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Fact or fiction

Carson, Susan J.; Freeman, Ruth

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Susan Carson

Ruth Freeman

Fact or Fiction: Does a Relationship Exist between Free Sugars, Dental Caries and Body Weight?

Abstract: This article is about dental caries and body weight. It will provide the reader with an overview of the complexity in the relationship between these and suggest the implications of taking a public health approach when addressing them within a primary dental care setting.

Clinical Relevance: To provide dental care professionals with an update on the available evidence surrounding the relationship between free sugar, dental caries and body weight.

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The amount of sugar we consume in our diet and the resulting health effects has received extensive coverage in the media in recent months. Excess consumption of added sugars is a recognized contributor to the development of a number of chronic conditions and diet-related diseases including obesity, type 2 diabetes and dental caries. Health professionals, including dentists, are encouraged to make use of a common risk factor approach¹ to prevent such diet-related diseases. In simple terms,

dental caries and body weight are linked via the common risk factor of diet. It therefore seems appropriate to examine the evidence which places sugar at the centre of the dental caries/body weight relationship; in doing so we have the potential to inform policy, practice and provide an opportunity for the development of tailored dietary intervention in primary dental care.

In the developed world, the incidence of people experiencing obesity has risen while the prevalence of dental decay has fallen. The WHO (World Health Organization) defines people being overweight and/or obese as having an 'abnormal or excessive fat accumulation that may impair health'.² In the USA, for example, 35% of the adult population are categorized as obese. The incidence of adult obesity in England has risen from 13.2% of men and 16.4% of women in 1993, to 24.4% of men and 25.1% of women in 2012.³ Twenty-eight percent of English children aged between 2 and 15 years are now classified as being overweight or obese.³ Public Health England has predicted that

over 50% of English men and women will be obese by 2050. In contrast to trends in obesity, the dental health of English adults has generally improved. The 2009 Adult Dental Health Survey reported 10% of dentate adults as having 'excellent' oral health with the average number of carious teeth per person being <1 and the mean number of sound/untreated teeth as 18.⁴ However, encouraging as these figures are, they somewhat mask the huge individual variations found between both age and socioeconomic groups.⁴

While oral health generally has improved in countries with developed economies, a careful examination of the WHO worldwide database shows something rather different in those with emerging economies. Globally, around 12% of adults aged 20 and over are obese⁵ and nearly 100% of adults have experienced dental decay.⁶ Interestingly, WHO data also shows that in some countries a relationship exists between dental caries and low body weight. This could suggest that other features such as geography and economic factors may

Susan Carson, BDS, MPH, MFDS RCPS(Glasg), Clinical Lecturer, Hon StR in Dental Public Health and **Ruth Freeman**, BDS, PhD, MSc(DPH), MMedSc, DDPH RCS(Eng), FFPH RCP(UK), Professor of Dental Public Health Research, Hon Consultant in Dental Public Health, Dental Health Services Research Unit, Dundee Dental School, University of Dundee, Park Place, Dundee, DD1 4HN, UK.

act as moderators between diet, tooth decay and body weight.⁵ The notion that the relationship between dental caries and obesity is straightforward and obvious is not supported by the epidemiological data. In order to examine this association in more detail, we initially return to the common dietary risk factor of sugar, or more specifically 'free sugar', as described below.

Free sugars and dental caries

The association between sugar and dental caries has a long and detailed history. Observational studies^{7,8} have shown convincingly that not only does a relationship exist but that it is the frequency of sugar intake, not just amount, that results in a greater number of carious lesions.⁹ Relatively small additional amounts of sugar (beyond 10 teaspoons per day) have been shown to result in a greater increase in dental caries experience.¹⁰

In 2014, the WHO published guidance on the consumption of free sugars by adults and children.¹¹ Free sugars are defined as 'mono- and disaccharides added to foods by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit concentrates'.¹¹ Free sugars, which include, glucose, fructose or sucrose, are also found in the majority of sugar-sweetened drinks. Bernabé *et al* re-examined the dose response in relation to dental caries and the consumption of sugar-containing soft drinks in 2014.¹² They demonstrated that there appeared to be a greater risk of dental caries in adults who regularly consumed sugar-sweetened drinks such as tea or coffee taken with sugar, sugared juices and fizzy drinks. Drinking one to two sugar-sweetened soft drinks per day also seemed to be associated with a greater overall increase in DMFT (Decayed, Missing or Filled Teeth) irrespective of socioeconomic status or the use of fluoride toothpaste.¹²

The 2003 WHO report entitled 'Diet, nutrition and prevention of chronic diseases' concentrated on dental caries.¹³ This report stated that it was 'important to set a recommended level for the consumption of free sugars' and suggested that the intake of foods and/or drinks containing free sugars be limited to a maximum of four times a day.¹³ More recently, the WHO commissioned

a systematic review which revisited the relationship between sugar and dental caries.¹⁴ While acknowledging the moderate quality of the evidence provided, this review demonstrated that free sugars should contribute to 10% or less of an individual's total energy intake.¹⁴ The reviewers also highlighted that dental caries is a progressive disease and, in general, is mostly occurring in adults. In order to prevent life-long caries, an individual is recommended to reduce free sugar intake to 5% of his/her total energy intake.¹⁵ For an adult of average body weight this equates to around six teaspoons of sugar (26 grams) per day. It is of interest to note that this would correspond to less than one 330 ml can of regular carbonated juice containing 26 g of free sugars.¹⁶

Free sugars and body weight

There has been a global increase in body weight of adults and children over the last 30 years.¹⁷ In 2008, 1.46 billion adults were overweight (Body Mass Index >25 kg/m²) and 502 million were obese (Body Mass Index >30 kg/m²).¹⁴ Figures also showed that a quarter of children were classified as overweight or obese.¹⁴ The cause of this global rise in people being overweight and/or obese has been associated with the increased availability of processed, affordable and easily accessible foods, both in the last decades of the previous and the beginning of the current century.¹⁸ In 2011, Finucane *et al* carried out a systemic analysis of 'health examination surveys and epidemiological studies' and found that a country's GDP (gross domestic product) and an individual's socioeconomic position probably acted at some level in determining his/her body weight.¹⁷ The specific role of free sugars on body weight and obesity remained unclear.¹⁷

In 2013, Te Morenga *et al* carried out a systematic review as part of the WHO's guideline development process to examine the relationship between free sugars and non-communicable diseases.¹⁶ This asked the question: 'What is the effect of a reduction in free sugar intakes in adults and children?' The review included both randomized controlled trials and prospective cohort studies. The results from the randomized control trials were combined in a meta-analysis. This

demonstrated that changing the amount of free sugars consumed corresponded to changes in body weight. Calls for the reduction of foods and drinks containing free sugars have followed. Such calls for action are of central importance for countries like the UK, since an average 62 g of free sugars are consumed daily, contributing to 12.6% of an individual's daily calorific intake.¹⁹ A reduction of around 40% in added free sugar intake would be needed to allow individuals to meet the WHO recommended 5% maximum level.²⁰

Free sugars, dental caries and body weight

The literature suggests that free sugars are a common risk factor for both dental caries and body weight. Based on two systematic reviews,^{14,16} the WHO has recommended that free sugars contribute to less than 10% of an individual's calorific intake and conditionally recommend that free sugars should be limited to 5% of the total daily energy intake.¹⁴ If free sugars are a common risk factor for both dental caries and body weight, what is the relationship between dental caries and body weight?

To allow an examination of the connection between dental caries and body weight, we need to refer to studies with the highest level of evidence. Between 2012 and 2013, three systematic reviews have looked at the relationship between dental caries and body weight in children and adolescents.^{21,22,23} These reviews have several points in common:

- All restricted their search to those under the age of 20 years;
- All acknowledged variations in how dental caries was examined, measured or classified;
- All included studies using Body Mass Index (BMI) as a measure of body weight.

The combined conclusions showed that, while a relationship exists between dental caries and body weight, it is far from simplistic. Hooley *et al* demonstrated that in some of the included studies a positive relationship existed between dental caries and body weight, while in others it was negative.²¹ Hayden *et al* found that, where standardized BMI measures were used, there was a strong significant relationship between caries and obesity in children with permanent

dentitions.²² Silva *et al* also highlighted that, in some instances, dental caries and BMI appeared to be closely related, although in other studies they were not.²³ Collectively, the review findings suggested that factors with a direct dietary link act as moderators in the relationship. All of the reviews highlighted that there are inherent difficulties in using Body Mass Index as a measure of body weight in children and adolescents.^{21,22,23} BMI is a measure of weight-to-height ratio which is reliant on standardized allowances for factors such as age, stage of development and gender, if values are to be compared. Reviewers also found variation in the classification of people who were overweight and/or obese,^{22,23} in the use of standardized equipment for recording¹⁹ and in the allowances made for age and gender.^{21,22,23}

Age and country of origin emerged as moderating factors in the relationship between dental caries and body weight. Hooley *et al* pointed to the moderating effect of age, with increased dental caries being associated with increased BMI in children between 5 and 9 years of age.²¹ They also highlighted the inverse relationship (where caries was associated with low rather than high Body Mass Index), suggesting that socioeconomic position could act as a moderator in some countries. This possibility is supported by the observation that, as countries emerge from low to high income (eg Mexico) the burden of people who are overweight shifts from individuals in higher to those in lower socioeconomic groups. The moderating effect of country is therefore important when trying to understand the relationship between dental caries and body weight.²²

Hayden *et al*'s meta-analysis also supports the view that, for children and adolescents living in countries with industrialized economies, there is a significant relationship between BMI and dental caries.²² Researchers have previously explored the role 'economic prosperity has as an enabler for obesity', while continuing to maintain a recognition of the fact that 'most countries still have a substantial burden of under-nutrition'.¹⁸ It has also been suggested that economic factors, such as transport systems, recreation and culture can act as environmental moderators.¹⁸ It is likely, as part of a group of wider social determinants, that these factors will

also have a moderating influence on the relationship between dental caries and body weight.

The available evidence suggests that a relationship does exist between dental caries and body weight, however, this is a weak connection. Factors relating to the economic status of the country of origin and socio-economic position of the individual are potential moderators in this relationship.^{21,22,23}

Free sugar and public health approaches

With mounting evidence and calls for a reduction in free sugar consumption we could ask: What is being done to make healthier choices the easier choices for the population? Sugar saturation, it would seem, is unavoidable both in terms of our daily diet and its current level of exposure in the press. Consequently, calls for legislations to reduce the sugar content of processed food, using a similar model to that which enabled salt reduction in the UK²⁰ have been made. The introduction of a 'sugar tax' has been suggested by some as a way of encouraging the food industry to reformulate high sugar products if other lobbying fails.²⁴ The Government's 'Public Health Responsibility Deal Calorie Reduction Pledge'²⁵ outlines tools which individual food companies can use to reduce overall calorie intakes. These include approaches to reduce sugar content, such as: reformulation or recipe change, reduction of portion sizes, voluntary maximum calorie limit per serving and energy balancing awareness adverts.²⁶

Conclusions and implications for primary dental care

The evidence presented here would suggest that there is a global epidemic in people who are overweight and/or obese and that free sugars in the form of sugar-sweetened drinks are implicated in both dental caries and increased body weight. The relationship between dental caries and body weight, however, is less clear and appears to be moderated by several factors which include geography and economic status. The question remains how can this type of research information be used to promote

health in primary dental care? In order to answer this, it is necessary to return to the common risk factor of free sugars, especially those found in sugar sweetened beverages, and consider action at two levels. In order to 'turn off the sugar tap' and reduce the amount of free sugar available within current food stuffs, Public Health England plan to launch a focused national behaviour change campaign on sugar reduction in January 2015.²⁶ There is also support within the broader healthcare community for wider discussion on areas such as 'advertising of foods to children, fiscal measures that relate to sugar-sweetened drinks, the role of the food industry and food procurement across the public sector' as well as education and training.²⁶ Dental health professionals are well placed to make use of proven behavioural strategies to negotiate with their patients one-to-one and assist them to reduce their overall intake of free sugar in terms of frequency and quantity by specifically reducing their consumption of sugar-sweetened drinks. The consumption of sugar-sweetened drinks could be used as a central plank in a tailored dietary intervention to prevent people having dental caries and being overweight and/or obese.

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