SACN – Draft Carbohydrates and Health report
Scientific consultation 26 June – 1 September 2014

Response from the British Soft Drinks Association

1. Introduction

1.1. The British Soft Drinks Association (BSDA) welcomes the opportunity to comment on the Scientific Advisory Committee on Nutrition's (SACN) draft report on carbohydrates and health. We recognise that it is essential that public health nutrition recommendations are based on strong science and take into account the totality of available relevant evidence.

1.2. There is no doubt that a thorough and systematic review of the literature to *circa* 2010 has been carried out. However, with respect to the proposed conclusions related to sugar sweetened beverages (SSBs), the Committee appears to have changed or not followed its own stated methodology for interpreting meta-analyses, [1]. In addition it has been suggested that placing undue emphasis on the results of meta-analyses despite recognised limitations and without appropriate emphasis on the entire body of relevant evidence can lead to discordant conclusions [2].

1.3. Our main points are:

- In view of the terms of reference of SACN which relate to "Dietary Carbohydrate" we are puzzled by the specific reference to SSBs, which are a food and beverage group and at odds with the approach adopted in relation to other carbohydrate groups including fibre.

- Could SACN explain the change or lack of application of its stated methodology for interpreting meta-analyses?

- The Draft Report's conclusion in relation to SSBs and Type 2 Diabetes Mellitus (T2D) appears to rest primarily on the highly heterogeneous data from one meta-analysis (conducted outside the systematic review) comprising of a limited number of studies of questionable relevance to the UK population.

- The reliance on epidemiology in describing the claimed association between SSBs and risk of T2D does not allow all confounding lifestyle factors to be taken fully into account, e.g., not all cohorts correct for body mass index (BMI) while obesity is a recognised risk factor for T2D.

- The Draft Report concludes existence of a linear relationship between sugars intake and energy intake and hypothesises a relationship between higher energy intake and higher bodyweight for which substantiating evidence is not provided.

- The scientific evidence presented on SSB intake, bodyweight and BMI in the Draft Report appears inconsistent and it is unclear how this provides a sound basis for a general total population recommendation to minimise SSB consumption.

- The Draft Report recommends consumption of SSB be minimised in **both children and adults** despite identifying that there is no association between SSBs and cardiometabolic health, glycaemia or colorectal cancer and recognising the role of

such confounding factors such as oral hygiene and global preventative measures in respect to oral health. In addition, associations between SSBs and T2D are weak and speculative, thus the totality of evidence presented would not appear to align with the conclusion in Chap12 p212 [3].

1.4. In this response, our focus has been to comment on the sections covering SSBs and their proposed association to T2D, weight gain and BMI. The BSDA is aware that the industry has expressed views more broadly on the Draft Report through the Food and Drink Federation; we are cognisant of their response and fully endorse their comments.

2. Terms of reference

2.1. The terms of reference detailed on page 7 of the Draft Report [3] state:

"to provide clarification of the relationship between dietary carbohydrate and health and make public health recommendations.
To achieve this they were asked to review:
The evidence on dietary carbohydrate and cardio-metabolic health (including cardiovascular disease, insulin resistance, glycaemic response and obesity)..."

Various other areas of health were also to be considered as well as the terminology, classification and definition of types of carbohydrates in the diet.

2.2. The consideration of the role of specific foods and beverages in disease risk does not form part of these terms of reference. We would therefore request that SACN reflects as to whether SSBs as a food and beverage group are outside the scope of the report, which does not appear, in other respects, to assess the impact of specific food and beverage groups on markers of health.

3. Methodology

3.1. The Draft Report does not follow the standard methodology for reaching conclusions about potential cause and effect relationships that it cited [1, 4]. In particular, the Draft Report does not integrate all the available evidence into a specified framework such as the Bradford Hill criteria [5], instead relying primarily on summary risk estimates from a subset of observational studies combined in a meta-analysis. Also, the Draft Report does not adequately address the entire body of available data and hence, assess the totality of evidence, e.g., by considering the significant inconsistency between the majority of its findings as to sugar and SSBs on the one hand and SSBs and T2D on the other; see paras 6.21, 6.32 and 6.34 [3].

3.2. The principles adopted by SACN in reviewing the evidence are clearly defined in Appendix 1 Cardio-metabolic Health protocol [1]. The statistical pooling of evidence allows an effect size to be quantified. In this respect meta-analysis is often the statistical tool of choice and although systematic reviews with meta-analyses are considered more objective than other types of reviews, it has been suggested that their interpretation can be subjective even among reviewers with extensive experience conducting meta-analyses [2]. The Draft Report does not sufficiently evaluate the acknowledged potential for bias and confounding as an explanation for the weak associations found in some underlying studies and in the resulting meta-analysis.

3.3. Another important consideration is the assessment of the rigor of the pooled estimate. It is stated in Appendix 1 [1] that the principles adopted with reference to heterogeneity do not allow evidence to be included in the report where the I^2>50%. This allows the variation between study estimates to account for half of the total, and this value has been described as indicating medium heterogeneity [6], and as such, a generous standard for inclusion and one where the data require scrupulous interpretation, particularly where the meta-analyses consist of few studies. As detailed [1, 6], it is wholly appropriate that where there is excessive heterogeneity (I^2 greater than 50%) that pooled estimates and meta-analysis are not presented.

3.4. It is interesting to note that in the Draft Report, the standard for medium heterogeneity is changed from the more commonly used 50%, cited in Appendix 1, to 25-75% and it is stated that analyses will not be presented if the I^2 >75% (see Annex A2.8 [3]). In devising this statistic, Higgins *et al* [6] proposed that low, moderate, and high I^2 values were 25%, 50%, and 75% respectively. Thus 'high' was not designated >75%, nor medium 25-75% rather that values circa 50% were medium (but not +/- 25% units) and when noticeably greater than 50% they would be designated high. Higgins *et al* also state that the I^2 value is a measure of inconsistency and as such allowing analyses to be retained as evidence with up to 75% inconsistency do not appear a sound basis on which to make recommendations for public health. We would ask SACN to reflect on the work of Higgins *et al*, and the established standards for dealing with heterogeneity.

Report Detail

4. SSBs and Type 2 Diabetes Mellitus

4.1. Studies

4.1.1. In section 6.32 of the Draft Report six cohort studies are identified as presenting evidence on the relationship between SSBs and the incidence of T2D. It is stated that "these were not combined into a meta-analysis due to variation in both serving size and the definition for SSB." In the supporting documents (Chapter 4: Diabetes) [7] it is stated "there was little confidence that the studies could be combined in meta-analysis without a very large amount of heterogeneity." In contrast, section 6.33 refers to the publication by Greenwood *et al* 2014 [8] in which a meta-analysis is carried out and discussed in significant detail. This is confused, it appears the authors of both the Draft Report and the supporting documentation believe a meta-analysis was not appropriate but yet the Greenwood meta-analysis is used to inform the conclusion of this section. Furthermore the selection criteria used by Greenwood does not reflect the SACN criteria. Significant review of the evidence used and the appropriateness of a meta-analysis is sought. Without the inclusion of the Greenwood paper it would be questioned whether the conclusions drawn in section 6.34 of the Draft Report could be made, and if the evidence base could be considered moderate.

4.1.2. Regarding SSBs and T2D, the Draft Report's analysis excludes nearly half the identified studies (4 of 9) because of varying definitions of SSBs (Section 6.33 [3]). Setting aside whether that exclusion was proper in the quantitative analysis, it does not necessarily follow that those studies should also be excluded from a qualitative analysis. These studies illustrate the complexity and inconsistency of this body of data.

4.1.3. Montonen *et al.* 2007, found no significant association (RR 1.60, 0.93, 2.76 in the highest soft drink consumers) [9]. Nettleton *et al*., 2009 found no significant associations among men (1.09 (0.89, 1.33) or women (1.17 (0.94, 1.46) among the highest consumers [10]. Eshak *et al*. 2013 found no association in men (0.98 (0.68, 1.42)), but a significant association (1.79 (1.11, 2.89) among women [11]. Paynter *et al*. 2006 found no association for men (1.09 (0.89, 1.33) or women (1.17 (0.94, 1.46) among subjects consuming ≥ 480 ml a day [12].

4.2. Heterogeneity in this dataset

4.2.1. Examination of the paper cited in support of the risk of T2D from consumption of SSBs recommendation, Greenwood [8], which is outside the main systematic review and where the associations reported for SSBs exceed proposed I^2 statistic for moderate of 50%, indicates that the authors themselves identify extreme heterogeneity within the database of six cohorts included in the analysis. The pooled RR estimate presented from the linear-dose response meta-analysis was 1.2 (95% CI 1.12, 1.29)/330ml/d SSB with significantly high (P<0.001) heterogeneity, I^2 = 80%. Despite the authors best attempts to identify the cause of the heterogeneity and the removal of one study (the ARIC cohort with a RR risk of 1.01) heterogeneity remained at I^2 = 65% with huge variation in the confidence interval of this value from 9 to 87%.

4.2.2. Four of the five studies in the remaining analysis are from US cohorts, one of which relates solely to a population of African American women. This I^2 statistic is greater than the criteria set by the committee and the submission of this data without the rigorous control imposed by the systematic review is questioned, particularly as the original review identified, "that there was little confidence that the studies could be combined in meta-analysis without a very large amount of heterogeneity" and that three of the cohorts are common to both analyses [7].

4.2.3. The one European study included in the Greenwood meta-analysis [8], the EPIC - InterAct study [13], would fail to meet the inclusion criteria established by SACN as it a case-cohort study of incident T2D based on cases occurring within the EPIC study cohorts and matches incident cases with a random sub cohort. Thus it is not a prospective cohort and includes incident cases of T2D. In addition usual food intake was established once only at baseline and thus any changes made to intake during the course of the study have not been measured.

4.2.4. It is worth recalling that the I^2 values equate to the variation between study estimates to accounting for either 4/5th or approx. 2/3rd of the total in these two analyses and appears only to be included when the standards for heterogeneity are changed and relaxed to a highly questionable extent.

4.3 Lack of consideration of potential confounding

4.3.1 A major limitation of meta-analyses is the inability to control for potential confounding, including residual confounding. The data indicate that the potential for residual confounding to affect the association between SSBs and T2D is substantial. As the Committee stated in the Diabetes background section, "Most studies included here, that were conducted in the USA, report that high consumers of sugar-sweetened beverages differ from non- or low-consumers in many aspects of lifestyle. Consumers are more likely to smoke, to be sedentary and to have a higher energy intake (Schulze *et al*., 2004 [14]). These are lifestyle attributes that could potentially confound the association between SSB

consumption and risk of T2D (p140 [7])".

4.3.2 There is evidence of confounding in this data, and the problem may be more severe than the study methods are capable of addressing. BMI is an example. Adjustment for BMI attenuates the association between SSBs and T2D, which is consistent with the dominant role that chronic obesity plays in T2D. If self-reported estimates of BMI are biased downward, particularly among higher SSB consumers, this could in turn lead to under-adjustment for BMI. Data from the Harvard Nurses Study and Health Professionals Follow-Up Study [14-16], data on which the Draft Report relies, show that subjects on average tend to under-report their weight by 2-3 pounds. Data from several sources, including the EPIC cohort cited by the Draft Report, indicate that heavier subjects tend to under-report their weight more than other subjects [17]. Men, in particular, tend to over-estimate their height, again leading to an under-estimate of BMI [17]. This evidence indicates that adjustment for BMI may be incomplete in an important subset of study subjects. In addition in many of the cohorts intake of SSB is also self-reported.

4.3.3 Energy intake is another important potential confounder that may lead to spuriously increased risks. There is evidence from several cohorts that heavier subjects tend to under-report their energy intake, which could in turn lead to under-adjustment in that group [18]. Any meaningful overlap between those subjects and higher SSB consumers will artificially inflate the relative risks. SSB consumption also tends to be correlated with a number of other potential risk factors for diabetes, which may not be accurately reported or adjusted for in the data. For example, in the Harvard Health Professionals Follow-Up Study, higher SSB consumers tend to have lower Alternative Health Eating Index Scores, higher intake of red and processed meat, a higher prevalence of smoking, and less physical activity than those who consume little or no SSBs [19].

4.3.4 The Draft Report acknowledges that with cohort studies, “There is substantial potential for bias” and the authors of the cohort studies on which the Draft Report relies in relation to SSBs and T2D, echo that need for caution in their papers:

- Schulze *et al*., 2004b [14]: “We cannot prove that the observed associations are causal because residual confounding could theoretically affect the observed association.” Similarly, although the authors adjusted for BMI, “It is possible that underreporting of body weight, particularly among heavier women, may have led to an underestimation of weight gain.”
- The InterAct Consortium, 2013 [13]: “Although we adjusted for multiple factors and performed several sensitivity analyses, we cannot totally rule out residual confounding or reverse causality”.

Despite acknowledging the “substantial” potential for confounding, which is born out in the data and in particular the fact that the association between SSBs and T2D diminishes following adjustment for known and suspected risk factors, the Draft Report appears not to follow its advice for caution given in Chap 4 [7], specifically to “Please interpret observational data with caution: With observational studies there is substantial potential for biases.”

4.4 <u>Conclusions related to T2D</u>

4.4.1 Despite the high degree of variation and heterogeneity in the evidence, the Draft Report says, "An association is indicated between greater sugar-sweetened beverage consumption and higher incidence of type 2 diabetes mellitus (RR 1.07, (95% CI 1.05, 1.08) for each 100ml/day increase, with a heterogeneity I^2 = 65 [8]".

We would suggest that this conclusion does not reflect the detailed analysis reported in Chap 4 [7], but perhaps reflects undue emphasis on the results of a single meta-analysis not conducted by SACN, where the limitations of the underlying studies and analysis have not been taken fully into account. It is suggested that this draft conclusion cannot be said to be a true reflection of the totality of the data. The significance to public health of an increased RR of 0.07 is likely to be inconsequential particularly where the meta-analysis is based on 10 or fewer trials as there is less power to detect bias and false positive results can be generated [20].

Important factors for consideration in respect of this conclusion include:

4.4.2 "No RCTs reported outcomes concerning sweetened beverages and incident DM (p140) [7]".

4.4.3 There were no associations reported between sugars, SSBs or for other diabetes-related endpoints:

- Sucrose and type 2 diabetes: no association, based on limited evidence p88 [3]
- Glucose, fructose, or lactose and type 2 diabetes: no association, based on limited evidence p89 [3]
- SSBs and insulin resistance: no firm conclusions can be drawn p105 [3]
- SSBs and glycaemia: no firm conclusions can be drawn p105 [3]
- SSBs and insulinaemia: no firm conclusions can be drawn p105 [3]
- There is a lack of evidence to draw conclusions about an association between SSBs and a number of diabetes co-morbidities like coronary events, stroke, incident hypertension, weight gain, fatness, energy intake, and an adverse lipid profile. p102-103 [3]

4.4.4 The evidence for most dietary components and obesity outcomes (which is related to T2D) is acknowledged on p102 -103 of the Draft Report and summarized in para 6.72 [3]. "Due to the paucity of studies there is a lack of evidence to draw conclusions on the impact of sugars intake on the majority of cardio-metabolic outcomes in adults including bodyweight."

4.4.5 Overall, therefore, the picture is not one of an association between SSBs or sugar and T2D or other cardiometabolic end points. Importantly, the Draft Report does not appear to address the totality of the data including, e.g., the significant inconsistency between the lack of an association between carbohydrates or sugar and T2D and the reported association between SSBs and T2D.

4.4.6 In light of the major methodological limitations, confounding, variability of the evidence, the unsound nature of the association and the lack of supporting evidence (randomised controlled trials demonstrating an association between SSB and incident T2D or risk factors thereof, see Table 6.1 (p102) describing insufficient evidence of links of sugars, and SSB to BMI, weight gain, etc. We suggest that consideration is given to the following conclusion which more accurately reflects the totality of the evidence base:

<u>Sugar sweetened beverages and type II diabetes</u>

- **No** association
- Limited evidence

For the same reasons it is also suggested that reference to this association in Section 12.12 [3] should be removed.

5. Energy intake, sugars, body weight and BMI

5.1. The Draft Report (p102-3 [3]), summarised in para 6.72, acknowledges that there is inadequate good quality evidence to "draw conclusions on the impact of sugars intake on the majority of cardio-metabolic outcomes in adults including body weight".

5.2. The Draft Report states that "as energy intake in excess of requirements can lead to weight gain over time, higher energy consumption is deemed to be detrimental to health".

5.3. The Draft Report concludes that diets higher in sugars are likely to be higher in energy and infers that higher sugars consumption is therefore detrimental to health. However, whilst body weight and BMI measures are available in most of the studies comprising the evidence base, this objective measure of 'health' is not evaluated. Whilst many of these studies are not of sufficient duration to give an accurate, confident reflection of a longer impact on weight gain, in the majority of cases body weight fell from baseline, regardless of the contribution of sugars to total energy intake. We propose that short term energy intake is not a reliable proxy for long term weight gain.

5.4. In reviewing the totality of the available evidence, it is apparent that the interpretation of the scientific evidence from a number of Expert Reports is at variance with the conclusions in the Draft Report. Scientific Authorities suggest that sugars (free or otherwise) do not have a unique effect on body weight beyond its contribution to calorie intake (WHO, 2004 [21]; EFSA, 2010 [22]; and IOM, 2005 [23]).

5.5. More recently, the WHO Nutrition Guidelines Advisory Group's (NUGAG) published systematic scientific evidence review and meta-analysis on dietary sugars and body weight confirms that any role of sugars on body weight results from its energy contribution to the diet overall and not specific to sugars (Te Morenga, *et al*, 2012 [24]). The authors state, "The data suggest that the change in body fatness that occurs with modifying intake of sugars results from alteration in energy balance rather than a physiological or metabolic consequence of monosaccharides or disaccharides."

5.6. Despite different inclusion criteria these various authoritative reports and analyses arrive at similar conclusions. Consequently, we and others conclude that the totality of the evidence does not support a specific relationship between the intake of sugars and body weight when consumed at typical levels as part of a regular diet on a long term basis.

5.7. <u>SSBs, bodyweight and BMI</u>

5.7.1. Evidence relating to this food and beverage group, SSBs (presented as a subsection of the so called free sugars) and body weight is limited. The Draft Report identifies three randomised controlled trials (RCT) on SSBs and BMI in children (James et al., 2004 [25], Ebbeling *et al*., 2012 [26] and de Ruyter *et al*., 2012 [27]). As the committee reported, James *et al*., 2004 [25] did not test the direct effect of SSBs on body weight. Thus the recommendations that SSBs have an effect on BMI are based on the two trials (Ebbeling *et al*, 2012 [26] and de

Ruyter *et al*., 2012 [27] Ch.11[3]).

5.7.2. In the study by Ebbeling *et al*, the authors concluded that "replacement of sugar-sweetened beverages with non-caloric beverages did not improve body weight over a 2-year period". This paper is discussed in section 6.56 [3]. The primary outcome measure of this study was the change in BMI at 2 years, which was not different between the intervention or control groups. Furthermore the change in BMI between groups at year 1 was only of borderline significance (p=0.045). In addition, the control group, as well as the intervention group significantly reduced their SSBs consumption at yr 1 & 2; therefore the success of the intervention could be questioned.

5.7.3. In the trial by de Ruyter *et al,* the BMI in the non-caloric group did not go down, but the magnitude of increase was less than the control group. It is of significance that when the intention to treat analysis, including the study completers and dropouts, was performed, the difference in BMI Z-score between the control and the intervention group became non-significant (P = 0.06). In response to comments regarding de Ruyter paper, Kahn and Sievenpiper [28] stated that "the trial results were not persuasive that sugar *per se* has an impact on body weight. Indeed, sugary beverages seem no better a target for reduction than any other source of excess calories. The issue likely remains overconsumption in general".

5.7.4. Considering the lack of effect on the primary outcome measure, we would ask SACN to reflect on the statement in point 6.58 that "The other two trials (those referred to above)…both report effects of consumption of SSB on increasing BMI (Ebbeling *et al*, 2012 [26]; de Ruyter *et al*, 2012 [27])". This is certainly not a true reflection of the evidence presented in the Ebbeling paper as it reported no difference in BMI; with the same being the case, in what many perceive as the more rigorous intention to treat (ITT) analysis of [27].

5.7.5. We would ask SACN to reflect on the judgment of the evidence base in this section, both its consistency with respect to the effect of SSBs on BMI and also on the adequacy of the available data.

5.8. <u>Study limitations</u>

5.8.1. Many of the studies required mandatory consumption of large volumes of SSBs. Studies that are blinded do not reflect the real-life situation and will not adequately reflect the behavioural changes that might more naturally occur in practice and are therefore limited in their applicability as an evidence base for public health recommendations.

5.8.2. However several SSB studies demonstrate that weight gain is much less than predicted or expected from the energy difference (Rabin *et al*., 2002 [29]; Reid *et al,* 2007 [30], 2010 [31], 2014 [32]). The RCTs on children are noteworthy in using more realistic amounts of SSBs substituted with low calorie beverages.

5.8.3. It could be suggested that blinded studies such as that by De Ruyter *et al*. [27], where subjects are not aware of the caloric content of the drink, do not reflect day-to-day practice and thus whether they truly reflect behavioural changes that would take place in practice is debatable. It is also noteworthy that in these studies compliance was measured only in the intervention group and not in the control group. In RCT's, measuring compliance, particularly with dietary interventions is very challenging.

5.8.4. In Chap 11, 11.8 [3] there is confusion between SSBs **reduction** and addition "RCT's conducted in children and adolescents indicate that consumption of SSBs as compared with non-calorically sweetened beverages resulted in weight gain". It would be more accurately stated: *consumption of non-calorically sweetened beverages in place of SSBs resulted in reduced weight gain*.

5.8.5. We would ask that SACN consider whether the totality of the scientific evidence presented on SSBs, bodyweight and BMI does, in fact, provide scientific substantiation for an association. This consideration, along with the lack of evidence linking the consumption of SSBs to cardiometabolic risk (Chap 12 12.10 or colorectal cancer (Chap 6 6.5) [3] questions the basis for the resulting population recommendation, in both adults and young people, to "minimise sugar-sweetened beverage consumption.

6 Concluding comments

Overall, the recommendation for the population to minimise the consumption of SSBs is not supported directly or indirectly by the evidence presented in the Draft Report on Carbohydrates and Health. This recommendation appears to go beyond the terms of reference of SACN and does not accurately reflect the totality of the evidence, which is fragmented, inconsistent and therefore inconclusive.

It is hoped that SACN will address the scientific points that have been raised in our response and will reflect this in the final report on Carbohydrates and Health.

Gavin Partington
Director General

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