

# Sugar- The Sweet Silent Killer

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**Abstract**— Sugar begin a basic ingredient in almost all food culture, from ancient times till date performs various technological functions in food. It also has a significant role in our body. Sugar is a carbohydrate which has sweet taste. Also, a rapid and easy fuel for body to use. However, sugar consumption can implicate similar responses as consumption of drug of abuse. Sugar imbalance can result in sweet craving. It is important to eat sugar but if it is over consumed then it can be one of the reasons for diabetes, cardiovascular diseases, and obesity. It has also negative implications on body and brain. The reason behind over consumption of sugar is whenever sugar or sugary products are consumed by our body the reward system of our brain get activated due to which the individual feels better. Replacing or removing will alter the characteristic such as texture, taste, appearance of a food. For this, sugar substitutes can be the way to compensate will the reformulation giving the exact desired product. This review is focused on ‘sugar’ a term that simply mean sucrose and combined term for glucose, fructose and galactose. Aims on sugar and its potential impact on health on human health. Also, addiction of sugar, which is a controversial issue.

**Index Terms**— Sugar, Carbohydrate, ingredient, addictive, craving, over consumption, diabetes, stimulant, sugar substitutes, dangerous effects.

## I. INTRODUCTION

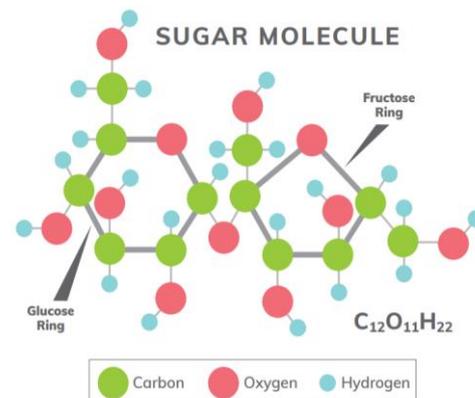
Who don't like sweet? From small toffies to chocolates and cakes, everyone loves eating sweet. We crave for eating chocolate in both bad and good moods. When someone says sweet, the first thing that comes to our mind is white amorphous crystalline sugar that make our lives sweeter. Sugar is naturally present in fruits and vegetables and Certainly, there is more to this. Sugar has the same effect on the brain as cocaine, is still an issue. Sugar rich foods including fructose or glucose are major concerned due to their detrimental effect on body. Sugar in one or other form is present in numerous types of foods, from drinks to processed foods.(Macdonald, 2016)



## II. WHAT EXACTLY SUGAR IS?

Sugar a term simply means sucrose and refers to a category of carbohydrates that includes the monosaccharides, disaccharides, oligosaccharides, polysaccharides and fibers. The monosaccharides are glucose, fructose and galactose,

and the major disaccharides are sucrose (glucose + fructose), lactose (glucose + galactose) and maltose (glucose + glucose). The mono and disaccharides are combined under the category of sugars. It has a simple chemical structure that contains one molecule of glucose linked to one molecule of fructose.(Butler & Barrientos, 2020)



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Fig.2 Sugar Molecule(Fructose, 2018)

Sugar is a rapid and easy source of fuel to body. Body uses this energy to motivated engage in various activities. So, do we have to consume extra sugar for more energy? No. John Yudkin, nutritionist and the author of book “Pure, White and Deadly” stated that we do not require sugar for our physiological functions. As we get glucose from various foods we consume.(John, 1986)

## III. CRAVINGS FOR SUGAR

Craving play vital role when it comes to addiction. Cravings can be resulted due to various factors directly related to reward stimuli that makes the brain wanting more and more sugary product containing both high sugar and fat. The implications for weight gain and other adverse effects can be combined effects of sugar and fat. Fructose in food, responsible for fat production and storage in part of

concern.(Freeman et al., 2018) Impairments in brain due to dopamine effect can be related to compulsive eating behaviors and also motivating and engaging in food-seeking. Findings on cravings of food (specially sugar) concluded that it can be the neurological factors that sense nutrient requirements and its taste.(Volkow et al., 2011) Intake of excessive sugar can trigger neuroadaptations in the reward system that lead to certain eating behavior, wanting more calories and resulting into overeating.(Macdonald, 2016) The sugar in the blood is actually glucose called as 'blood sugar'. There are hormones (insulin and glucagon) and various interactions that contribute to keep blood sugar normal. Mechanism is simple, when any ordinary food containing sugar is consumed, gets digested, it releases glucose in the body and gets absorbed by alimentary canal into blood. When blood sugar rises, insulin from pancreas, is released into blood stream, which lowers the sugar level to normal.(Freeman et al., 2018) When the blood sugar level lowers, our body crave for foods to increase it. It is a up and down process and hard to control. The prevalence of obesity, heart diseases and various other diseases can be directly linked to excessive intake of sugar.

There can be various reasons for craving for food such as unhealthy eating habits, stress, lack of sleep, and many more that makes a person to search for food to make one self-satisfied, relaxed, to overcome negative emotions and even feel happy. However, it's a major concern if this behavior becomes a habit.

Study done by Michael J. Butler and Ruth M. Barrientos suggested that the excessive consumption of foods high in fats, sugars and refined carbohydrates (western diet) throughout the world, contributes to prevalence of obesity and type 2 diabetes and could increase risk for severe covid-19 pathology and mortality among these people.(Butler & Barrientos, 2020)

Study argues on, overweight brain of people seems to be addicted to food or some obese people binge on food as food addiction. Particularly on food rich in added sugars and fat. Consumption of sugar can be related to the consumption of addictive substances such as nicotine or alcohol, as sugar intake raise the release of dopamine that is directly related to the rewarding system. But the effects of this is not as strong as by the addictive substances.(Freeman et al., 2018)

#### IV. METABOLISM

Millions of people across the world are getting affected by the type 2 diabetes disease; which may be one of the main causes of improper sugar metabolism. Growing scientific evidences shows that overconsumption of sugar, overtime is one of the reasons behind obesity, diabetes and cardiovascular diseases.

We all know that sugar contain glucose in it which is the primary source of fuel in our body. This fuel is very essential for the cells which are present in our body to grow. When we consume any food, enzymes present in the digestive process converts the complex elements into simpler form. For example, proteins are converted amino acids; fats into fatty acids and carbohydrates and starches into sugars like glucose and fructose. All of these elements are readily

absorbed into the blood. Insulin and glucagon are the two hormones which are involved in maintaining the blood glucose level.(Schorin et al., 2012) Cells requires glucose to grow and perform their normal functions. The flow of sugars in our body takes place as follows: Glucose (sugars) small intestine blood stream Insulin liver and other tissues.(Schorin et al., 2012) But the problem arises when the amount of sugar consumed and the amount of insulin secreted are not compatible or equivalent. me

When the food is consumed, the blood glucose level changes; the changes are corresponding increase in blood glucose level and subsequent decrease in glucose level. The blood in our body absorbs the glucose from gastro-intestinal tract. Then, the glucose present in the blood sugar stimulates the insulin which is present in the pancreas of human body. As a result of which the cells in our body starts up taking glucose. Due to which the blood glucose level again comes at its base level. Because of this the process of fat burning will stop and burning of glucose will start for energy production; as glucose is the primary source of energy. And excess glucose level will be store as glycogen in liver; glycogen is nothing but the polysaccharide of glucose or the excess glucose can also be store as lipid in fat tissues.(Schorin et al., 2012) This is the reason why excess glucose or overconsumption of sugar is one of the reasons for obesity.

When the blood glucose level decreases then, the glycogen is converted to glucose and thus glycogen fulfills the requirement of glucose.(Schorin et al., 2012) Regulatory mechanism of hormones like insulin and glycogen is very crucial for normal functioning of body.

From above content it is clear that; moderation is the key for consumption of any type of sugar. As the human body is unable to understand the difference between various types of sugar as they have same chemical structure.(Schorin et al., 2012)

#### V. PROBLEMS ASSOCIATED WITH SUGAR

Consumption of sugar in excess amount is a threat to body and brain. Guidelines by WHO on sugar intake for adults and children, concerned about the intake of free-sugar – specially in the form of sugar sweetened beverages (SSB). This adds to the total energy intake and may decrease the consumption of foods containing more nutritionally adequate calories, associated with an unhealthy diet, weight gain and increased risk of non-communicable diseases. Also, concerned of problems related to intake of sugar and dental caries. Sweeten beverages such as fruit drinks, fruit juices, soft drinks are consumed most by young children. Though, it contributes to quarter of the total calories taken up by preschool diets in all. But, in adult's consumption of this fruit drinks and soft drinks can result into higher risk of cardiovascular diseases (CVD) and type 2 diabetes and even increased level of CMR factors can be seen in adolescence.(Eny et al., 2020)

In an experiment conducted by Karen and colleagues, for TARGET kid on children of different age groups aiming to calculate the consumption of SSB and its effect on children and their cardiometabolic risk score concluded that higher sugar sweetened beverage consumption was directly proportional to higher CMR score on an average of different age groups. And was clear that high sugar beverages can

adversely associated to the cardiometabolic health by direct metabolic mechanisms.(Eny et al., 2020)

Study done afterwards, AAP (American Academy of Pediatrics) have recommended the parents specially to not to feed the infants who are younger than 1 year with fruit juice which contains high amount of sugar than fibers and nutrients.(Macdonald, 2016) The cohort study on type 2 diabetes associated with sugar solely cannot be related to onset of type 2 diabetes. But it is one of the reasons for it. All in all, sugar responsible for T2D is not scientifically evaluated; however unhealthy eating habits can be cause of obesity and strongly associated with incidence of T2D.(Prinz, 2019)Recommended consumption of added sugar varies substantially, whereas, the WHO recommends less than 10%.

Quanhe yang and colleagues studied consumption of added sugar and its impact on cardiovascular diseases mortality, adults in US consumes more added sugar than is recommended for a healthy diet. Ultimately, higher calories percentage from added sugar resulted into increased risk of CVD mortality. Moreover, daily consumption of SSB is interrelated with raised CVD mortality.(Yang et al., 2014)

When considering the sugar, it's the fructose part of sucrose that may be responsible for undesirable issues of sucrose on human health and even high fructose corn syrup. Study shows even cutting down one teaspoon of sugar from tea or coffee will reduce 10 pounds of weight over a year.(John, 1986) An experiment done on rodents on the food addiction found bingeing on sugar and also fat can be associated with addictive properties. There has been several studies and scientific experimentation that proves unsavory effect of excess consumption of sugar on body, brain and behavior. (Avena et al., 2009 ) However, the consumers are made confused by advertisement, uncertain publications, popular press and many more. But, scientific proofs over the years are helping consumer to clear this confusion

## VI. WHY ADDICTED TO SUGAR?

Sugar is a highly palatable food that triggers the reward system due to both caloric input and taste. The overconsumption of sugar triggers this reward stimuli too strongly, inducing compulsive eating.(Freeman et al., 2018) Whenever any sugar or sugary product is consumed by our body dopamine in the brain gets activated and they are secreted in the brain. Due to the various chemical reactions the reward system of the brain gets activated after sugar or sugary product consumption. This reward system of brain is known as mesolimbic dopamine system.(Freeman et al., 2018) Some of the drugs like cocaine, amphetamines and nicotine are also responsible for secreting the same dopamine hormone in the brain. And due to this reward stimuli drugs are addictive.(Freeman et al., 2018) Sugar addiction is not as hard as drugs but due to the overconsumption of sugar and sugary products various health problems arises. Some of the people are addicted to sugar. Some of the symptoms observed in sugar addicted people includes headache, lethargy, tiredness etc. when they do not consume sugar. For example, headaches, lethargy and tiredness is commonly observed in people who are addicted to tea and coffee. This is the reason why many people start their day with a cup of tea or coffee. And these people feel uncomfortable and disturbed when

they do not consume their morning tea or coffee. Some people also think that tea or coffee is the solution for their headache; so, they consume a cup of tea or coffee. Due to the sugar they get instant energy and they feel much better than earlier. This is the reason why many people get addicted to this cup of tea rather a cup of tea with tablespoons of sugar. This kind of addiction is commonly observed in old age group and middle age group; although youth is not an exception though. Even though the sugar taste good it is bad to consume it beyond the limit; especially the refined sugar is one of the leading causes for obesity, diabetes etc. Of course, sugar is not only the reason for these diseases but it is definitely one of the reasons. There is no harm to consume the sugar in limit but yes if it is over-consuming many risk factors are associated with it. Yes, sugar addiction is not as hard as drug addiction but it is not an easy task to overcome sugar addiction. People who are willing to overcome their sugar addiction can badly crave for sugar during initial time but, it also not an impossible task to overcome it. Some of the solutions to overcome sugar addiction includes-

1. Searching for natural sugars for example honey, stevia etc.
2. Increasing protein intake.
3. Good sleeping habits and a well-arranged body clock can also help to get rid sugar cravings; as sleeping disorders can trigger the sugar cravings.
4. Increasing water intake is also a safe and reliable way to control the consumption of sugar.
5. And the most important is to reduce the stress and live a happy and balanced life.

## VII. WHAT CAN BE DONE?

Due to the increased prevalence of obesity and health issues, various organizations are aimed at reducing the number of calories and fats people consume from processed foods. But this not an easy task to reformulate the product. Sugar in many foods is responsible for many properties and due to this reason cannot be usually replaced by only one ingredient. Replacing or removing sugar will alter the properties such as texture, taste, appearance, of a food, keeping in mind the consumer perspective of the product. Reformulating the product as per the requirements. For this, sugar substitutes can be the way to compensate with the reformulation giving the exact preferred product. Also, there can some ways such whenever you to buy a product check the label or the package of it and according to your requirement purchase the product. Some can also go for sugar-free or natural sweetener in their diet. Following a healthy diet practices and counting on calories consumed will help to intake needed number of calories than excess consumption.

Recommendations on 'Sugar intake in children and adults', WHO recommends reducing the intake of free sugar to less than 10% of total energy intake. WHO suggests a further reduction of the intake of free sugar to below 5% of total energy intake.(Anderson, Annie , Reid, Jenny, Thomson, 2018)

### VIII. SUGAR SUBSTITUTES

Sugar substitutes can be defined as an additive which has the same sweetness like the sugar but comparatively less or zero calories. There are many natural as well as artificial sweeteners are available in market. Some of the common example are stevia, brown sugar, honey, monk fruit extract, sorbitol, maltitol, aspartame, neotame, acesulfame-k, and many more. These sugar substitutes or alternatives have few or less calories so they are beneficial for obese people. These sugar substitutes do not spike blood sugar level as regular sugar does because they have low glycemic index than normal sugar. Glycemic index value of tablespoon of regular sugar is 68. They do not cause tooth decay and cavities. Some of the sugar substitutes are-

#### 1) Honey

From ancient times honey is used as a sweetener in many sweet dishes. Honey has low glycemic index than regular sugar. It has more calories than sugar but it is also sweeter than sugar so required in less amount. It contains more vitamins and minerals such iron which is helpful to cure anemia.

#### 2) Monk fruit extract

Unlike other fruit monk fruit does not get its sweetness from the natural sugar present in it but from an antioxidant called "mogrosides" it promotes weight loss as there are zero calories, carbohydrates, fats. It also possesses anti-inflammatory properties. As its glycemic index value is zero it is safe for diabetes people.

#### 3) Brown sugar

The presence of molasses result in brown color of the sucrose sugar i.e. brown sugar. It is unrefined or partially refined soft sugar. It is also prepared by adding molasses to refined white sugar. Due the presence of molasse, it contains slightly more minerals than refined sugar. It is also having 0.25 fewer calories per gram than white sugar.

#### 4) Stevia

Leaves of stevia rebaudiana plant are used to extract the sugar due their sweet nature. It is also used as a medicinal herb to cure high blood sugar; as it has anti-diabetic properties. And it is also good antioxidant. Stevia is about 100- 300 times sweeter than table sugar.

These are the natural sweeteners extracted from natural ingredients which are safe to consume if consumed in limits. Over consumption of these sweeteners is also not advisable as they may also cause the same effect as over consumption of normal sugar does.

### IX. ALTERNATIVE BULK SWEETENERS

Alternative bulk sweeteners are used to replace sucrose in various confectionery products for special purposes. They are effective to improve the texture and modify the sweetness of various types of sweet products. Sugar alcohols such as maltitol, sorbitol, and xylitol are used in diabetic confectionery as they have fewer calories and they do not spike blood glucose levels.

Alternative Sugars-

#### 1) Glucose-

It is nothing but a simple sugar or carbohydrate which

consists of some calories. It is a monosaccharide found in many plants and algae. It is referred as a source of energy. It is useful to treat low blood sugar; diabetes mellitus. It instantly provides energy to those who requires it. Honey, Molasses, Fruits, Table sugar etc. are some of the sources of glucose.

#### 2) Fructose-

Fructose is often referred as fruit sugar. As it is readily found in the sweet fruits. Honey, fruits and table sugar consists of this sugar. It has comparatively less glycemic index than normal table sugar. It also moderately releases the insulin in blood streams compared to the glucose and sucrose. But it should be consumed in moderation or else it can cause adverse effects on the liver.

#### 3) Lactose-

Lactose is called as a milk sugar as it is abundantly present in the milk and dairy products. Lactose sugar provides energy to the cells to perform many functions. But some people are allergic to this sugar. And it is also not an option for vegan people. Besides this it is a good anti-caking agent. It is used in various candies and confectionery products. It is also used in the bakery products as it improves the texture of products.

### X. SUGAR ALCOHOLS

Sugar alcohols are also called as polyols. Polyols provides less calories compared to normal table sugar as they are not completely absorbed in the body as like normal table sugar.(Schorin et al., 2012) Polyols are beneficial for the people who are concern about their calorie intake. Another benefit of polyols is regarding dental health as they do not cause tooth decay like normal sugars does. For example, Xylitol prevents the growth of oral bacteria so used in many oral care products like toothpastes, sugarless mint and chewing gums.(Schorin et al., 2012)

#### 1) Maltitol-

Maltitol contains less calories than normal sugar. It contains 2 to 3 calories per gram. It is one type of carbohydrate and does possess calories but fewer than table sugar. As table sugar have 4 calories per gram. It is having glycemic index value as 52. It is used in many confectionery products.

#### 2) Xylitol-

Maltitol is sometimes considered and mentioned as xylitol or sorbitol as all of them refers to the same category of sugar alcohol. It is less sweet than normal table sugar but provides 40% less calories. So, it is useful for people who are aiming to loss their extra fat. It also has low glycemic index.

#### 3) Sorbitol-

It contains 1/3rd less calories than table sugar. It is present in berries like blackberries, strawberries and various fruits like apples, cherries etc. It is around 60% sweet as sugar. And it is good for the oral health as it inhibits the growth of oral bacteria called streptococcus mutans. It is used in the manufacturing of tooth pastes as well. Moderate

consumption of this sugar is advisable.

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## CONCLUSION

Sugar is a substance that is used in day to day life. Although, sugar is necessary for our body as it contains fifty percent glucose in it, to perform various functions in our body, it also has its own negative effect if consumed beyond the limits. Even though sugar may have some negative effect on human health, human body require it for healthy diet. It's all the intake that causes the problem. There are not strong scientific evidences about addiction of sugar. Consumption of sugar can be reduced or can be replaced with alternatives available. As per the recommendations, energy can be obtained from glucose (blood sugar), the gasoline of our brains. Eating sugar is not a major concern but excess amount can definitely result in various health problems including long term effect on body and brain. Research should be done on strong addiction of sugar. Whereas, other sugar can be directly associated on NCD. Considering the daily intake i.e. around 6-9 teaspoons sugar per day will keep the sugar level normal. Also, sugar substitutes are a good substitute to sugar in diabetic patients. The key to this is to consume any type of sugar in moderate amount.

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