Comments on the WHO Draft Guideline: Sugars intake for adults and children.

Submission by Professor WPT James* and Professor A Sheiham**

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We declare that both authors have no interests to declare.

- We welcome and congratulate the WHO on this much needed report. The extent and depth of the analysis of both weight relationships and dental caries sugar are very timely and the use of the systematic reviews gives greater general credibility to the proposals made.

- Separate comments are made on dental caries and on overweight and obesity.

- Our comments centre mainly on the Recommendation that the WHO suggests further reduction to below 5% of total energy is described as a "conditional" recommendation.

Suggested Recommendations.

1. **Adult caries and adult obesity should be emphasized in the context of the recommendations**.

We consider that the recommendation should be reworded to highlight the applicability of the recommendation to adults as well as to children as WHO may not realize that in terms of dental caries even international experts still focus on children only. Furthermore policy makers unfamiliar with the real evidence also tend to focus immediately on children's obesity and do not recognize the huge importance of bringing adult weights down soon to reduce the health expenditure as well as limiting the disability and early deaths related to excess weight.

The citing of adult caries is valuable but underplayed in the draft release - it is exceptionally important that this is highlighted as adult caries accounts for about 80% of the dental care costs relating to caries compared with only 20% for children up to the age of 18 years.

In both adults and children, WHO recommends that intake of free sugars not exceed 5% of total energy (strong recommendation on the basis of the best quantitative data that the unique cause of dental caries is sugars).

2. As in the previous WHO reports on Diet, Nutrition andthe Prevention of Chronic Diseases (TRS 797, 916),dental caries gives us the unique ability to set quantitative limits for sugar intakes in relation to disease. The dose response relationship between sugar and caries is actually log linear".Recommendationsshould therefore be based not only on the dose response relationship, as in the earlier WHO reports on the subject but on the basis of WHO's policy of assessing risk factors and their magnitude on a counterfactual basis. That is exactly why one should consider 5%E needs greater precision in thinking.

Dental caries.
Introduction:

1. Many helpful points were set out and the WHO is to be congratulated on this. Thesystematic review by Moynihan and Kelly is the most extensive and rigorous on the subject and will enrich the scientific literature. However there are some drawbacks in the presentation perhaps arising from a stereotyped interpretation of epidemiological data relating to the disease process of dental caries.
2. Cariesis uniquely caused by free sugars. The only confounders on a population basis relate to the potential benefit of exceptional dental care on a routine basis and the use of fluoride in drinking water and in toothpastes. We are now, however, fortunate to have exceptionally good evidence on these two confounders. The first confounder of dental care can be discarded because even with superb systematic dental care in an affluent society there is a progressive increase in the prevalence of caries if the sugar intakes are similar to those in many affluent countries as revealed by the Dunedin study (Broadbent et al 2008, 2013).So effective repeated dental care - actually incorporating the use of fluoride enriched toothpastes does not stop the progressive increase in dental caries from the age of 5 years up to the age of 32 years. The WHO report citing the NUGAG committee's analyses and presumably reflecting the NUGAG associated systematic review by Moynihan and Kelly,do not explicitly deal with this issue to demonstrate that the standard dental view that routine tooth brushing and even repeated dental care cannot prevent the progressive increase in dental caries if free sugars are provided in the diet and in soft drinks.
3. The second supposed confounder is fluoride in the drinking water. Here we are fortunate to have plenty of evidence that fluoride does not prevent the development, but simply reduces the burden of caries by about 10% (Slade et al 2013).The NUGAG report failed to take into account the old evidence,recently made available in English,of the established quantitative relationships between sugars and dental caries and the more recent evidence that there is a major burden of dental caries in middle aged and older adults who have been exposed to fluoridated drinking

water for most of their lives.We now have clear evidence of the quantitative link between caries and national estimates of dietary sugars (Sheiham & James 2014).

4. There is no evident threshold for sugars but a log-linear increase in caries rates between <1kg sugar/caput/yr. (≈0.05%E) and 5–7·5kg sugar/caput/yr. (≈2·7%–4·1%E) if teeth that have been erupted for 7–8 years are considered. The positive correlation between sugars and caries was +0·7 with a log-linear relation at both lower and higher sugar intake levels for all tooth types if 1–8 years of sugar exposure is considered (Figure 1).

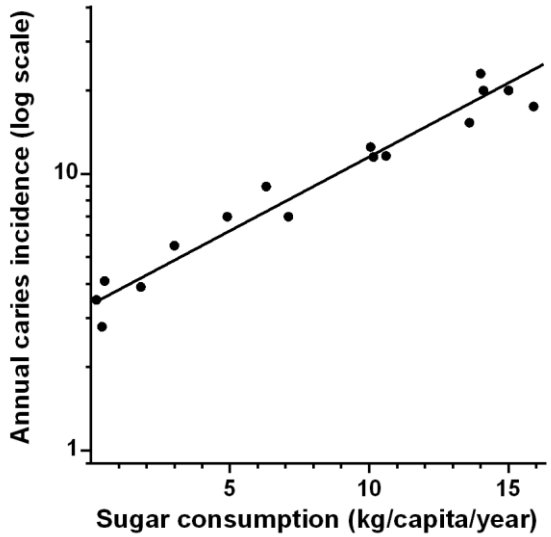

Figure 1. Relationship between annual per capita sugar consumption and annual caries incidence in lower first molars. Data based on a nationally representative sample of 10,553 Japanese children who were monitored yearly from the age of 6 to when they were 11 years old. Data plotted on a log scale. (See Sheiham & James 2014a,Attached)

5. The report should have pointed out that a disease that is caused specifically by free sugars and affecting 3.9 billion people worldwide means thatuntreated caries is the most prevalent of all 291 conditions assessed in the recent Global Burden of Disease study (Marcenes et al 2013). “Worldwide, oral disease is the fourth most expensive disease to treat; dental caries affects most adults and 60-90% of schoolchildren, leading to millions of lost school days each year, and remains one of the most common chronic diseases; ...” (FDI 2012).
6. The Report might also have highlighted thatif any foodstuff commonly consumed were to cause ulceration of tissues in the gastro-intestinal tract, it would be banned. Yet the intake of sugars, that causes cavitation and destruction of the hardest tissue in the human body (Figure 2) is not considered a risk factor that needs strong controls to ensure that intakes are minimized.

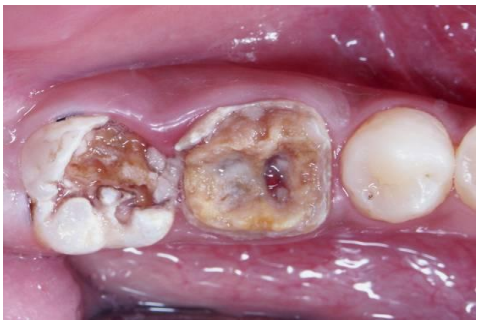

Figure 2. Dental caries in children related to sugars consumption. Dental decay has destroyed most of the molar teeth and the disease has extended into the dental pulp.

Detailed Comments:

1. **NUGAG should not downgrade the 5% of total energy value to conditional on the basis of only having so called "ecological" evidence.**Sugars have been known for several decades to be the unique causative factors (we can supply papers on this if this is not understood). The usual great caution associated with ecological analyses is appropriate when one has several confounding casual or major potential modifying factors but there are none in relation to dental caries: when sugar intakes in a region, or country are negligible caries is practically non -existent even in octogenarians who have been exposed to the dietary sugar intakes for many decades. For example, people of all ages on diets low in sugars, such as in Nigeria in the 1960s, had negligible dental caries(98% of all ages being completely free of caries) despite having poor hygiene and many variables considered to be confounders of dental problems in general.
2. **Caries does not develop unless dietary free sugars are available**. Fluoride and tooth brushing only modify the magnitude of the relationship between free sugars and dental caries. So, ecological studies which take account of the prevailing fluoride content of drinking water and the availability and practice of toothbrushing with fluoride toothpastes, allow one to set very clear limitsto appropriate free sugar intakes from ecological studies alone. The simple dismissal of ecological studies may well be relevant to other analyses but the fundamental link between the presence of free sugars and caries, doubtless understood by the eminent NUGAG panel, cannot be dismissed by epidemiologists if these analysts of population data do not take account of the intrinsic biology of dental caries development. Therefore the sugar/dental caries intrinsic link allows the use of so-called ecological evidence as a fundamental part of the epidemiological analysis; analyses are intrinsically incomplete and likely to be unsound if they rely only on trial evidence or cohort studies.
3. **Cohort studies are very unreliable in quantifying diet in individuals** over the period of observation chosen in many studies. Some of the most famous routinely cited studies have been formally analyzed by statisticians and shown to generate both highly significant positive as well

as negative results purely on the basis of the intrinsic measurement errors in dietary methodology and in any outcome variable being considered.Where any genetic inter-individual differences in responsiveness to a dietary ingredient are substantial (as in the case of saturated fat intakes and plasma cholesterol responses) then cohort studies will often show no effect given the usual errors and limited variability in the dietary range within a cohort. The increasing reliance on cohort studies to infer the potential effects of dietary change is therefore of concern. However, this is different from deriving an overall national **average**figure for a dietary ingredient and a disease outcome if these measures are carefully made and appropriate on a national basis.

4. **Goal setting.** It is specified that the ecological association cannot take account of what the individual intakes areof the children or adults with caries. True but that is not the point. In making national guidelines one is taking account of the prevailing conditions in a country and setting a national average value for some dietary factor. That is the point of guidelines. So even if there is variation in intake in the country it does not matter as the measure that one is specifying is the average value of sugar intake. This is clearly understood to mean an average value on a national, regional or community level. This is the essence of public health policy making.
5. **Failure to take proper account of caries in adults.**
The WHO Guidance text specifies that “Dental caries is a progressive disease, and being free of cavities in childhood does not mean being caries free for life.” Most dental caries occurs in adults (Figure 3)(Bernabé& Sheiham 2014a, 2014b). Taken together, the data showing lower dental caries rates in children at intakes of sugars equivalent to less than 5% of total energy intake still reveal a progressive and substantial burden of current or treated dental caries when one considers adults. Thus to prevent the accumulated burden of a disease that progresses throughout the life-course suggestsgreater benefits in adult life from limiting free sugars intake to less than 5% of total energy intake. Given the greatest burden of caries occurs in adult life and the majority of treatment costs are also occurring in adults we now need to see the general understanding of this problem extend to both academic and practicing dentists (Sheiham & James 2014).

Most policies, research programmes and surveys on dental caries have focusedon children. However, in a study in 26 countries with comparable summary data on dental caries for different World Health Organization (WHO) index ages, **v**ery much higher levels of caries occurred in adults in all 26 countries. For most countries, irrespective of the DMFT levels in 12-year-olds, the percentage difference in levels of DMFT between 12-year-olds and 35-44-year-olds was above 500% and the relative difference was 5 or more. Caries levels were also very much higher in adults than in children in all countries with high percentages of their population consuming fluoridated water (Bernabe &Sheiham 2014b).The numbers of fillings needed to treat the extra caries between the age of 12 and 35-44 years is as follows: Finland 20 fillings per person, Germany 13.8, Denmark 15.8, UK 10.4, Czech Republic 14.9. Figure 4 shows the age relationships of dental disease in children and adults of

different ages where it is evident that there is a verymarked increase in dental caries after the teenage years. Even in countries with fluoridated water supplies, the burden of dental decay progresses throughout adult life.(Bernabé& Sheiham 2014b).

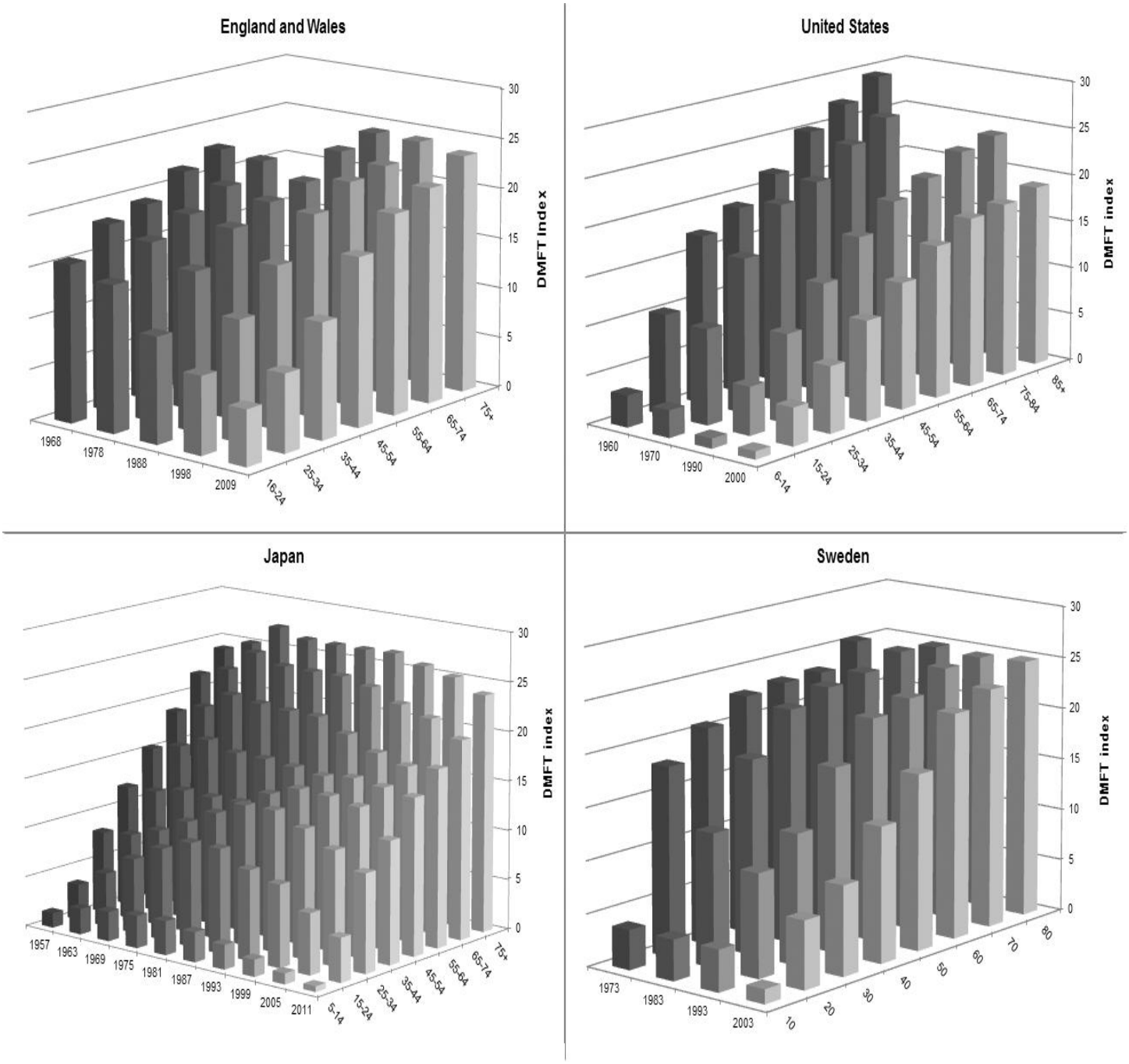

Figure 3. Increase in caries in four countries showing that the largest burden of caries (Decayed, Missing and Filled Teeth = DMFT), is in adults and that caries rates increase as people get older (See Bernabé and Sheiham 2014a, Attached).

6. **5%E sugar is a high value andshould not be conditional.** The attached papers generated from a background document with references provided to some of the NUGAG committee already show that there is an absolutely clear log linear relationship between sugar intake exposure over 5-8 years only and the incidence of dental caries. Indeed a 2-3%E sugar intake(equivalent to a 5kg/year intake leads to about a3 fold increase in caries rates so that if one takes the accumulation of caries over 6-7 decades then this, in a non-fluoridated water society induces a heavy burden of disease. So a 5% value(equivalent to <10kg/yr as shown in Figure 1) in a non- fluoridated country leads to almost a 9 fold increase in caries rates) and such a high figure can only be justified in a fluoride water treated country where fluoride toothbrushing is also routine. We suggest that this should have been a major public health point made in the WHO document.
7. **A 10%E sugar value is near sugar saturation levels for a maximum dental caries burden.**Because the NUGAG concentrated so much on clinical trials and cohort studies the point that **10%**E sugar value is near sugar saturation levels for maximum dental caries burdenseems to have been overlooked. This is clear from Figure 1 but also from numerous observationalstudies. For example, in Low and Middle income countries where fluoridation was not yet applied to water sources, e.g. Bangladesh, Cambodia, China, Ethiopia, Ghana, Laos,Mozambique,Nepal, Nigeria, Laos, Tanzania, Uganda, Vietnam and where annual per capita sugar intakes as low as 10Kg/year (about 5%E) was common levels of dental caries in 12 year olds were already high; about 50% of children were affected (WHO 2004). Given the expected marked subsequent increase in dental caries to be expected in adults, a 5% free sugar intake in these societies would still lead to a major increase in the burden of dental disease.
8. **Fluoride is valuable in reducing and delaying sugar induced caries**We stress the benefits of fluoride but it is not a substitute for drastically limiting sugars in the diet. Flouride use still leaves a prevalence of sugar induced caries affecting over 90% of adult populations. We regret theWHO Report did not make this point so that the importance of fluoride could be emphasized. Yet when populations consuming fluoridated water e.g. Australia where 80% are consuming fluoride, or Malaysia (76%), Ireland (73%), United States (66%), New Zealand (61%) and Canada there is still a striking increase in caries with age and most of the caries experience is in adults not in children (Sheiham & James 2014b).
9. **Role of fluoride**An explanation for why there are high numbers of teeth affected by caries in adults despite the low levels of caries in children and adolescents is that fluoride, the main reason given for the caries decline in children, does not appear to increase the resistance of enamel enough to control the demineralizing effects of acids produced from dietary sugar. Fluorides may be indeed be slowing the progression of the sub-clinical caries process and this may be more effective than in previous decades when fluoride toothpastes were not so widely available and used but the fluorides are simply delaying the clinical manifestation of caries as a cavity until later in the life course. Nevertheless, the caries process continues,

because the determining factor, sugars, has not been adequately controlled.

10. **Neglect of last decades' counterfactual analyses.**It seems clear that some of the review group considering the NUGAG reportmay not be conversant with the wealth of new WHO analyses which specify an optimum level of a risk factor when analysing the burden of disease. WHO made a major contribution in developing this concept which illuminates the need globally to consider the global diet and not just the Western "norms". We advocate the continued use of this counterfactual approach and therefore the importance of setting optimum levels. The report notes the previous WHO analyses, but perhaps they should have considered the original 797 report on sugars in more detail because in the 797 report (where one of us was the author of the expert report on dental caries and the other the Chair of the Expert Technical Consultation), we set the lowest limit at 0% free sugars on the grounds that it is a totally unnecessary dietary ingredient. At that stage the counterfactual concept had not emerged but now one should be able to say confidently that the counterfactual level for free sugars intakes is 0%E. This argument would have immediately strengthened the very generous choice of the high level of 5%E sugar intake provided one has suitably fluoridated water for universal use.Certainly most lower income countries do not have dental facilities and dental caries is a recognized cause of slow growth in children in these environments.

We attach 4papers which are either published or in press or in the late stages of review with editorial boards.

1. Bernabé E; Sheiham A. 2014a.Age, Period and Cohort Trends in Caries of Permanent Teeth in Four DevelopedCountries. Amer J Pub Health (In press).Shows the increase in caries with increasing age based on national surveys in four countries.
2. Bernabé E, Sheiham A. 2014b. Extent of Differences in Dental Caries in Permanent Teeth Between Childhood and Adulthood in 26 Countries. Int Dent Journal (in press). Shows the percentage and actual increases in caries between the ages of 12 and 35-44 years. International Dental Journal (In press).
3. Sheiham A, James WPT. 2014a. The quantitative relationship between sugar intake and dental caries; the need for new criteria for developing goals for sugar intake. PloS One (Submitted). This outlines the basis for the dose response relationship between caries in children and sugars being linear.
4. Sheiham A, James WPT. A new understanding of the relationship between sugar, dental caries and fluoride use: implications for limits on sugars consumptionPublic Health Nutrition (accepted subject to higher quality redrawn figures) 2014b.

Free sugars and weight gain

a) Limited emphasis on burden of disease The WHO report should have specified that previous WHO analyses have shown that excess weight gain is the third most important cause of the burden of disease and early deaths in affluent societies and isthe 5th most important for all world health issues (WHO Global Health Risks 2009). No mention was made of the fact that now that obesity has become quantitatively more important in lower income countries than in affluent societies the DALYs in these regions are likely to be far higher than previously thought - for clear evidence of this see the new work on the Arab World in the Lancet 2014:

Rahim HF, Sibai A, Khader Y, Hwalla N, Fadhil I, Alsiyabi H, Mataria A, Mendis S, Mokdad AH, Husseini A. Non-communicable diseases in the Arab world. Lancet. 2014 Jan 25;383(9914):356-67

b) No mention of the burden and costs of weight gain induced diabetes, especially in lower income countries

There was also no emphasis on the huge burden of diabetes now induced in part by weight gain - one of its principal causative factors together with the nutritional and other epigenetic effects which are increasingly documented as the basis for the astonishing increases in diabetes globally.. Nor is it mentioned that the projected cost of diabetes induced by weight gainis unsustainable in lower income countries e.g. Latin America, the Middle East and Asia where the propensity to diabetes is 2-5 times greater for each increment of weight gain than that observed in well fed Caucasian populations. This extra burden has been attributed to maternal and early childhood nutritional problems amplifying the risk of later weight gain. Whatever the cause for this additional burden the widespread documentation of this additional susceptibility compared with the weight induced diabetes seen in Northern European and US Caucasians means that far more rigorous dietary and health policies are needed in lower income countries to prevent weight gain. The NUGAG's member's systematic review of the role of sugars in promoting weight, while not readily showing a quantitative relationship between sugars intake and weight gain, is still of exceptional value particularly in demonstrating that at present there seems to be no selective sugar or fructose effect on weight gain. Indeed this is to be expected as the effect seems largely (but not entirely) related to the impact of sugars on the energy density of foods and of course its presence in soft drinks and in fruit juices.This aspect of the widespread vulnerability of societies to diabetes and the remarkable levels of adult diabetes in Mexico and elsewhere in Latin America and Caribbean, the Middle East and Asia should have increased the emphases in the obesity section which is surprisingly weak given the need, as in the recent WHO plan,to arrest the increase in diabetes and obesity levels. Indeed the levels of gestational diabetes, relating to pre-pregnancy weight as well as gestational weight gain already evident in these regions warrants major emphasis in the WHO response to the systematic review conducted by the WHO group on sugars and weight changeswhich was couched in very conservative terms. Public health responses cannot afford, however, to be so conservative when dealing with the majority of the world's population in Latin America, the Caribbean, the Middle East and Asia where the populations are now already showing their exceptional vulnerability to weight gain induced or amplified diabetes.

c) Issue of quantitative relations between sugar intakes and weight

Given NUGAG's difficulty in quantifying the relationship between extra sugar intakes in either food or/ and drinks this is even greater grounds for the use of a counterfactual approach to setting sugar limits. Some of the reports on double blind trials, for example, that conducted in Copenhagen adults showed an effect of sugars on blood pressure and perhaps on some other cardiovascular risk factors as well as on weight gain so one might well argue that a free sugar intake of 0% is the ideal in these societies where the burden of disease appears to be so great on weight gain. This would then have reinforced the idea that a 5% level of intake is rather high if not generous from a public health point of view and a 10% value unwise. The WHO team developing this overview should also recognise the previous emphasis in the UK's National Institute of Clinical Excellence that public policy making should not rely on double blind trials since otherwise a huge burden of disease may be allowed to develop while supposedly suitable double blind trials are conducted. These trials are suitable for drug devices and pharmaceutical testing but not for dietary measures in public policy making. To argue otherwise smacks of inventing supposedly robust approaches to policy making with the intention of delaying appropriate public health initiatives.

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