

Sugar Consumption, Mood, and Mental Health

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Over the past few years, sugar consumption has gradually increased. According to the data provided by Badan Pusat Statistik (BPS), sugar consumption in Indonesia reached up to 5,2 million tons in 2018. These days, sugar is not only consumed through naturally occurring sugars found in food and beverages like fruit, vegetables, or milk but it is also consumed in the form of added sugars.

Based on United States Food and Drug Administration (US FDA), added sugar is defined as sugars that are added during the processing of foods (such as sucrose or dextrose), foods packaged as sweeteners (such as table sugar), sugars from syrups and honey, and sugars from concentrated fruit or vegetable juices. Main sources of added sugar include baked goods, desserts, fast foods, sugar-sweetened soft drinks or energy drinks, and other sweet tasting snacks. Most common types of added sugar are table sugar (sucrose) and high fructose corn syrup which contain glucose and fructose (DiNicolantonio *et al.*, 2017). Other than added sugars, numerous kinds of artificial sweetener also have been developed to add sweetness even when the food or beverages itself is already naturally sweet. A few types of artificial sweeteners that are popular among the food industry are aspartame, saccharine, sucralose, and neotame. These artificial sweeteners are much sweeter compare to regular sugar.

Most people love sweet tasting foods and beverages. One of the reasons is because many people strongly believe there is a connection between sugar consumption and mood. There is an assumption that consuming sweet stuff, for instance drinking sugar-sweetened soft drinks or eating chocolate, can uplift their mood instantly. It has become quite common that people use sweet tasting food or beverages as a form of coping mechanism to deal with negative feelings such as anxiety, stress, sadness, boredom, disappointments, loneliness, or other feelings that they have problem handling (Van Strien *et al.*, 2007 and Van den Tol *et al.*, 2019). This kind of coping mechanism is known as “emotional eating”. In that case, what is the exact link between sugar and mood? Is sugar consumption good or bad for long-term mental health?

First of all, let us talk about how sugar affects the brain. It is a common fact that there is a major link between sugar levels and how the brain works. Sugar, especially in the form of glucose, is in charge of how the brain functions, which include thinking, memory, and learning (Edwards, 2020). Glucose is needed by the brain as its primary source of energy in order to function properly. Our brain is the organ that is most energy-demanding due to the fact that it is so rich in nerve cells or neurons (Edwards, 2020). That is why the brain requires much more

glucose to supply energy compares to other organs of the body. The brain is dependent on sugar as its main fuel as it takes one half of the total glucose energy in the body (Novak, 2020 and Edwards, 2020). Therefore, it is proven that sugar undoubtedly has effects on cognition.

For the effects of sugar consumption on mood itself, there are quite a few researches that have been done to investigate this particular thing. The results are still much debated, since there are reports that confirm how sugar helps with mood improvement but there are also reports that state opposite findings. Unlike the effects of sugar consumption on cognition that are already well-proven and documented, the association between sugar consumption and mood on the other hand are not as dependable (Mantantzis *et al.*, 2019). Even though researches have not come up with a consensus regarding the exact effects of sugar consumption on mood, majority of people still agree with the idea of how sugar consumption facilitates mood improvement. That being so, which hypothesis should we believe?

It appears that there is a scientific physiological basis behind the theory that sugar consumption has something to do with the change of mood. As stated by Messier (2004), consumption of sugar, or pure carbohydrate consumption in general, is positively associated with the increase of neurotransmitters synthesis in the brain. This leads to increased availability of neurotransmitters like glutamate, acetylcholine, and gamma-aminobutyric acid (Messier, 2004 and Mantantzis *et al.*, 2019). Increased availability of gamma-aminobutyric acid affects alterations in dopaminergic activity (Levin, 2000). It is well known that dopamine is one of the neurotransmitters that regulates feelings of well-being (Blum *et al.*, 2014).

Apart from the dopaminergic activity, the serotonergic system, a system that is much related with mood, is said to be influenced by sugar levels as well. It has been suggested that effects on mood are associated with fluctuations in availability of serotonin that is affected by glucose ingestion (Markus, 2008). Tryptophan, an essential amino acid, is a precursor that is in charge of serotonin synthesis. On the report of Jenkins *et al.* (2016), it is stated that tryptophan levels play a significant role in mood regulation and showed antidepressants qualities. As stated by Rosenthal *et al.* (1987) and Markus (2007), sugar consumption leads to higher amount of tryptophan availability and increases serotonin synthesis. It is suggested that tryptophan levels only increase after pure carbohydrate ingestion, while protein consumption leads to lower levels of tryptophan (Mantantzis *et al.*, 2019). In other words, sugar is believed to have effects on mood improvement because of its connection with mood-related neurotransmitters, such as dopamine and serotonin.

However, a more recent study has been done to put things more into perspective. Back in 2019, Mantantzis and colleagues did a systematic review along with a meta-analysis about carbohydrate consumption (glucose, sucrose, fructose, or some mix of these) effects on mood.

They attempted to systematically deconstruct the complex relationship between sugar and mood as well as assess the influence of moderator variables, which have not been done in any researches before. The study combines results from 31 experiments that include a total of 1.259 participants. The purpose of this study is to assess carbohydrate consumption effect on a number of positive and negative overall mood at three different time-points, which are 0—30 minutes (immediate), 31—60 minutes (short term), and more than 61 minutes (long term). Surprisingly, the meta-analysis does not show any evidence of positive mood changes caused by sugar consumption at any time point. At the same time, it was found that sugar consumption leads to decreased alertness within 60 minutes post consumption and caused higher levels of fatigue within 30 minutes post consumption.

Moreover, it seems that the validity of sugar and serotonin mechanism is still questioned and received numerous critics since it has been difficult to replicate in experimental settings (Boyle *et al.*, 2018 and Mantantzis *et al.* 2019). Even in reports that provide explanations of how sugar affects the serotonergic system, it is found that this effect is only observable under specific conditions (e.g., people under stress and women during luteal phase of menstrual cycle). Furthermore, it becomes questionable if the effect of sugar consumption towards the serotonergic system applies to the general population, since studies are more often done with clinical populations (e.g., depression and obesity) rather than healthy individuals (Wurtman, 2018 and Mantantzis *et al.*, 2019). In addition, Jenkins *et al.* (2016) stated that manipulation of tryptophan level in healthy, never-depressed individuals showed no or little overall effect on mood. In contrast, lowering tryptophan levels resulted in acute depressive relapse in depressed patients.

Other than the systematic review by Mantantzis and colleagues (2019), similar outcome is found in a study done by Van der Zwaluw and colleagues (2014). They did a study that aimed to examine short-term effects of glucose and sucrose drinks consumption toward change of mood among 43 elderly people. The result provides no evidence of coherent effects on how sugar consumption (glucose and sucrose) has anything to do with mood. In fact, it is found that participants ended up with worse mood after consumption of sucrose drink. This leads us to the next question: “is sugar consumption good or bad for the long-term mental health?”

Strikingly, it is suggested that sugar consumption does not present beneficial effects on long-term mental health but could be harmful instead since it is related with depressive symptoms in some populations (Knüppel *et al.*, 2017). Depression is a common mental disorder that is affected by several modifiable environmental factors, which include diet (Danqing *et al.*, 2019). Multiple studies throughout the year have come out with biological

explanations regarding how sugar consumption is linked with increased risk of depression. Firstly, there is evidence from an experiment done in animals, rats to be exact, that are fed with high sugar diet (in the form of fructose) during preadolescence ended up with anxiety-like behaviour along with depressive-like behaviour in their adulthood (Danqing *et al.*, 2019). Similar results are found in human. High consumption of added sugar during adolescents promotes long-term dysregulation of stress response (Harrel *et al.*, 2015). In addition, overconsumption of sugar could increase risk of obesity. According to Sanchez-Villegas *et al.* (2018) and Mannan *et al.* (2016), obesity might be associated with depression development. Lastly, a meta-analysis presented by Danqing and colleagues in 2019, which combines 10 observational studies involving 37.131 depression cases among 365.289 participants, also discovered a possible link between sugar-sweetened beverages consumption and increased risk of depression.

In conclusion, sugar consumption does not provide a clear effect on any aspect of mood, at least not on healthy individuals. Therefore, consuming sweet tasting food or beverages as a form of coping mechanism is not particularly right. There are better and healthier strategies that can be done in order to cope with stress, anxiety, or any difficult emotions, such as exercising, watching movies, listening to music, taking a shower, sleeping, etc (Chan *et al.*, 2009 and Labrague *et al.*, 2016). It would be better to limit sugar consumption because it has quite many detrimental effects on health, on both short-term and long-term effects. For the short-term effects, sugar consumption is responsible for decreased alertness and higher level of fatigue (Mantantzis *et al.*, 2019). While for the long-term effects, excessive sugar consumption could be harmful for the mental health as it leads to higher rate of depression as well as promotes dysregulation of the stress response (Harrel *et al.*, 2015 and Danqing *et al.*, 2019). Not to mention, overconsumption of sugar could also increase risk of obesity.

Hence, it will not be a problem to consume sugar-sweetened drinks or sweet tasting snacks every once in a while. The most important thing is to maintain a balanced diet and keep in mind to not consume sugar excessively, especially in the form of added sugars. In Indonesia, it is suggested that a person's daily intake of sugar does not exceed 10% of the total energy intake (2000 kcal) or equals to 50 grams of sugar per day (Permenkes No. 30 Tahun 2013).

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