Effects of Sugary Drinks (Sugar Substitutes) on the Human Body

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Abstract. The emergence of artificial sweeteners and sugar-sweetened beverages is a change in the types of people who began to pay more and more attention to the impact of these foods on the human body. Certain studies have confirmed the intake of artificial sweeteners and sugar-sweetened beverages on the use of cancer cells, T2D, high blood pressure, obesity, metabolic syndrome, etc. have a certain impact, but the current study cannot fully explain all the sweeteners have a harmful effect on the human body. This paper analyzes the study of artificial sweeteners and sugary drinks on disease and gets the results that artificial sweeteners are not disease-free. This article analyzes the research on diseases caused by artificial sweeteners and sugary drinks and finds that artificial sweeteners have some significant impact on various sugar-related diseases in the human body. There is still the problem of food safety standardization that has not been solved, and future research can focus on the direction of food safety and food additive standards and the limitations of artificial sweeteners.

Keywords: Sugar drink; artificial sweetener; type 2 diabetes; cancer.

1. Introduction

The emergence of sugary drinks has promoted the development of sugar substitutes, but in different countries and regions, the control of sugar has a very different system. For example, in the consumer market of mainland China, the sugar in most sugary drinks is fructose syrup, while in Hong Kong and Macao, the use and addition of fructose syrup and other such sugar substitutes are prohibited, Sweeteners in Hong Kong are regulated under the Sweeteners in Food Regulations (Cap. 132U). The Regulation defines "sweetener" as any compound that is sweet in taste but does not include sugar, other carbohydrates, or polyols. For example, sorbitol, which is a type of polyol, is not regulated under the Regulation in Hong Kong and can be used as an ingredient in food in accordance with GMP without specifying its class of action as a sweetener in the list of ingredients. There are 10 permitted sweeteners specified in the Schedule to the Regulations, Food manufacturers should follow GMP for the proper use of sweeteners in food. It can be seen that fructose syrups such as those used in mainland China are not permitted to be added. So it can be seen that the sugar substitutes are not recognized as completely healthy, and with the continuous With continuous, in-depth research, it is noted that the intake of some sugar substitutes may also lead to the occurrence of some diseases.

There are also examples of the relationship between sugar and sugar substitutes on breast, lung, and oral cancer cells, the risk of mortality, obesity, type 2 diabetes (T2D), high blood pressure, and the impact of disease in children and adolescents. Improved understanding of the effects of sugar-sweetened beverages and sugar substitutes on the human body through research on the relationship between their effects on disease and morbidity, re-examination of related food safety issues, and adjustments to the control of sugar or sugar-containing substances. Although the impacts of sugar-sweetened beverages and sugar replacements on the human body, adolescents and children, and mortality are three areas that this article will examine, many people are ignorant of them.

2. The Effects of Sugar-sweetened Beverages and Sugar Substitutes on the Human Body in General

2.1 Cancer Cells

According to the Warburg effect, cancer cells' use of lactate in aerobic glycolysis has replaced pyruvate as the energy source for oxidative phosphorylation in their glucose metabolism. It is believed that two factors contribute to the proliferation of cancer cells: the efficiency of ATP synthesis through the tricarboxylic acid cycle (TCA cycle) and the conversion of glucose to amino acids to form building blocks for increasing biomass. Warburg effect metabolism is a cofactor for the epidermal growth factor receptor (EGFR). A Drosophila model requires this growth factor for epithelial neoplasia and metastasis. According to the study, lactate dehydrogenase (LDH) promotes the growth of neoplastic organisms, while increased glucose consumption accelerates the growth of neoplastic organisms [1].

Cancer cell reproduction requires large amounts of ATP. Blood vessels play a vital role in various diseases. Blood vessels increase their ability to deliver energy to the cells, so diets high in sugar may increase the proliferation of cancer cells. It has been shown that artificial sweeteners can proliferate cancer cells in vitro by producing ATP, including breast, oral, and lung cancers.

2.2 T2DM and High Blood Pressure

And sugar-sweetened beverage (SSB) and artificially sweetened beverages (ASB) intake have also been found to raise the chance of T2D, obesity, hypertension, and death from all causes. Using linear or non-linear methods to compare the greatest and lowest consumption categories, the association between consumption of solid and non-solid beverages and four distinct health outcomes was examined in the meta-analysis. All-cause mortality, obesity, diabetes, and hypertension were among the outcomes. It was discovered that there was a nonlinear relationship between the risks of hypertension and all-cause mortality and ASB consumption. However, it was discovered that the risk of obesity and type 2 diabetes was directly correlated with consumption of ASB [2].

Consuming SSB and ASB has a positive link with the risk of obesity, type 2 diabetes, hypertension, and all-cause mortality, which can be explained by a multitude of biological reasons. First, eating SSBs raises blood sugar levels and increases hunger, both of which can result in weight gain. Second, since solid beverages are the main source of dietary fructose-containing carbohydrates, intake of large amounts of fructose leads to hepatic metabolism into lipids, which increases liver fat, leads to dyslipidemia and visceral obesity, and further contributes to insulin resistance. Nucleotide turnover, uric acid generation, and intracellular adenosine triphosphate depletion are further effects of fructose that may exacerbate insulin resistance and worsen diabetes and cardiovascular disease. Thirdly, renin-angiotensin system activation, obesity, and higher blood uric acid concentrations are hypothesized to result from SSB. Acute endothelial dysfunction, long-term sodium retention, and renal microvascular alterations can result from these circumstances. The higher risk of hypertension linked to the use of solid drinks is also explained by these processes. Those who drink a lot of solid beverages also probably have a lower-quality diet, consume more unhealthy foods and snacks, are less likely to be physically active, and are linked to a higher risk of obesity, type 2 diabetes, hypertension, and all-cause mortality.

Independent of weight, a British study discovered that regular use of drinks with added sugar was linked to a higher risk of type 2 diabetes (T2D). Fruit juices and drinks containing artificial sweeteners were also favorably correlated with the incidence of T2D. Fruit juices and drinks with artificial sweeteners cannot thus be used as alternatives to avoid T2D.Available studies have also found that the higher the consumption of sugar-sweetened beverages, the higher the prevalence of T2D, with prevalence rates of 18% and 13% per serving per day before and after adjusting for fat content, respectively; artificially sweetened beverages: 25% and 8%; fruit juices: 5% and 7%. In the case of fruit juices, the results were not significant in studies where T2D was objectively

determined. Based on population-specific attributable proportions, 1.8 million of the 20.9 million cases of T2D expected to occur in the United States over a 10-year period (absolute prevalence of 11.0%) are attributable to the consumption of sugar-sweetened beverages. Furthermore, it explains the positive association between sugar-sweetened beverages and the incidence of end-stage diabetes [3].

An ongoing study recorded height, weight, MBI, and some health behavior information in subjects without hypertension, diabetes, cardiovascular disease, or cancer and without baseline dietary assessment information, and then passed questionnaires, blood pressure recordings, and biochemical measurements. Total intake of solid beverages has been found to be significantly associated with the risk of hypertension. After adjusting for other possible influences, subjects with the highest intake of solid beverages had a significantly higher risk of hypertension than those in the lowest group (20%). The HR remained significant by further adjusting for daily intake of fish, whole grains and dairy products, as well as potassium and sodium. In the total population, the highest quartile of SSB consumption had a 5.2% increased attributable risk of developing hypertension [4].

Based on the available studies, more beverage consumption has been found to be strongly associated with the incidence of hypertension, as has upregulation of the renin-angiotensin system and increased insulin resistance. Fructose intake may be associated with elevated serum uric acid, which leads to decreased nitrogen oxides and insulin sensitivity. In addition, reduced insulin sensitivity in the obese state leads to renal sodium current, It causes hypertension because it activates the renin-angiotensin system, leading to endothelial dysfunction. Therefore, it can be hypothesized that fructose intake in obese individuals may have a synergistic effect on the development of hypertension.

2.3 Chronic Kidney Disease (CKD)

95% confidence intervals (CIs) and summaries summarizing relative risks (RRs) were obtained using a random effects model. In each investigation, data from beverage consumption categories that included sugar or artificial sweeteners were used to assess both linear and non-linear dose-response correlations. Six included studies totaling 25,455 participants provided summary RRs of CKD for high versus low consumption of sugar-sweetened beverages of 1.30, while three studies totaling 19,995 participants provided pooled RRs of CKD for high versus low consumption of artificially sweetened beverages of 1.40. Using dose-response analysis, it was found that consuming more than seven servings of sugar- or artificially-sweetened beverages per week significantly elevated the risk of chronic kidney disease (CKD) [5].

Apart from the established hazards of metabolic syndrome and cardiovascular disorders, established studies has verified the correlation between the ingestion of SASBs and persistent kidney ailments (like proteinuria) as well as reduced kidney function, which could result in kidney stones.

There is a correlation between drinking soda that has been artificially sweetened and the chance of developing chronic kidney disease (CKD) according to three investigations (four publications). There was a statistically positive correlation found if the intake of artificially sweetened soda exceeded seven servings per week, However, no non-linear association was found between consumption of the beverage and the likelihood of chronic kidney disease [5].

2.4 Metabolic Syndrome

ELSA-Brasil also conducted a study on the relationship between intake of sugar-sweetened beverages and the metabolic syndrome (MetS) and its components. During four years of follow-up, participants found that sugary drink intake was associated with a higher relative risk of suffering from MetS.Furthermore, consuming these drinks on a regular basis raises the risk of high blood pressure. Consuming unsweetened fruit juices was not linked to these metabolic disorders or any of its constituent parts after correction [6].

Participants' questionnaires were recorded and analyzed in groups to categorize and compare frequency of eating, amount of eating, and whether or not they were taking medication. In a survey conducted four years later, the cumulative prevalence of metabolic syndrome was 27%, suggesting an association between sugar-sweetened beverage intake and metabolic syndrome [6].

3. The Effects of Sugar-sweetened Beverages and Sugar Substitutes on Adolescents and Children Groups

Insulin resistance, hypertension, atherogenic dyslipidemia and pro-inflammatory states are health problems associated with obesity, weight gain and obesity. Hypertension is an important component of the metabolic syndrome, which is closely associated with obesity and is increasingly prevalent in adolescents.Hypertension is one of the key components of the metabolic syndrome, is strongly associated with obesity status, and is increasing in prevalence among adolescents. Hypertension in children and adolescents is defined as a mean systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) that exceeds 95% of the time on at least 3 occasions. Pre-hypertension, on the other hand, is defined as an average SBP or DBP level above 90% but below 95%. Childhood hypertension and increased blood pressure are linked to obesity and cardiovascular risk factors. Children with hypertension are susceptible to intermediate markers of damage to target organs, including left ventricular hypertrophy, retinal vascular alterations, thickening of the carotid artery wall, and mild cognitive abnormalities, even though they do not experience the major consequences of cardiovascular disease, such as death or cardiovascular disability. It is widely recognized that environmental and genetic factors influence blood pressure levels. As a result, ninety different genetic polymorphisms have been associated with hypertension. For instance, a recent study discovered that elevated aldosterone levels and aldosterone/renin ratios were linked to polymorphisms in the aldosterone synthase gene and hypertension. However, the main environmental variables that lead to hypertension include obesity, smoking, alcohol intake, nutrition, and inactivity [7].

Existing research has indicated that children and adolescents who consume large amounts of solid soda are more likely to develop hypertension and high systolic blood pressure. Furthermore, a meta-analysis of the literature indicates that drinking solid soda is linked to higher systolic and diastolic blood pressure among those who appear to be in good health. However, considering that most of the studies included healthy subjects, since only one study was conducted on diabetic patients, the results may not accurately reflect the relationship between patients' health status. Also, since the original study showed that the intake of sugary beverages was positively associated with diabetes and other health outcomes, these data support the benefits of reducing the intake of sugary beverages [7]. It can be seen that the intake of sugary drinks has an impact on the health of children and adolescents, and timely intervention in their intake of sugary drinks can help to reduce the risk of hypertension. Relevant departments and the government can also formulate measures to regulate the frequency of sugary drinks in school meals to protect the health of minors.

Higher intake of sugar-sweetened drinks at age 1 was related to higher cardiometabolic risk factor scores in boys, but not in girls, according to research on the impact of age 1 sugar-sweetened beverage intake on cardiometabolic status at age 6 [8].

4. The Effects of Sugar-sweetened Beverages and Sugar Substitutes on the Mortality Rate

An analysis from the U.S. National Health and Nutrition Examination Survey noted that higher ASB intake was not found to be significantly associated with all-cause mortality, heart disease, and cancer mortality over a 7.9-year follow-up period, whereas the RCS showed a J-shaped relationship between ABS intake and all-cause mortality and heart disease mortality [9].

This is a comparison of the risk of all-cause and heart disease mortality when equal amounts of other beverages are substituted for one sugary drink per day [9]. Higher intake of solid beverages was associated with higher all-cause and heart disease mortality than ASB intake [9]. It is also possible that consumption of SSBs and ASBs may increase the risk of all-cause mortality [2]. Nowadays, the problem of obesity is getting worse, and the solutions to this problem are focused on sugar, especially sugary drinks. The UK Biobank's long-term follow-up survey of participants found that higher mortality rates were particularly associated with the intake of sugary drinks, as their energy intake would be higher, and the body mass index was higher in those who consumed more than two artificial sweeteners per day [10].

5. Conclusion

Through the analysis of existing studies, it is found that there is a certain amount of research that confirms that the use of artificial sweeteners and the intake of sugar-sweetened beverages affect the occurrence of diseases such as T2D, hypertension, cancer, metabolic syndrome, etc., and it is found that children have a certain disease response to the early intake of artificial sweeteners. The findings of these studies can be more effective in recognizing that the use of artificial sweeteners is not completely safe and the intake of sugary drinks is not healthy. These findings can help to realize that artificial sweeteners are not completely safe, that sugary beverages are not healthy, and that the use of artificial sweeteners in food can be re-examined in all regions of the world. However, the current study is still a large-scale study, and the study on the effects of individual controversial sweeteners is still insufficient. In the future, researchers can help to better understand the food safety of artificial sweeteners through more accurate studies and experiments on more artificial sweeteners, especially for artificial sweeteners like fructose syrup, which has a large difference in the use of different countries and regions and can help to better understand the food safety of artificial sweeteners. Especially for artificial sweeteners such as fructose syrup, which is used differently in different countries and regions, the research can make more countries and regions pay attention to the problem of food safety.

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