing higher levels of dental disease.<sup>19,20</sup>

There is confusion over the difference between energy and sports drinks. An energy drink is marketed for its mental stimulant effect and contains high levels of substances such as caffeine, taurine and glucuronolactone.<sup>21</sup> Sports drinks do not have a stimulant effect, but concentrate on providing carbohydrates, salts and hydration.<sup>21,22</sup> For the purpose of this study, the participants were not told what constitutes a sports or energy drink, as their knowledge of sports drinks was also being tested.

According to Mintel (2014), 78% of UK 16-24-year-olds have reported consuming a sports drink in the last 12 months, with 39% drinking them at least once per week.<sup>1</sup> From 1989-2008, the percentage of American children aged 6 to 11 consuming sports drinks increased significantly, from 2% to 12%. The amount of sports drinks consumed by these American children also increased, from 255 millilitres per day to 289 millilitres per day during the same timeframe.<sup>2</sup>

All school meal policies in the devolved countries of the UK have banned the sale of fizzy/sugary drinks other than fruit juices diluted with carbonated water.<sup>23-26</sup> Therefore students are accessing sports drinks from outside the school gates.

Few studies have investigated the use of sports drinks in children, their knowledge about the product and the impact they may have on their oral health. The aim of this study was to investigate the use of and knowledge surrounding sports drinks by 12-14-year-old school children in South

Wales, UK. This paper reports on consumption aspects only; the knowledge component is reported separately.

## METHOD

This study consisted of a questionnaire survey of 12-14-year-old school children recruited from a convenience sample of four secondary schools in South Wales. Schools were selected to reflect the range of deprivation experienced within the area (according to the Welsh Index of Multiple Deprivation, WIMD 2011<sup>27</sup>). School A was a private school; School B a comprehensive school, whose catchment area draws from the most deprived areas in Wales; Schools C and D were also comprehensive schools, but their catchment area drew from a more mixed demographic.<sup>27</sup> Furthermore schools C and D provided male and female education on separate sites.

Prior to the commencement of this study ethical approval was gained from the Dental School Research Ethics Committee at Cardiff University.

A focus group of eight adolescents (aged 12-16) was undertaken to inform the questionnaire design. Participants were informally asked whether they drank sports drinks and why?

With information gained from the focus group, a self-complete anonymous questionnaire was designed containing mainly closed questions, allowing categories to be analysed efficiently and with minimum bias.<sup>28</sup>

Questions reported in this paper were designed to assess:

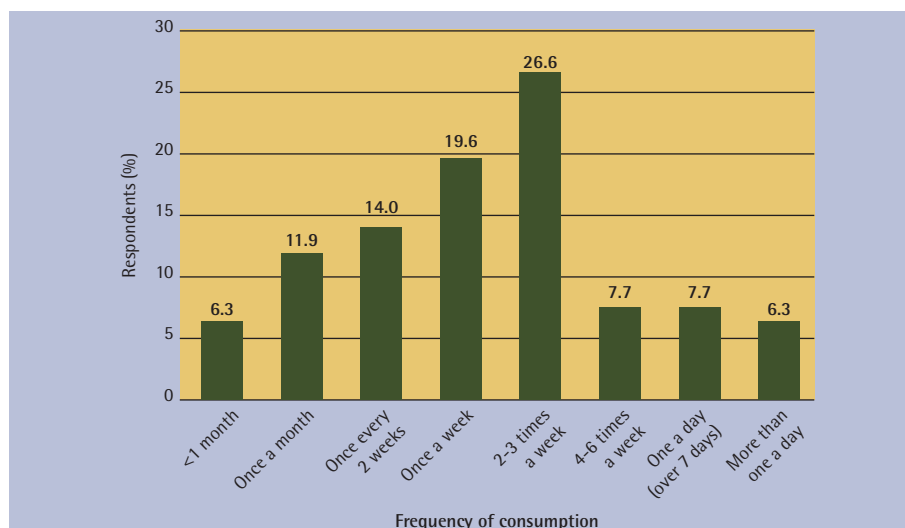
1. whether respondents consume sports drinks and if so how often and what types?
2. where and when respondents purchase and consume sports drinks?
3. why respondents consume sports drinks?

Children from school years 8 (12-13 years old) and 9 (13-14 years old) were invited to take part in the study from each of the selected schools. Headmasters from each school were asked to nominate one class

**Table 1** Location and participation by school and year group

School	Location	Number of respondents			
		Year 8		Year 9	
		Total number in class	Number taking part	Total number in class	Number taking part
A	Cardiff	20	0	13	12 (7M, 5F)
C	Rhondda Cynon Taf	21	21 (21M)	18	18 (18M)
B	Rhondda Cynon Taf	30	30 (15M, 14F, 1 MV)	30	30 (15M, 15F)
D	Rhondda Cynon Taf	25	25 (25F)	26	24 (24F)
Total number of respondents		96	76	87	84

\*M – male, F – female, MV – missing value



**Fig. 1** Reported frequency of sports drinks consumption, for the 143 respondents who reported drinking them

per school year to take part. A combination of school consent, parental negative consent and child assent was used in this study. Respondents were told that participation was voluntary before they completed the questionnaire. One researcher (DB) was present at each school to distribute and collect the questionnaires and also to answer any questions about the project.

The data were analysed using appropriate descriptive and inferential statistics, such as frequency distributions and chi-squared test for categorical variations (with an alpha value of 0.05 accepted as significant). Statistical analysis was performed with IBM SPSS Statistics (Version 20) software.

## RESULTS

Demographic details of the schools and the number of participants from each school and year are presented in Table 1. One hundred and eighty-three questionnaires were distributed among the four schools. In total, 160 respondents completed the survey (87% response rate); one Year 8 class from school A was unable to take part because of the timing for exams coinciding with data collection. The majority, 89.4% (143/160), of respondents claimed to drink sports drinks. The analyses below relate to the responses from those ( $n = 143$ ) who claimed to drink sports drinks.

### Consumption of sports drinks, frequency and type

Almost half of these respondents drank sports drinks more than once a week (48.3%, 69); 14% (20) drinking one or more every day. The modal consumption frequency was two to three times a week (Fig. 1).

Respondents were asked to indicate which of the four bestselling UK sports drinks (Lucozade Sport™, Powerade™, Gatorade™, LSV®) they consumed and an 'other' category was also provided. The most popular drink was Lucozade Sport™ (88.8%, 127) while Gatorade™ was the least popular (9.8%, 14, Figure 2).

All but one response to the 'Other' category were 'energy' drinks, not marketed as 'sports' drinks. These energy drinks were Relentless®, Monster®, Red Bull®, Power-up™, Original Energy Drink, Rockstar Energy drink™, Emerge, No Fear™ and Boost energy drink. The only 'other' sports drink was an unbranded isotonic drink.

### Location of purchase

The purchase locations for the sports drinks are presented in Figure 3; there were 242 locations mentioned by 143 respondents who reported drinking them, allowing multiple purchase location responses.

Most of the sports drinks were being purchased in local shops, with 115 (80.4%) of respondents. Supermarkets were also popular with 78 mentions, which equated to 54.5% of respondents. The four mentions of 'Other' were; bakery, Home Bargains, Spar and Lidl.

### Context of consumption

Respondents were asked in which situation they drank sports drinks, limited to five categories which were isolated during the focus group discussion (Fig. 4).

There was a clear gender difference; far more boys than girls consumed sports drinks during physical activity and at meal times (Fig. 4). One respondent failed to state their gender on the questionnaire resulting in  $n = 142$  for this analysis. The majority of boys (77.9%, 53 respondents out of 68) reported drinking these products during physical activity compared with only 48.6% (36 respondents out of 74) of girls ( $P < 0.001$ ). However, more girls drank sports drinks at home (41.9% of girls compared with 32.4% of boys) and socially (51.4% of

girls compared to 48.5% of boys); neither of these results were statistically significant ( $P > 0.05$ ). These results reflect responses to respondents' participation in sport. Results showed that 86.8% (59/68) of male respondents participated in sport compared with 71.6% (53/74) of female respondents.

### Reasons for consuming sports drinks

The most popular reason for consuming sports drinks was the taste of the product (90.2% 129/143). Energy and hydration were reasons given by 47.6% (68/143) and 23.1% (33/143) of respondents respectively. The fact that sports drinks enhance performance was only stated by 18.2% (26/143) as a reason for consumption (Fig. 5).

Approximately one third (32.9%, 47/143) of respondents stated price as a reason for purchasing sports drinks (Fig. 5). When questioned how much they would spend, the majority would spend between 50p and £1 for a sports drink (55.9% of respondents), whereas 38.5% would pay over £1 for a sports drink.

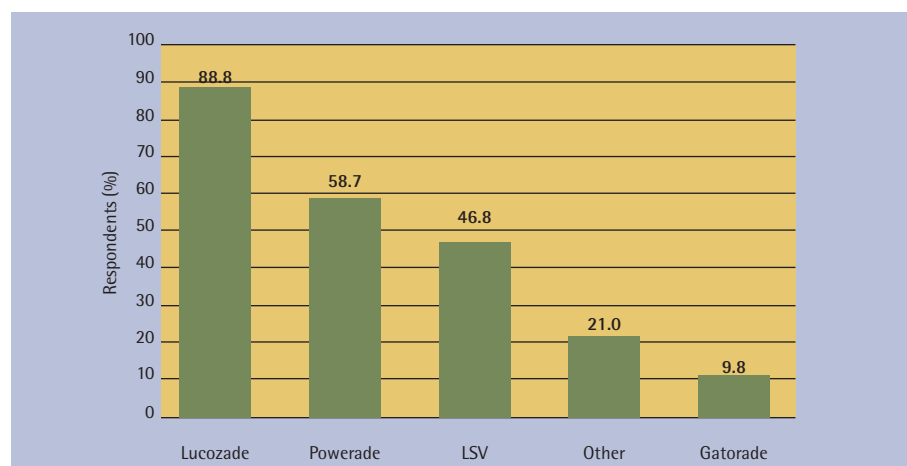


Fig. 2 Drink type consumed, by the 143 respondents who reported drinking them (respondents could report drinking more than one type)

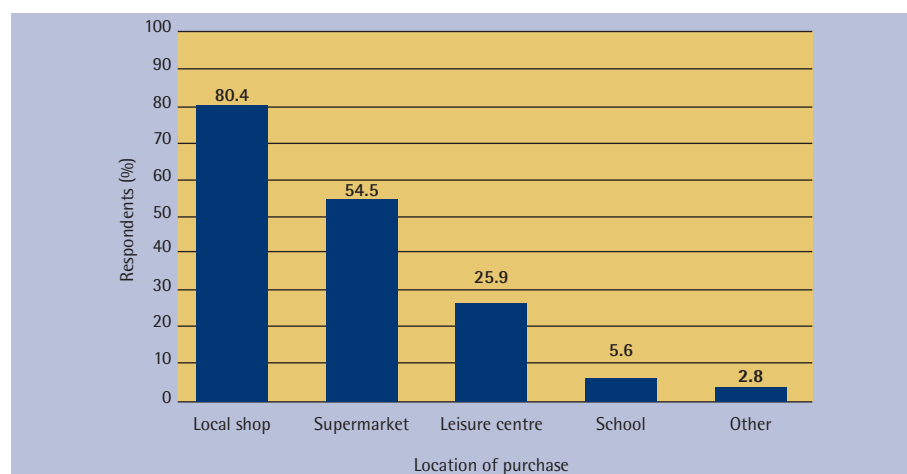


Fig. 3 Location of purchase, identified by the 143 respondents who reported drinking sports drinks (respondents could report more than one location)

## DISCUSSION

The results obtained indicate that a high proportion of adolescents in South Wales are consuming sports drinks.

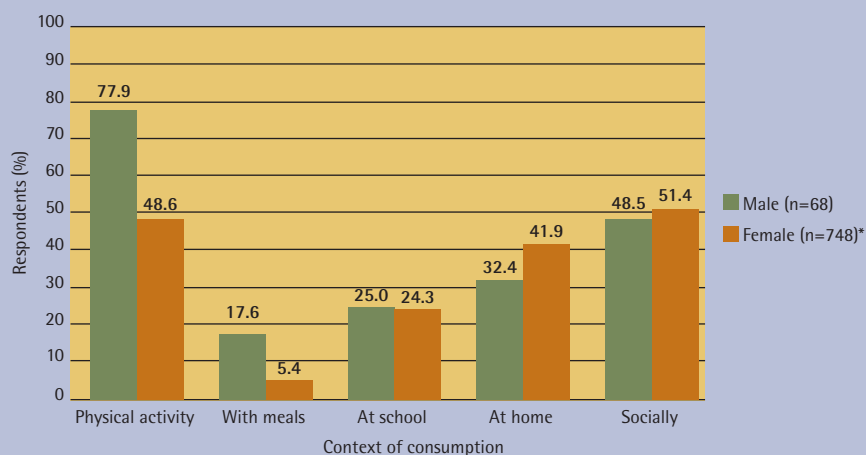
The reported prevalence of sports drinks consumption for 12–14-year-olds participating in this study was high at 89%, with 68% of these children drinking them regularly (1–7 times a week). Both the prevalence and the frequency of consumption in this age group appear to have increased in recent years.<sup>29,30</sup>

In the late 1990s a study of 418 14-year-old secondary school children in Birmingham, recorded a prevalence of 44%, with 77% of these consuming sports drinks 1–7 times per week.<sup>29</sup> While a larger UK study in the North West of England, of 2,385 14-year-old children in 1999, reported 81% drinking sports drinks occasionally or regularly.<sup>30</sup>

Mintel market analysis data (52 weeks ending 1 March 2014) indicated that Lucozade™ represents 63% of the sports drink market, followed by Powerade™ taking 14% and own label and others taking 23%.<sup>1</sup> This was reflected by the younger population of this study where Lucozade™ and Powerade™ predominated. However, just under half of the sample reported drinking LSV® which was not separately identified by the Mintel data – this may be a reflection of the fact that LSV® is labelled as an Energy Drink but marketed as ‘a functional beverage, specially developed for periods of increased mental and physical exertion.’<sup>31</sup>

When questioned why they drink sports drinks, 90% claimed the taste was a factor where only 18% of the respondents claimed it was due to the performance enhancing effect. This mirrors findings of the US Healthy Eating Research Review in 2012<sup>2</sup> and Food Standards Australia New Zealand in 2010,<sup>32</sup> which found people were consuming these drinks simply because they tasted nice. Taste of these sports drinks was the primary factor given by this group of 12–14-year-olds and appears to be the main reason why they appeal to younger consumers. Improvements in physical performance was given as a reason for drinking by a minority of participants, even though over 71.6% of girls and 86.8% of boys in this study claimed to be taking part in exercise.

The results also showed that about a half of the respondents who drink sports drinks claim to drink them socially. This is likely to be linked to the fact that consumer independence is well developed and also the fact that the influence of peers (while socialising) is particularly strong for this age-group.<sup>33</sup> This has implications for dental and wider public health, in terms of dental caries, dental erosion and obesity.



			When					
			Physical activity	Meal time	School	Home	Socially	Total
Gender	Male	Count	53	12	17	22	33	68
		% within gender	77.9	17.6	25.0	32.4	48.5	
	Female	Count	36	4	18	31	38	74
		% within gender	48.6	5.4	24.3	41.9	51.4	
Total		Count	89	16	35	53	71	140

Percentages and totals are based on respondents  
\*1 missing value for gender

Fig. 4 Context of consumption, identified by the 142\* respondents who reported drinking sports drinks (respondents could report drinking in more than one context)

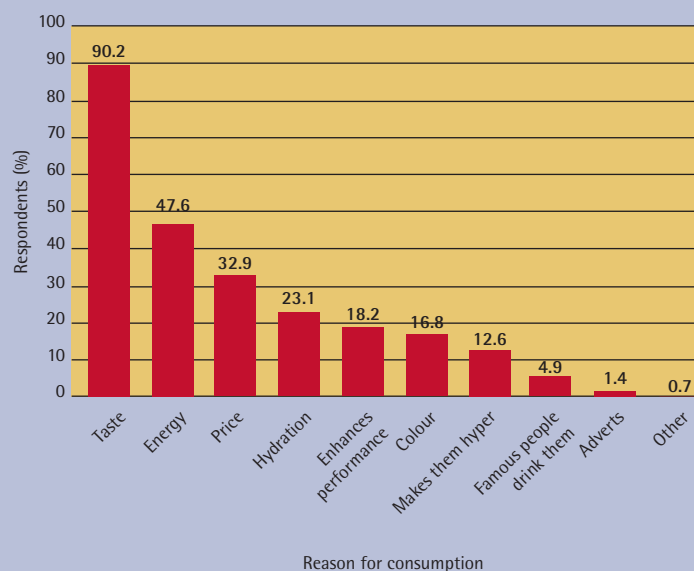


Fig. 5 Reason for consumption, identified by the 143 respondents who reported drinking sports drinks (respondents could report more than one reason)

Most of the children (80%) purchased sports drinks in local shops, once again highlighting the influence of stores surrounding the school fringe in the availability of ‘less healthy’ foods and beverages, including sports drinks – often available at value prices.<sup>34,35</sup> Indeed, price itself was the third most recorded reason for purchase. Of concern, 26% and 6% of children cited

leisure centres and schools as purchase sources. In the UK in recent years holistic food and health policies<sup>35,36</sup> have come to the fore, where local government, health and third sector agencies work together to address food, health and exercise. These can involve whole school approaches to food and health and the promotion of healthier choices in leisure centres.<sup>37</sup> However, these



findings appear to suggest that there is room for improvement, similar to experiences in other parts of the UK.<sup>38</sup>

While the majority of participants claimed to drink sports drinks, it became apparent that there was some confusion over the definition of a sports drink versus an energy drink. However, from a dental and wider health perspective these two drinks types have similar detrimental effects due to their high free sugar (unless sugar free) content and low pH.

In supermarkets and local shops, sports drinks are sold alongside other sugar sweetened beverages. This could indicate to children and parents that they are meant for use by everyone. Where these drinks are sold in shops should be re-assessed, so as to ensure people do not misunderstand the purpose of the product. The prices of these drinks also needs to be considered; the recent lobby by Public Health England<sup>39</sup> and others for a sugar tax on sugar sweetened beverages was successful in March 2016.<sup>40</sup>

The fact that sports drinks are so popular with children because of their sweet taste as opposed to reasons associated with sport (which are tenuous) should add weight to the case for an excise duty on sweetened beverages incorporating sports drinks.

## CONCLUSION

A high proportion of children consumed sports drinks regularly and outside of sporting activity. Dental health professionals should be aware of the popularity of sports drinks with children when giving health education advice or designing health promotion initiatives.

- Mintel. *Sports and energy drinks – Executive Summary: UK*. Mintel Group Ltd: London, 2014
- Healthy Eating Research. *Consumption of sports drinks by children and adolescents*. 2012. Available online at <http://healthyeatingresearch.org/wp-content/uploads/2013/12/HER-Sports-Drinks-Research-Review-6-2012.pdf> (accessed September 2015).
- Cohen D. The truth about sports drinks. *BMJ* 2012; **345**: e4737.
- Noble W, Donovan T, Geissberger M. Sports drinks and dental erosion. *CDA Journal* 2011; **39**: 233–238.
- Schnieder M B, Benjamin H J. Sports drinks and energy drinks for children and adolescents: are they appropriate? *Paediatrics* 2011; **127**: 1182–1189.
- Heneghan C, Howick J, O'Neill B *et al*. The evidence underpinning sports performance products: a systematic assessment. *BMJ* 2012; **2**: e001702.
- Department of Nutrition at Harvard School of Public Health. *Sugary Drinks and Obesity Fact Sheet*. 2012. Online information available at <http://www.hsph.harvard.edu/nutritionsource/sugary%20drinks%20fact-sheet/> (accessed October 2012).
- Burt B A, Pai S. Sugar consumption and caries risk: A systematic review. *J Dent Educ* 2001; **65**: 1017–1023.
- Harris R, Nicoll A, Adair P, Pine C. Risk factors for dental caries in young children: a systematic review of the literature. *CDH* 2004; **215**: 71–85.
- Ruxton C H, Gardner E J, McNulty H M. Is sugar consumption detrimental to health? A review of the evidence 1995–2006. *Crit Rev Food Sci Nutr* 2010; **50**: 1–19.
- World Sugar Research Organization. *Sugar and dental caries*. 2011. Available online at <http://www.wsro.org/Portals/12/Docs/position-statement-sugar-and-dental-caries-2011-11.pdf> (accessed October 2012).
- Scientific Advisory Committee on Nutrition. *Carbohydrates and Health*. TSO: London, 2015
- Sirimaharaj V, Brearley Messer L, Morgan M V. Acidic diet and dental erosion among athletes. *Aust Dent J* 2002; **47**: 228–236.
- Rees J, Loyn T, McAndrew R. The acidic and erosive potential of five sports drinks. *Eur J Prosthodont Restor Dent* 2005; **13**: 186–190.
- Burt B A, Eklund S A, Morgan K J *et al*. The effects of sugars intake and frequency of ingestion on dental caries increment in a three-year longitudinal study. *J Dent Res* 1988; **67**: 1422–1429.
- Moynihan P J, Kelly S A M. Effect on Caries of restricting sugar intake: systematic review to inform WHO guidelines. *J Dent Res* 2013; **93**: 8–18.
- Needleman I, Ashley P, Petrie A *et al*. Oral health and impact on performance of athletes participating in the London 2012 Olympic Games: a cross-sectional study. *Br J Sports Med* 2013; **47**: 1054–8.
- White D, Pitts N, Steele J, Sadler K, Chadwick B. *Disease and related disorders – a report from the Adult Dental Health Survey 2009*. The Health and Social Care Information Centre: London, 2011.
- Pitts N, Chadwick B, Anderson T. *Children's Dental Health Survey 2013. Report 2: Dental Disease and Damage in Children, England, Wales and Northern Ireland*. The Health and Social Care Information Centre: London, 2015.
- Watt R G, Listl S, Peres M, Heilmann A. *Social inequalities in oral health: from evidence to action*. International Centre for Oral Health Inequalities Research & Policy. 2015. Available online at [http://media.news.health.ufl.edu/misc/cod-oralhealth/docs/posts\\_frontpage/SocialInequalities.pdf](http://media.news.health.ufl.edu/misc/cod-oralhealth/docs/posts_frontpage/SocialInequalities.pdf) (accessed September 2015).
- British Soft Drinks Association. *Code of practice on high caffeine soft drinks*. Available online at [http://www.britishtsoftdrinks.com/write/MediaUploads/Soft%20Drinks/130924\\_high\\_caffeine\\_soft\\_drinks.pdf](http://www.britishtsoftdrinks.com/write/MediaUploads/Soft%20Drinks/130924_high_caffeine_soft_drinks.pdf) (accessed October 2013).
- International Olympic Committee Report. *Sports or energy drinks?* 2002. Available online at [http://www.olympic.org/Documents/Reports/EN/en\\_report\\_539.pdf](http://www.olympic.org/Documents/Reports/EN/en_report_539.pdf) (accessed October 2012).
- Scottish Executive. *Hungry for success: a whole school approach to school meals in Scotland*. Edinburgh: Scottish Executive, 2002.
- School Meals Review Panel. *Turning the tables: transforming school food*. London: Department for Education and Skills, 2005.
- Welsh Assembly Government. *Appetite for life action plan*. 2008. Available online at <http://new.wales.gov.uk/dcells/publications/publications/guidanceandinformation/apetiteforlife/apetiteforlifeactionplan.pdf?lang=en> (accessed September 2015).
- Health Promotion Agency for Northern Ireland School Food: *Top marks! Initiative*. 2009. Available online at [http://www.healthpromotionagency.org.uk/work/Publicrelations/PressReleases/school\\_food\\_09.html](http://www.healthpromotionagency.org.uk/work/Publicrelations/PressReleases/school_food_09.html) (accessed September 2015).
- Cardiff University School of Dentistry. *Welsh index of multiple deprivation*. 2011. Online information available at <http://wales.gov.uk/statistics-and-research/welsh-index-multiple-deprivation/?lang=en> (accessed October 2013).
- Babbie E R. *The practice of social research*. 10th Edition. California: Belmont, 2004.
- Al-Daigan Y H, Shaw L, Smith A. Dental erosion in a group of British 14-year-old school children Part II: Influence of dietary intake. *BDJ* 2001; **190**: 258–261.
- Milosevic A, Bardsley P F, Taylor S. Epidemiological studies of tooth wear and dental erosion in 14-year old children in North West England. Part 2: The association of diet and habits. *BDJ* 2004; **197**: 479–483.
- LSV, 2015. *What are the effects of LSV® Energy drink?* Available online at [http://54chd3v4.wix.com/lsv#!\\_page-1](http://54chd3v4.wix.com/lsv#!_page-1) (accessed October 2013).
- Food Standards Australia New Zealand. *Consumer research investigating the use of formulated supplementary sports foods*. 2010. Available online at <http://www.foodstandards.gov.au/publications/Pages/Consumer-research-investigating-the-use-of-sports-foods.aspx> (accessed August 2015).
- World Health Organization. *Nutrition in adolescence: issues and challenges for the health sector: issues in adolescent health and development*. 2005. Available online at [http://apps.who.int/iris/bitstream/10665/43342/1/9241593660\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/43342/1/9241593660_eng.pdf) accessed 11th September 2015 (accessed September 2015).
- Sinclair S, Winkler J T. *The School Fringe: what pupils buy and eat from shops surrounding secondary schools*. Nutrition Policy Unit, London Metropolitan University, 2008.
- Caraher M, Lloyd S, Madelin T. The "School Food-shed": schools and fast-food outlets in a London borough. *BFJ* 2014; **116**: 472–493.
- Fairchild R M, Morgan M Z. Delivering multi-disciplinary public health in action – the Cardiff food strategy case study. *Public Health Nutr* 2007; **10**: 42–48.
- Cardiff Health Alliance. *Cardiff Food and Health Strategy*. Cardiff Health Alliance: Cardiff, 2006. Available online at <http://www.physicalactivityandnutritionwales.org.uk/Documents/740/Cardiff%20Food%20and%20Health%20Strategy.pdf> (accessed September 2015).
- Ennis K, Holt A, Cheater S. Sugar sweetened beverages availability and purchasing behaviour within the school fringe. *Int J Health Prom Educ* 2014; **52**: 300–312.
- Public Health England. *Sugar reduction: the evidence for action*. 2015. Available online at [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/470179/Sugar\\_reduction\\_The\\_evidence\\_for\\_action.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/470179/Sugar_reduction_The_evidence_for_action.pdf) (accessed 21 April 2016).
- Lord's Hansard text for 03 February 2016. Column 1791–1793. Available online at <http://www.publications.parliament.uk/pa/ld201516/ldhansrd/text/160203-0001.htm> (accessed April 2016).