



A perspective on sugar

Definitions

Sugars or total sugars – all sugars including all mono and di-saccharides present in foods and drinks whether naturally occurring or added.

Natural or intrinsic sugars – sugars naturally occurring and not added. These sugars are an integral part of the food such as fructose in fruit and lactose in milk.

Added or extrinsic sugars - (also called free sugars) sugar added to food products during commercial or home food preparation, as well as sugars that are naturally present in honey, syrups, fruit juices and fruit concentrates.

Sugar or refined sugar – purified sucrose or sucrose, a di-saccharide made up of glucose and fructose. Includes all forms – white, brown, icing, caster, muscavodo, demerara, golden syrup etc.

The role of sugar

Sugar containing foods have moved from being a highly sought after over 200 years ago to a major source of calories in the food supply of every country.

Food Production

Preservation – sugar maintains both flavour and colour of fruits in jellies and jams and preserved fruit. By retaining water sugar also keeps products like breads fresher for longer, adding to shelf life.

Texture – sugar can control the rate and extent of sugar crystallisation to create a wide variety of textures in foods. Sugar can vary in its degrees of viscosity impacting the mouth feel of a food.

Colour – when heated sugar caramelises enhancing colour and flavour.

Flavour – sugar is commonly used as a sweetener and to balance the tastes of salt, sour and bitter.

Fermentation – sugar provides “fuel” for speedy growth of yeast in foods and alcoholic beverages.

In our bodies

As a carbohydrate, refined sugar or sucrose provides energy and has physiological effects on our bodies, including, blood glucose and insulin metabolism, bile acid dehydroxylation and satiety.

Energy: Glucose (a breakdown product of sucrose and starches) is the sole “fuel” used by the brain and its processes, except during prolonged starvation. Because the brain lacks fuel stores, the body maintains more or less a continuous supply of glucose to the brain.

Insulin: Insulin is secreted in response to increasing blood glucose concentrations. It plays important roles in both carbohydrate and lipid metabolism and is necessary for metabolism of glucose by many cells.

Fructose Metabolism: The metabolism of fructose (the other breakdown product of sucrose) can lead to raised levels of uric acid. Studies have shown that uric acid stimulates the laying down of fat in the liver while fructose can be directly metabolised to form fat in the liver. Fatty liver is a risk factor for metabolic syndrome in susceptible individuals and studies have reported raised uric acid concentrations independently predict risk for obesity and diabetes.

Satiety: It is proposed sugar in large amounts induces leptin resistance and reduced satiety. Leptin is a hormone with a key role in regulating energy intake and expenditure. It has been described as the master regulator of appetite.

How much do we consume?

The most recent data on local intake comes from the 2008/09 New Zealand Adult Nutrition Survey (ANS). The survey reported a median daily total sugar from all sources of 120g (males) and 96g (females). The median intake of sucrose was reported as 55g (males) and 42g (females). A limitation of dietary surveys is when people record what they have eaten there is a temptation to under-report, so there may be many more people having larger amounts than this.

Generally men consume more sugar and calories than women and younger people have a higher intake than older people. Interestingly, under 30s consume approximately 25% of their sugar in beverages.

The main sources of total sugars in the New Zealand diet in decreasing order of magnitude are fruit, non-alcoholic drinks, sugar and sweets, milk and cakes and muffins.

How much do we need?

Both the American Heart Association (AHA) and the WHO have recently released guidelines around added sugar.

AHA – 6tsp / day women

9tsp / day men

WHO Less than 10% of energy intake (based on the median energy intake data from the 2008/09 ANS this would be no more than 15tsp (males) and 11tsp (females).

They also state there would be additional health benefits if we could go below 5%.

These recommendations include honey, syrups and fruit juice but exclude other intrinsic sugars, tacitly acknowledging while fruit and milk are naturally high in sugars in the form of fructose and lactose respectively they are important core foods in a healthy diet. It is also postulated the form and the amounts in which they naturally occur can mean some of the adverse effects described below may not occur, for example:

- In fruit, but not in fruit juice, the sugar is encapsulated in the cell wall, made of fibre, slowing the digestion and absorption.
- You get much more sugar when you have fruit as fruit juice, even without added sugar, because you use more fruit for a juice serving than when you eat the whole fruit.

What's the problem?

According to a review of literature some sugar as part of a healthy and balanced diet can pose little risk. However, the definition of a healthy and balanced diet can vary widely and the threshold and time of life at which sugar may have a negative health impact is unclear. Further muddying the water - there are many health conditions anecdotally linked to consumption of sugar and the threshold for which sugar has a negative impact is not the same for each condition.

The literature review highlighted six health issues; diabetes, cardiovascular disease, obesity, oral health, ADHD and addiction.

Diabetes

The review of the literature showed a positive association between added sugar intake and the risk of type 2 diabetes. It was thought this was because of its effect on weight gain and insulin resistance but there is also a growing body of work looking at the role fructose may have in the development of metabolic syndrome and insulin resistance in susceptible individuals.

Sugar added to drinks may also play a part. A review study based on 16,154 participants of which 12,403 had type 2 diabetes showed a daily intake of one (336ml) or more sugar sweetened beverages (SSBs) was associated with a 22% higher risk for type 2 diabetes compared with low consumers (< 1 glass / month). This association persisted after adjustment for BMI, indicating obesity may not be the main driver.

Cardiovascular Disease

In 2009 the American Heart Association recommended a significant reduction in added sugar intake, based on a positive association between added sugar and risk factors for cardiovascular disease. This is supported by a meta-analysis carried out at the University of Otago in 2013 (and published May 2014). The review found sugar adversely affects lipids and blood pressure suggesting sugar may be metabolised differently from other carbohydrates. Their conclusion; added sugar contributes to the risk of cardiovascular disease independent of the effect of sugar on body weight. This is supported by recently published results by Yang et al who showed a dose response of free sugars intakes on cardiovascular mortality.

Obesity

There is strong evidence to suggest a positive association between added sugar intake and excess fat accumulation or obesity. However obesity is a complex metabolic issue and it is very unlikely sugar, as a single food is the primary casual factor.

Its role is thought to be that added sugar contributes to more energy-dense nutrient-poor diets, promoting positive energy balance. It is also thought SSBs may have a stronger association with weight gain due to their low satiety signals and the likelihood they will be consumed with other energy dense foods. A meta-analysis carried out by the University of Otago concluded, "*Intake of sugar is a determinant of body weight in free living people consuming ad libitum diets*". The data supports the contribution of sugar to energy-dense diets, contributing to excess energy intake and therefore weight gain. This is in contrast to other views which include physiological and metabolic consequences of sugar intake as described earlier.

Oral Health

This is where the evidence is strongest and because it starts in childhood, affects life-long health. There is clearly a strong association between the consumption of added sugar and the development of dental decay, the most prevalent chronic disease in New Zealand. Sugar in food and drinks is hydrolysed by amylase in saliva to produce substrates which provide a favourable environment for oral bacteria. The bacteria cause demineralisation and destruction of the hard protective surfaces of teeth. Once these surfaces breakdown caries or holes can form. This effect is compounded when acid is present as in fruit juices and cola drinks.

The impact sugar on the development of dental caries is dependent not just on sugar consumed but also on oral hygiene, salivary function and fluoridation. Frequency of eating and / or drinking along with the amount consumed is also important, with studies showing a high frequency of consuming high sugar products is linked with an increase in the likelihood of developing dental caries. The amount of sugar consumed at one time is also important.

Attention-Deficit Hyperactivity Disorder (ADHD)

There are some cross-sectional studies showing a “dose-responsive” relationship between high sugar intake and behaviours like hyperactivity, lack of attention and aggression. Cross sectional studies cannot be used to show cause but may point the way to further research.

This is a controversial area close to the heart of many parents, with a lot of on-going research and we look forward to more definitive evidence.

Sugar Addiction

This is another highly controversial area with arguments both for and against sugar as an addictive substance. As discussed above, there is evidence sugar has an effect on the dopamine reward system in the brain. One limitation is many of the studies in support of addiction have been carried out in sugar-fed rats whose results do not always translate directly to humans. However they do point the way to on-going areas of research.

In the ‘against’ corner some researchers have argued it’s not addiction to sugar that motivates us to consume sugar; rather, it is because sugar is found in almost all food products. Most of us choose foods such as ice-cream, soft drinks and sweets because of their taste and texture not their nutrition content. The idea behind sugar as a rewarding substance may shed some light - perhaps we associate reward with sweet food as a whole and not necessarily sugar. And perhaps some people are more susceptible to sugar ‘temptation’ than others.

Conclusion and Recommendations

Sugar alone is not responsible for all the ills of today. However, it undoubtedly plays a role in some conditions, including dental caries, obesity, cardiovascular disease and diabetes - some to a greater degree than others.

So what does the NZNF recommend for consumers?

1. Eat food from all four food groups;

- vegetables and fruits
- cereals and grains (preferably wholegrain),
- protein rich foods like legumes, beans, meat, fish, eggs and chicken
- dairy products

Also include foods rich in healthy fats like olive oil, avocado, oily fish and nuts.

2. Aim to have no more than 10% of energy from added sugars. This means no more than 50g / day or 12 teaspoons. Less is preferable.

- Foods high in added sugar like sweets, muffins, cakes, muesli bars, biscuits and cakes should be regarded as treat foods and enjoyed in small portions.
- Sugar sweetened beverages (SSBs) should be replaced with water, milk, or “diet” versions.

A closer look: breakfast examples

Breakfast 1 – added sugar		Breakfast 2 – added sugar	
Toasted muesli ½ C	14.5g	Weetbix 2 biscuits	0.8g
Wholegrain toast 2 slices	2.2g	Wholegrain toast 2 slices	2.2g
Jam 2 teaspoons	21.2g	Marmite 1 teaspoon	0.7g
Orange juice 1 C	<u>19.7g</u>	Water	<u>0.0g</u>
TOTAL	69.7g	TOTAL	3.7g
TOTAL kJ	1171kJ	TOTAL kJ	62.2kJ
% energy men	12.3%	% energy men	0.7%
% energy women	15.6%	% energy women	0.8%
*foods with no added sugar are not included here		*foods with no added sugar are not included here	

Breakfast 1 seems like a healthy breakfast, but upon closer inspection of the numbers, it actually provides well over the recommended 10% of total daily energy from added sugar. By swapping out the toasted muesli with Weetbix, replacing jam with marmite and exchanging the orange juice for water the total sugar intake is reduced by more than 95%.

NZNF thanks Saphiya Zaza and Lauren Whitworth for their work in preparing the literature review; *The Role of Sugar in the Diet of New Zealanders*.

A list of references is available on request – email: info@nutritionfoundation.org.nz