COMMENTS BY SUGAR NUTRITION UK ON THE SCIENTIFIC ADVISORY COMMITTEE ON NUTRITION'S DRAFT CARBOHYDRATES AND HEALTH REPORT

EXECUTIVE SUMMARY

Sugar Nutrition UK welcomes the opportunity to respond to the scientific consultation of the draft Report on Carbohydrates and Health. We recognise that this is a very substantial piece of work and have given it our full consideration.

We acknowledge the commissioning of three systematic reviews in the areas of cardio-metabolic, colorectal and oral health which form the basis of this draft Report and inform the Scientific Advisory Committee on Nutrition's (SACN's) draft recommendations.

We specifically commend SACN on the transparency through which data for the draft Report was compiled, and the way in which the evidence was assessed and graded.

Sugar Nutrition UK strongly support tackling obesity as a critical public health goal, and support the principle that all government recommendations need to be based on robust scientific evidence. In that context, we consider that there are some areas in the draft Report that would benefit from further scientific analysis. There are also other key scientific studies that we feel should have been included. This is to ensure that data has been represented accurately or recommendations are not made until there is scientific evidence to support them. These areas are:

- **Terminology:** We believe the term 'total sugars' is more appropriate than the proposed term 'free sugars' because 'total sugars' conforms with EU labelling law and would be less confusing for consumers. Use of the term 'free sugars' is inappropriate as these cannot be determined analytically. It incorrectly implies a nutritional or physiological influence of 'free sugars' that differs from other dietary sources of the same sugars.
- **Intake Recommendations:** There is insufficient evidence to support the individual recommendation to limit 'free sugars' to no more than 10% of total energy intake and to support the population average 'free sugars' intake of around 5% of dietary energy. In particular, for the 5% recommendation, we are concerned that the basis for the calculation of this value is misrepresentative of the data, as it is unclear how replacing energy from free sugars with that from other carbohydrates would achieve the desired energy deficit. Furthermore, evidence needs to be provided to show that there would be no unintended consequences of this recommendation, particularly on those not over-consuming calories.
- **Obesity, Body Weight and Energy Intake:** The literature review on obesity that accompanies the draft Report does not support the theory underpinning the proposed dietary reference value (DRV), that reducing sugars will aid the reduction of body weight and obesity. More specifically, the notion of sugars having a role in body weight other than, like all macronutrients as a source of calories, is not supported.
- **Oral Health:** There is a difference between the reported strength of the evidence presented in the draft Report and the conclusions of the Oral Health review, which concluded that the evidence linking the development of dental caries to sugars consumption was 'relatively weak'.
- **Type 2 Diabetes Mellitus:** We welcome the conclusion of the draft Report suggesting no association between the incidence of type 2 diabetes mellitus and total or individual sugars intake. However, the recommendation that the consumption of sugars-sweetened beverages should be minimised is based on observational data, which has recognised limitations, and the draft Report fails to address the question of whether this recommendation should be supported by robust scientific clinical trials and intervention studies.

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INTRODUCTION

Sugar Nutrition UK welcomes the opportunity to respond to the scientific consultation of the draft Report on carbohydrates and health. We recognise that this is a very substantial piece of work and have given it our full consideration.

We acknowledge the commissioning of three systematic reviews in the areas of cardio-metabolic, colorectal and oral health which form the basis of this draft Report and inform the Scientific Advisory Committee on Nutrition's (SACN's) draft recommendations.

In particular, we welcome the level of transparency with which the data were compiled, and the way in which the evidence was assessed and graded using the SACN Framework for the Evaluation of Evidence (SACN, 2012). Specifically, we applaud the methodological section outlining the strength and quality of the evidence identified and the exclusion of ecological studies. We also welcome the distinction drawn between 'associations' of carbohydrates and health from observational cohort studies in contrast with cause and 'effect' evidence from controlled intervention trials. Furthermore, it is also acknowledged within this section where the evidence was deemed of insufficient quality on which to draw conclusions.

The main conclusion from the draft SACN Report is that the dietary reference value (DRV) for carbohydrate should be maintained at a population average of approximately 50% of dietary energy. In addition, the draft SACN Report made recommendations for the definitions for 'free sugars' and dietary fibre to be adopted in the UK.

For 'free sugars', the proposed DRV recommendation is for a population average set at around 5% of dietary energy for age-groups from 2.0 years upwards. This is based on the perceived need to limit 'free sugars' to no more than 10% of total energy at an individual level. The rationale used to underpin these DRVs is based primarily on the assumption their adoption will reduce levels of obesity, with dental caries as a supporting factor.

There is also a recommendation that sugars sweetened beverages should be 'minimised' in both children and adults, based on a relationship with type 2 diabetes mellitus and weight gain.

We have reviewed the draft Report, its proposals and accompanying reviews thoroughly and welcome the opportunity to provide our observations for consideration and response by SACN, as part of this scientific consultation process.

KEY POINTS

The key evidence base on which the conclusions of the draft Report are drawn with respect to overall carbohydrates and health is presented within Annex 1 of the draft Report. Therefore we have detailed our responses to specific areas within the draft Report, and cross referenced the relevant sections within the Annex (systematic reviews). The key points that we wish to make with respect to sugars and sugars-sweetened beverages are summarised below:

Terminology

- We feel that the use of the term 'total sugars' is more appropriate than the proposed 'free sugars' because 'total sugars' conforms to EU/UK labelling regulations and would avoid consumer confusion.
- Moreover, the inferred assumption that fruit sugars in fresh fruit (along with canned, dried and stewed) will not affect tooth decay, or contribute to energy intake in the same manner as 'free sugars' is not supported by the evidence in this draft Report.
- In addition, clarity is required as to whether the draft recommendations refer to dietary or total energy intakes as these terms are used interchangeably within the draft Report.

Intake Recommendations

- There is insufficient evidence presented in the draft Report and accompanying reviews to support the recommendations for a population average intake of 'free sugars' to be set at around 5% of dietary energy (for all age-groups from 2.0 years upwards) and for an individual intake level of no more than 10% total energy.
- In particular, the population average figure set at around 5% is based on a hypothetical calculation and is not supported by compelling data.
- The basis and calculations for a 28kcal reduction in energy intake for every 1% reduction in 'free sugars' is unclear and supporting evidence from the peer-reviewed literature is absent.
- The potential negative impact and unintended consequences of the proposed sugars reduction recommendation on dietary composition has not been investigated. Any policy should be based on sound science within this area. The draft Report does not provide this evidence, so should be a subject for further research before any policy decision is made.
- There is no evidence that such a radical change in the population's consumption of 'free sugars' would not lead to unintended consequences such as increased fat intakes via the occurrence of a sugar-fat see-saw.
- In addition, having two separate figures, one for an individual and the other on a population basis, only serves to add confusion to the public understanding of how dietary recommendations apply to their own diet, and not supported by the evidence in this draft Report.

- It is unclear how the replacement of energy from free sugars with that from starches, sugars within the cellular structure of foods and milk and milk products would achieve the energy deficit.

Obesity, Body Weight & Energy Intake

- We note that the systematic reviews found insufficient evidence of any effect of sugars in respect to body weight or eating motivation, while the draft Report solely focusses on the potential impact of sugars on subjective measures of energy intake.
- The evidence presented does not show that 'free sugars' have any specific effect on energy intake or body weight other than, like all macronutrients, as a source of calories.
- The lack of distinction between isocaloric and hypercaloric studies in both the supporting documents and draft Report when considering effects on energy intake is of significant concern.
- Food matrix and study duration should have been considered in regards to energy intake and compensation.
- The use, and connection, of end-point data from different test groups in Figure 1 is misrepresentative of the data and potentially misleading.
- Crucial studies have been missed in regards to energy intake and sugars. In addition, those that did not report baseline data and those employing unrealistic excessive caloric supplementation interventions should not have been included.

Oral Health

- We note that the draft Report finds an association between sugars and dental caries for the amount, but not for the frequency of consumption.
- There is a clear distinction between the strength of evidence presented in the draft Report and the conclusions of the review. It is apparent that the evidence on dental caries has been somewhat overstated, as the conclusions drawn within the draft Report do not reflect the cautious tone of the review.
- Moreover, an intake value for 'free sugars' in respect to dental caries has been set on the basis of data that does not represent 'free sugars' intake.
- We are concerned that a number of crucial studies appear to have been omitted from the review. This applies especially to the studies on amount and frequency of sugars. Worthy of particular consideration, the Vipeholm intervention study (Gustafsson *et al.*, 1954) investigated the effect of consuming sugar at or between meals on dental caries development, yet this study is not addressed. Therefore it is extremely difficult to unravel this residual confounding.
- The '*in situ*' studies, acknowledged by the authors of the review as a valuable source of evidence, were not subsequently taken into account in the draft Report or in the review.
- The conclusions from SACN with respect to an effect of frequency of sugars consumption are in sharp contrast to those by other expert review committees, including the European Food Safety Authority (EFSA), Institute of Medicine (IOM) and World Health Organisation, Food and Agriculture Organisation (WHO/FAO).

- The draft Report inappropriately applied its conclusions about sugars and caries to the general adult population when such conclusions were based exclusively on child data.

Type 2 Diabetes Mellitus

- We note the conclusions of the draft Report suggest no association between incidence of type 2 diabetes mellitus and total or individual sugars intake.
- In addition, no effect was observed between sugars and either blood glucose or blood insulin concentration.
- The association of a greater risk of developing type 2 diabetes with high sugars-sweetened beverages consumption is based solely on cohort studies; no evidence is presented from randomised controlled trials to support this observation.
- In Chapter 12 of the draft Report (p210), there is clear acknowledgement of the limitations and potential for biases with observational studies, with clarity that any associations must be interpreted 'with caution' (Paragraph 12.3).
- The draft Report failed to address the question of whether, prior to recommending that sugars-sweetened beverages should be consumed in minimal amounts based on the risk of incident type 2 diabetes, such a recommendation should be supported by clinical trials and intervention studies. This is particularly important given the cautious tone of the original meta-analysis.

Fructose

- The terminology used in discussion of the effect of fructose on health, with regards to HFCS and isoglucose, needs clarification.

DETAILED RESPONSE

TERMINOLOGY

Use of the term 'free sugars' is not based on the scientific evidence and assumes a nutritional and/or physiological influence of 'free sugars' that differs from other dietary sources of the same sugars.

The use of the term 'free sugars', along with 'NMES', 'added', 'intrinsic' and 'extrinsic sugars' has been stated to be misleading (Cummings & Stephen, 2007). The FAO/WHO update on terminology and classification recommends that these terms should not be used, and instead that 'Total Sugars' is the preferred and most appropriate term. They state that "*Many terms exist to describe sugars in the diet. The most useful are total sugars and their division into mono- and disaccharides. The use of other terms creates difficulties for the analyst, confusion for the consumer and suggests properties of foods that are not related to sugars themselves, but to the food matrix*". As free sugars cannot be differentiated analytically from those sourced from within the cellular structure of plant foods, the use of the term is inappropriate.

The European Food Safety Authority (EFSA) opinion on dietary reference values for carbohydrates and fibre states that "the available evidence is insufficient to set an upper limit for sugars based on their effects on body weight" (EFSA 2010), with a value of 90g 'Total Sugars' to only be used as a value for food labelling purposes for the *EU Food Information for Consumers Regulation (1169/2011)* (EFSA 2009, EU 2011). This is in agreement with the Australian recommendations, where no DRV is set in regards to sugars intake, but a value of 90g 'Total Sugars' is endorsed by Food Standards Australia New Zealand for labelling purposes (FSANZ, 2008). In the US, the Institute of Medicine (IOM, 2005) concluded that there was "insufficient evidence to set a daily intake of sugars or added sugars that individuals should aim for." Therefore they suggested a maximal intake level of 'added sugars' of $\leq$25% total energy, to prevent the displacement of foods that are major sources of essential micronutrients.

Food labelling in the UK is legally required to conform to the EU regulations since these were adopted into UK legislation as a UK Statutory Instrument (Food Information Regulations 2014*).* Consequently, the use of the term 'free sugars', and the setting of a DRV for this, is not of public health benefit, as neither individuals, nor health professionals, will be able to ascertain this information from the labels on food products purchased.

The term 'total sugars' not only represents the information that is available to consumers, but is the most appropriate term. There is no metabolic, nutritional or physiological difference between, for example, the sucrose present in raisins, in an orange, or added in the manufacture of a cereal bar. Use of the term 'free sugars' implies that fruit sugars in fresh fruit (along with canned, dried and stewed) will neither affect tooth decay nor contribute to energy intake in the same manner as 'free sugars' is not supported by the evidence in this draft Report. In addition, clarity is required as to

whether the draft recommendations refer to dietary or total energy intakes as these terms are used interchangeably within the draft Report.

INTAKE RECOMMENDATIONS

There is insufficient evidence to support the individual recommendation of no more than 10% total energy and the population average 'free sugars' intake of around 5% dietary energy.

The rationale used to underpin the proposed DRVs is based primarily on the assumption that they will help to reduce the prevalence of obesity, with dental caries as a supporting factor.

It is well documented by both the Cabinet Office (1999, 2001) and the Centre for Reviews and Dissemination (2009) that "health care decisions for individuals and for public policy should be informed by the best available research evidence." Therefore supporting the fact that public Health recommendations for an intake value require solid evidence that such an intake has been shown in a number of high quality studies to produce the benefit or risk reduction they are being set in regards to.

Only one of the studies presented actually investigated intakes close to the proposed 5% average population recommendation (Raben *et al.*, 2002), and this was achieved using a large amount of artificial sweeteners. We therefore question the evidence basis for the 'around 5% of daily energy' population intake recommendation.

It is also worth noting that whilst the average population recommendation of around 5% dietary energy is based on a theoretical calculation to remove 100kcal from the diet, this calorie reduction is only of benefit to those who are overweight or obese. It is therefore not applicable to a considerable proportion of the population who are of a healthy weight, or under-weight. A review and meta-analysis found that although weight loss resulted in a 13% reduction in the relative risk of all-cause mortality in unhealthy adults (those with diabetes or obesity-related health conditions), this was counterbalanced by an 11% increase in the relative risk of all-cause mortality for healthy adults (Harrington *et al.,* 2009). This highlights a potential unintended consequence of using a reduction in energy intake as the basis for a population intake recommendation. A hypothetical 100kcal reduction in food energy intake might benefit those who are obese, but it is not appropriate as a population target, as it does not take into account the effect this would have on healthy adults.

In addition, within the context of the recommendation of this draft Report that 50% of dietary energy should come from carbohydrates, reducing 'free sugars' from <10% to around 5% would result in starches, sugars within the cellular structure of foods and milk and milk products increasing from >40% to >45%. As these both contain 4kcal per gram, this would result in an isocaloric energy exchange rather than a decrease in caloric intake. Therefore this would not support the stated rationale of an obesity reduction objective. Furthermore, it has been shown that advice to reduce % energy from sugars frequently results in increases in the % energy coming from fat (Sadler *et al.,*

2013). Therefore with fat providing 9kcal per gram, this may result in the unintended consequence of increased energy intakes, in direct conflict with the primary objective.

Evidence needs to be provided to show that no unintended consequences of a single nutrient focused reduction will occur.

It is unclear what impact the proposed population sugars reduction would have on nutrient intake. Studies have shown that there is a sugar-fat see-saw, raising the concern that any reduction in sugar may be replaced by fat (Sadler *et al*, 2013). This may lead to unintended consequences and thus requires further study.

The basis and calculations for a 28kcal reduction in energy intake for every 1% reduction in 'free sugars' is not transparent.

We request clarification and reliable evidence from the peer-reviewed literature that this theoretical modelling will achieve the desired outcomes (eg. Weight/BMI reduction) in a 'real life' setting.

The calculations supporting this modelling do not appear in the draft Report, nor in the associated literature review. It is stated that this figure "assumes no dietary compensation" but it is clear from the studies included in the review, that this is not the case. Even when subjects added large volumes of sugars-sweetened beverages to their diets, they still compensated for approximately half of the additional energy provided (Reid *et al.*, 2007). Furthermore, it is evident that values for total sugars, as well as for non-milk extrinsic sugars and sucrose have been used simultaneously to derive Figure 1, as well as the associated meta-analysis in the literature review. This use of different measures of sugars intakes distorts the data and is inappropriate given that the proposed recommendation is solely for 'free sugars'.

Moreover, we would question the selection process for the inclusion of studies in Figure 1. In many instances, the hypothesis of increasing sugar(s) intake with energy intake is not supported by the studies included. In two studies, published by Drummond *et al.* in 1998 and 2003, groups were counselled to either reduce fat alone or reduce both fat and sugar. In these studies, both groups reduced their energy intake during the interventions, and where measured, also lost body weight, irrespective of whether they increased or decreased their intake of sugar(s). These findings are misrepresented by Figure 1 of the draft Report as the baseline values are not taken into account. Relying solely on endpoint values is highly misleading.

It is also worth noting for example, that in Drummond & Kirk (1998), whilst the group advised to reduce NMES and fat reported reductions in body weight of 0.5kg, EI of 1.31MJ and %NMES of 1.8% (%Total Sugars reduced 0.5%), the group advised to reduce fat alone also reported a body weight reduction of 1.2kg and a reduction in EI of 0.77MJ, whilst simultaneously reporting an increase in %NMES intake of 0.7% (%Total Sugars increased 3.1%). This suggests that reducing overall energy intake is the over-riding factor for weight-loss in all of these studies, and is not specific to the sugars

content of the diets. Secondly, the selective inclusion of test groups (not always suitable as controls) to include in Figure 1 and the meta-analysis may have significantly biased the reported outcome.

We would therefore question the validity of Figure 1 and ask for its inclusion to be reconsidered. Further specific comments are made in regards to this figure and the data from which it is derived on page 13 of this response.

OBESITY, BODY WEIGHT & ENERGY INTAKE

The outcomes of the reviews on body weight and eating motivation are not sufficiently described within the body of the main draft Report, which solely focusses on the potential impact of sugars on subjective measures of energy intake.

Given the inherent limitations of measuring self-reported energy intake, it is unclear why energy intake alone has been used to predict potential weight changes, and why this is considered sufficient to support the population recommendations for 'free sugars'.

The literature review on obesity that accompanies the draft Report does not support the theory underpinning the proposed DRV that reducing sugars will aid the reduction of body weight and obesity. More specifically, the notion of sugars having a role in body weight other than as a source of calories (similar to any other macronutrient) is not supported. Therefore to set a dietary reference value for 'free sugars' intake of around 5%, within the context of 50% energy from carbohydrates and thus providing no caloric reduction, is clearly not supported by the evidence provided within the draft Report and reviews.

As evidence from the RCTs presented in the energy intake review suggests that any effects of sugar(s) on energy intake may be transient, there is a clear need to control for study duration.

Evidence from the studies included in Figure 1 indicates that following a dietary intervention, changes in energy intake vary over time. For example, in a 6-month study comparing advice to reduce fat alone or reduce fat and sugar, energy reduction in both groups occurred during the first 6 weeks, with a much weaker effect at 6 months (Drummond and Kirk, 1998). This suggests that the impact of the dietary intervention may not apply to long-term outcomes.

Evidence presented in the draft Report and associated reviews do not show that 'free sugars' have any specific effect on energy intake or body weight, other than, like all macronutrients, being a source of calories.

Calories from any source can contribute to overeating and weight gain. As acknowledged by the authors of the review (page 104), the two hypercaloric studies where sugar was added to the diet (Reid *et al.,* 2007 and Raben *et al.,* 2002), do not demonstrate the impact of sugars supplementation on energy intake *per se:* "…it should be noted that this approach does not demonstrate the impact of sugars *per se* since no comparison with supplemental fat or protein was undertaken". It is also notable that the two studies providing evidence for an effect of sugars-sweetened beverages on BMI (Ebbeling *et al.,* 2012 and de Ruyter *et al.,* 2012, page 96 of the draft Report) cannot distinguish between calories from sugars and other macronutrient sources under the same rationale. A study excluded from the analysis due to lack of reporting of variability helps to address this concern. Mazlan *et al.* (2006) found that daily mandatory snacks, whether high in fat or sugar, increased energy intake and were similarly poorly compensated for. Another study not included in the review, but also comparing snacks high in sugar and fat, found that these were adequately compensated for, but crucially again found no significant difference in energy intakes between the two regimes, with a trend towards higher intakes (+364 kJ) with the high fat snacks (Lawton *et al.*, 1998). These studies suggest that sugars do not vary in their effects on eating motivation as compared to other macronutrients like fat. Moreover, as stated in the review, diets that vary in sugars tend also to vary in dietary fibre, energy density and GI, so any effects cannot be attributed specifically to sugars.

The setting of public health recommendations for a single nutrient in regards to energy intake or body weight requires robust evidence to show that there is something specific about a particular nutrient, other than it being a source of energy. The supporting documents for this draft Report highlight the fact that there is insufficient evidence to show that sugars have a specific role in obesity or eating motivation, other than being a source of calories (like all macronutrients). The lack of distinction between isocaloric and hypercaloric studies in the supporting documents and draft Report regarding energy intake is a significant concern and is a factor that needs to be specifically investigated. Although the inclusion criteria for the Te Morenga *et al.* (2013) review on sugars and body weight differed from the current draft Report, its conclusion that "isoenergetic replacement of dietary sugars with other macronutrients resulted in no change in weight" highlights this issue.

The energy intake section should distinguish between liquid and solid sources of sugars as there is evidence their compensation may differ (at least in the short term).

When the text of the draft Report refers to the compensation of sugars (6.19, 11.8, 12.10) this is in respect to 100% liquid (Reid *et al., 2007;* Ebbeling *et al.,* 2012*;* de Ruyter *et al.,* 2012) and 80% by weight liquid (Raben *et al.,* 2002) studies. It has previously been suggested that the food matrix could have a significant effect on energy intake independent of macronutrient composition. Therefore, this factor needs to be controlled for in the choice of evidence used for investigating the effect of sugars.

Tournier & Louis-Sylvestre (1991) concluded that "calories ingested in a liquid form are not well taken in account and could induce a subsequent overconsumption, at least until satiety was conditioned to the fluid".

DiMeglio & Mattes (2000) concluded that "liquid carbohydrate promotes positive energy balance, whereas a comparable solid carbohydrate elicits precise dietary compensation. Increased consumption of energy-yielding fluids may promote positive energy balance." Thus supporting the hypothesis that food matrix is a significant factor, particularly in respect to the conclusions drawn from the use of Reid *et al.* and Raben *et al.* in respect to chapters 6, 11 and 12.

This is further supported by Zijlstra *et al.* (2008) who concluded that "Products different in viscosity but similar in palatability, macronutrient composition and energy density lead to significant differences in intake. This difference is partially explained by the higher eating rate of liquids". Thus, indicating that solely/predominately liquid studies could unduly influence any findings in respect to energy intake conclusions.

Therefore the effect of solid and liquid sources of sugars should have been considered separately both within the text and meta-analysis, but also in the development of Figure 1.

Clarification is required as to how the effect of the food matrix has been accounted for, particularly in respect to the liquid-only/predominated studies (Reid *et al.*, 2007, Raben *et al., 2002*) and raises the question as to whether these should have been included within this section of the draft Report given their potential to skew the data.

It should also be noted that the studies to date that have compared the satiating effects of liquid and solid sources of sugars have been of short duration. There is a lack of evidence that any differences will be maintained over a longer term when learning and expectation effects will diminish.

Additional studies identified for inclusion within the energy intake section.

We wish to draw your attention to three studies that should have been included in the analysis according to the stated criteria:

- Lawton, C. L., H. J. Delargy, *et al*. (1998). A medium-term intervention study on the impact of high- and low-fat snacks varying in sweetness and fat content: large shifts in daily fat intake but good compensation for daily energy intake. *Brit J Nutr;* 80(2): 149-161.

- Reid, M., *et al.* (2010). Effects of sucrose drinks on macronutrient intake, body weight, and mood state in overweight women over 4 weeks*. Appetite;* 55(1): 130-136.

- Aeberli, I., *et al*. (2011). Low to moderate sugar-sweetened beverage consumption impairs glucose and lipid metabolism and promotes inflammation in healthy young men: a randomized controlled trial. *Am J Clin Nutr*; 94(2): 479-485.

As well as one published after the literature review was undertaken:

- Reid, M., *et al.* (2014). Effects on obese women of the sugar sucrose added to the diet over 28 d: a quasi-randomised, single-blind, controlled trial. *Brit J Nutr;* 111(3): 563-570.

These two studies by Reid *et al.* support the findings of the 2007 paper, published by the same group, that the inclusion of large volumes of sugars-sweetened beverages to the diet can be compensated for by voluntary reduction of other energy sources in the diet.

Also, of relevance to this area is a new study presented at this summer's Nutrition Society Meeting:

- Markey and Lovegrove (2014) OC122: Dietary energy compensation in response to reduced sugar diet in non-obese men and women. University of Reading.

This crossover study provided 45 subjects with original or reformulated lower sugar products over two 8 week periods, with large differences in NMES intake during the study: 19.7% versus 8.3% respectively. Notably, there was no difference in energy intake or bodyweight following the two arms.

Collectively, these studies do not support a positive relationship between intake of 'free sugars' and energy intake.

Studies without reported baseline data and that employ the supplementation of excessive supplementary feeding should not have been included within the energy intake section.

We question why the Raben *et al.* (2002) study was included, given the excessive supplementary sucrose (3.4MJ per day) that the subjects were advised to add to their habitual diets. According to the latest data available from the NDNS, the sucrose intakes achieved in this study exceed those of the upper 2.5 percentile for NMES, questioning the relevance of this study to everyday eating patterns.

Figure One – omission of body weight data

We would question the choice of self–reported energy intake data as the basis for Figure 1. For all but one of the studies cited, the more reliable metric of body weight is available. In the overwhelming number of these studies, whichever intervention or control group is selected, body weight fell from baseline irrespective of the proportion of sugars in the diets. This evidence is not consistent with the expected changes based on energy intake, indicating that the energy intake evidence is unreliable. Moreover, the change from baseline is more relevant to public health advice, since the assumption of the Report is that the proportion of "free sugars" chosen by an individual will influence the change in body weight they experience. The data shows that this assumption is incorrect.

The use and connection of end-point data from different test groups in Figure One is misrepresentative and highly misleading.

In addition to the points made earlier in regards to the calculation for the 'around 5%' value, we wish to make specific comments relating to Figure 1. The relationship between sugar(s) intake and energy intake is stated to be linear, however for each study there are only two data points making it impossible for the relationship to be anything other than linear. The use of endpoint data which does not represent potential differences at baseline in the two groups is misrepresentative. By connecting

the end point values for two separate groups of individuals, this could be misinterpreted by readers as being change from baseline and therefore what the graph actually shows can be easily misconstrued.

Also of concern is the selectivity of the data chosen to be included in the figure, as well as the associated meta-analysis. In several cases, the studies included more than two study groups and the results of controls or other intervention groups such as Low GI (Brynes *et al.,* 2003) have not been represented.

In addition, this figure combines plotting values for sucrose, NMES, sugars and simple carbohydrates. As these measure different aspects of sugars intake, they should not be plotted together on the same axis in a way that implies that they are representing the same intake measure.

With the significant number of scientific queries surrounding Figure 1 and the high possibility of it being misread, we feel that, at least in its current format, it should be removed from the draft Report.

ORAL HEALTH

Intake value for 'free sugars' in respect to dental caries has been set on data that does not investigate 'free sugars' intake.

The studies used in support of the association between amount of sugars consumed and dental caries do not define the term 'sugar' and so it is unclear precisely what is meant by this term. Therefore, this could be a single mono- or disaccharide, or a mixture of any of these. This is itself noted within the review, but is not mentioned in the draft Report. In light of this, we question whether it is legitimate to relate any of the outcomes of the review to the term 'free sugars' as defined by the draft Report.

Strength of evidence presented within the draft Report is overstated.

The Carbohydrates and Oral Health review notes that "evidence linking the development of dental caries to sugars consumption is relatively weak." (p.46; paragraph 132). However, the draft Report assigns a stronger tone to the level of evidence, suggesting there is "moderate evidence" for an association between the amount of sugars consumed and development of dental caries.

Furthermore, the draft Report notes "moderate evidence" for an association between the amount of sugar consumed and dental caries based on five publications. Of these, two report the same cohort study (Rugg-Gunn *et al.,* 1984, Rugg-Gunn *et al.,* 1987) and another did not adjust for tooth brushing (Campain *et al.,* 2003), thus leaving three cohort studies on which to form an opinion.

According to SACN's grading system as defined within the draft Report (page 222), at least 5 studies are required for the strength of evidence to be 'moderate' in the absence of a meta-analysis. Consequently, we would question the strength of this evidence, based on this duplication of findings, and propose that the association is downgraded to "limited", to comply with SACN criteria.

It is important to note that the evidence base underpinning this association is limited to prospective cohort studies, for which no meta-analysis could be performed. Only one randomised controlled trial was noted, which investigated the relationship between sugar and dental caries. The study did not find any significant effects of fructose and glucose compared to sucrose on caries development (Frostell *et al.*, 1991).

Therefore, any relationship that has been observed in the Oral Health review is unable to show cause and effect and it is unclear as to how the proposed recommendations are likely to impact on the dental caries experience of either children or adults within the UK population.

It is not appropriate to apply child data to an adult population.

The studies cited were all carried out in children, therefore reliable conclusions cannot be drawn as to how this applies to the population as a whole, or what benefit, if any, reducing population sugar intakes would have on dental caries in adults.

Misclassification and omission of research.

The oral health review notes the importance of *in situ* studies (paragraph 38), in which "the effects of sucrose were shown to be dependent on dose and the frequency of application, as well as being militated against by fluoride administration." However, five out of the seven citations looked at neither dose, nor frequency. Of the remaining two, one investigated the effect of various concentrations of test solution (which does not necessarily equate to overall dose consumed) and the other investigated frequency. We are concerned with the implications of this misclassification of these studies and ask that the findings within this section are reviewed.

In addition, whilst inclusion criteria were set for *in situ* studies such as these, the seven studies cited in paragraph 38 are not discussed further and do not form part of the review or draft Report. We would seek to understand the grounds for this exclusion, and urge that they are taken into consideration to ensure totality of the data.

The draft Report's conclusions on the effects of frequency and amount of sugars consumption on dental caries differs from other reviews.

In contrast to the draft Report, it has previously been noted by scientific reviews and expert committee reports that there is an important association between frequency of sugars consumption and dental caries risk (WHO/FAO, 2003; IOM, 2005; Anderson *et al.,* 2009; EFSA, 2010). Two of these

expert reviews (IOM, 2005; EFSA, 2010) also specifically comment that any clear relationship between amount of sugars and dental caries risk could not be deduced from the literature.

While the study by Gustafsson *et al*. (1954) was omitted due to lack of randomisation, it clearly showed a strong effect of frequency that could not be due to selection bias. Furthermore, the World Health Organisation and Food & Agricultural Organisation in its report 'Diet, Nutrition and the Prevention of Chronic Diseases' (2003) established that in regard to this particular study "the conclusions are valid", although remarking that they apply to a pre-fluoride era. As there is a general lack of other relevant evidence available, we strongly urge reconsideration of compelling historical data such as this, given that its methodology could not be replicated today.

The effect of frequency was observed in an *in situ* study by Ccahuana-Vasquez *et al.* (2007), who noted a clear effect above six exposures per day to a sucrose solution, when fluoride toothpaste was used. This is a similar finding to that of another *in situ* trial. Duggal *et al.* (2001) showed that the number of exposures to a sucrose solution that the teeth could cope with increased up to 7 times per day or more with the use of fluoride toothpaste, before any significant demineralisation effects were observed.

Use of Fluoride toothpaste in the prevention of dental caries is understated.

The draft Report fails to recognise the importance of fluoride toothpaste in the prevention of dental caries. The Oral Health Survey of Five-Year-Old Children 2012 (Public Health England, 2013) observed a substantial reduction in both the number of children with caries, and in the severity of decay between 2008 and 2012. The last time such a change was seen was in the Child Dental Health Surveys of 1973 and 1983, which was generally considered to have been a result of the introduction of fluoride toothpaste in the late 1970's. One possible explanation for the more recent reduction in caries is that levels of fluoride in children's toothpaste have been increased to at least 1000ppm by several large brands in the last few years.

The substantial effect of fluoride is further demonstrated in a study of children living in low fluoride areas, where it was only when oral hygiene was simultaneously poor that increased risk of caries was significantly related to increasing sugar consumption (Kleemola-Kujala & Rasanen, 1982). The finding of this study is further supported by Jackson *et al.* (2005), who initiated a teacher-supervised tooth brushing programme in children, which had a significant impact on the development of dental caries. Those in the intervention (brushing) group showed a significantly lower caries increment 10.9% ($p<0.001$), compared to the control group, with no change to dietary parameters.

Expert reports have noted the multifactorial nature of caries stating that it is "difficult to rationalise the relationship of sugars and dental caries as simply 'cause-and-effect'" (IOM, 2005), and the impact that fluoride has on this (IOM, 2005; WHO/FAO, 2003). EFSA (2010) concluded that an upper limit for sugars consumption in regard to dental caries could not be set, due to the strong influence of oral hygiene and exposure to fluoride, among other factors.

We therefore question the likely impact of initiatives to reduce sugar intake to such low levels on dental caries, when the effect of fluoride is so significant.

TYPE 2 DIABETES MELLITUS

Comments in relation to sugars-sweetened beverages and their risk to incidence of type 2 diabetes mellitus are not supported by the weight of scientific evidence.

The conclusions of the draft Report suggest no association between incidence of type 2 diabetes mellitus and total or individual sugars intake. In addition, no effect was observed between sugars and either fasting blood glucose or blood insulin concentration.

For sugars-sweetened beverages, an association of greater risk of type 2 diabetes mellitus was observed from prospective cohort studies. This was concluded on the basis of two reviews. The first (paragraph 6.32; p 89) identified six cohort studies investigating the relationship between consumption of sugars-sweetened beverages and incidence of type 2 diabetes mellitus, with no meta-analysis performed due to variation in the studies.

This was subsequently updated with research published after the original review and a meta-analysis conducted on five cohort studies in four publications (paragraph 6.33; p89). These observed associations were small, with a relative risk for sugars sweetened beverage consumption and incidence of type 2 diabetes mellitus of 1.07 (95% CI 1.05, 1.08 for each 100 ml/day increase; $p<0.001$).

In Chapter 12 of the draft Report (p 210), there is clear acknowledgement of the limitations and potential for bias in observational studies, stating that 'any associations must be interpreted with caution' (paragraph 12.3). Although many of the studies did adjust for multiple factors and performed sensitivity analyses, it is not possible to rule out residual confounding. These include variation in lifestyle patterns including, for example, that high consumers of sugars-sweetened beverages are more likely to smoke, be sedentary and have higher energy intakes (Schultz *et al.,* 2004). Taking this into consideration, we seek clarification that these factors were adequately controlled for. Any study that was included within the final analysis, but failed to adjust for these factors, should be interpreted with caution.

It is notoriously difficult to accurately quantify the dietary intake of subjects; use of questionnaires in the majority of studies is subject to measurement error thus adding to the weakness of the data. One significant and major limitation of The InterACT cohort (The InterAct Consortium, 2013) was measurement of dietary intake via a questionnaire at baseline. This single estimate cannot account for individuals who may have changed their dietary habits during the subsequent 16 years of the study, potentially weakening the association through misclassification of data. Moreover, in other instances, incident cases of type 2 diabetes relied on participants self-reporting diabetes, thus weakening any observation.

Greenwood *et al.* (2014) also noted substantial between study heterogeneity (I^2 80%, 95% CI 58, 91, $p<0.001$) which, on exclusion of one study (Paynter *et al.,* 2006) was only slightly attenuated (I^2 65%, 95% CI 9, 87).

The data presented on sugars-sweetened beverages consists of observational data. The Report fails to address the question of whether prior to making a public health recommendation to minimise one food group from the diet, the existing observational data (which has recognised limitations) should be supported by robust scientific clinical trials and intervention studies. This is particularly important given the cautious tone of the meta-analysis (Greenwood *et al.,* 2014).

Missing and misclassified data

Of the two studies excluded from the analysis for sucrose, (paragraph 6.27, p88), one was in relation to missing confidence intervals (Colditz *et al*., 1992), yet its non-significant RR of 1.16 was reported within the draft Report (p88). We would ask for this to be clarified, given that the CI cited within the results section of the paper (Table 1.0) show no association with risk for type 2 diabetes: RR (95% CI) for highest vs lowest quintile of sucrose intake (BMI<29) 1.16 (0.77–1.76) (p=0.76) and (BMI ≥29) 0.90 (0.64–1.28) (p=0.20).

One study published since the meta-analysis was completed has also been identified. No statistically significant association of SSB consumption was reported with incidence of type 2 diabetes (Sakurai *et al.,* 2013) within this cohort of middle aged Japanese men. A significant and positive association was observed with diet soda intake.

FRUCTOSE

The terminology used in discussion of the effect of fructose on health needs clarification.

In Annex 3, the SACN draft Report refers to "…HFCS, also known as isoglucose…". This statement is incorrect and we therefore seek clarification. HFCS contains 55% fructose, while isoglucose contains 42% fructose. In Europe, HFCS would be declared as 'fructose, glucose syrup', whereas isoglucose would be declared as 'glucose, fructose syrup' – that is, they are different materials. We would ask for this to be corrected in Annex 3 and elsewhere in the draft Report.

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