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## RESEARCH ARTICLE

### Health risks of soft drinks-a review

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#### ABSTRACT

A soft drink is a drink that typically contains carbonated water, a sweetener, and a natural or artificial flavoring. The sweetener may be sugar, high-fructose corn syrup, fruit juice, sugar substitutes, or some combination of these. Soft drinks may also contain caffeine, colorings, preservatives, and other ingredients. Interest in soft drink consumption has increased following a dramatic rise in intake over recent years. Rise in the number of people preferring soft drinks shows a rise in the number of new side effects. People. Every day thousands of people are being admitted in hospitals, just due to over consumption of these beverage drinks. The various Health Risks are diabetes, obesity, asthma, heart diseases, gout, depression, stroke, cancer, liver damage, tooth decay, osteoporosis, rheumatoid arthritis, menarche, adiposity, hypertension, hyperuricemia, impaired digestion, peptic ulcers, kidney diseases etc. The more soda you consume (regular or diet), the more hazardous your habit can become. And whether you're a six-pack-a-day drinker or an occasional soft-drink sipper, cutting back can likely have benefits for your weight and your overall health.

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#### INTRODUCTION

People who consume sugary drinks regularly 1 to 2 cans a day or more have a 26% greater risk of developing type 2 diabetes than people who rarely have such drinks (Malik *et al.*, 2010). But over the years, some research has suggested even if you're not overweight, regularly drinking sugary beverages might still increase your type 2 diabetes risk. Indeed a recent international study found drinking sugar sweetened beverages regularly was linked to a greater incidence of type 2 diabetes, regardless of whether you're carrying extra weight (Cathy Johnson, 2015).

##### Heart Diseases

A study that followed 40,000 men for two decades found that those who averaged one can of a sugary beverage per day had a 20% higher risk of having a heart attack or dying from a heart attack than men who rarely consumed sugary drinks (De Koning *et al.*, 2012). A related study in women found a similar sugary beverage heart disease link (Fung *et al.*, 2009). The Nurses' Health Study, which tracked the health of nearly 90,000 women over two decades, found that women who drank more than two servings of sugary beverage each day had

a 40 percent higher risk of heart attacks or death from heart disease than women who rarely drank sugary beverages. People who drink a lot of sugary drinks often tend to weigh more and eat less healthfully than people who don't drink sugary drinks, and the volunteers in the Nurses' Health Study were no exception. But researchers accounted for differences in diet quality, energy intake, and weight among the study volunteers. They found that having an otherwise healthy diet, or being at a healthy weight, only slightly diminished the risk associated with drinking sugary beverages. This suggests that weighing too much, or simply eating too many calories, may only partly explain the relationship between sugary drinks and heart disease. Some risk may also be attributed to the metabolic effects of fructose from the sugar used to sweeten these beverages. The adverse effects of the high glycemic load from these beverages on blood glucose, cholesterol fractions, and inflammatory factors probably also contribute to the higher risk of heart disease (De Koning *et al.*, 2012). Daily drinkers of soda and other sweetened beverages had elevated triglycerides, decreased HDL ("good" cholesterol), and higher levels of inflammation markers. All of these are linked to heart disease (Shawn Radcliffe, ?).

##### Gout

A 22-year-long study of 80,000 women found that those who consumed a can a day of sugary drink had a 75% higher risk of

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gout than women who rarely had such drinks (Choi *et al.*, 2010). Researchers found a similarly-elevated risk in men (Choi and Curhan, 2008). Compared with men who almost never drank sugar-sweetened soft drinks -- fewer than one per month -- frequent soft-drink drinkers were significantly more likely to suffer gout (Daniel *et al.*, 2008):

- Two or more soft drinks each day upped gout risk by 85%.
- One soft drink each day upped gout risk by 45%.
- Five or six soft drinks each week upped gout risk by 29%.

### Obesity

Dr. Frank Hu, Professor of Nutrition and Epidemiology at Harvard School of Public Health, recently made a strong case that there is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases (Hu, 2012). A meta-analysis of 88 studies evaluating the effects of soft drink consumption on health published in the American journal of public Health found “clear associations of soft drink intake with increased energy intake and body weight (Research links soft drinks with obesity and diabetes, ?)”

### Diabetes

Strong evidence indicates that sugar-sweetened soft drinks contribute to the development of diabetes. The Nurses' Health Study explored this connection by following the health of more than 90,000 women for eight years. The nurses who said they had one or more servings a day of a sugar-sweetened soft drink or fruit punch were twice as likely to have developed type 2 diabetes during the study than those who rarely had these beverages (Schulze *et al.*, 2004). A similar increase in risk of diabetes with increasing soft drink and fruit drink consumption was seen recently in the Black Women's Health Study, an ongoing long-term study of nearly 60,000 African-American women from all parts of the United States. Interestingly, the increased risk with soft drinks was tightly linked to increased weight. In the Framingham Heart Study, men and women who had one or more soft drinks a day were 25 percent more likely to have developed trouble managing blood sugar and nearly 50 percent more likely to have developed metabolic syndrome (Palmer *et al.*, 2008).

### Depression

Researchers recently found evidence to suggest that there is a link between consumption of sugary soft drinks and depression (Alice Fabbre, 2013). People who drank more than four cans or cups of soda per day were 30 percent more likely to develop depression than those who drank no soda (Drinking soda linked to depression, 2013). Daily consumption of diet soda raises the risk of type-2 diabetes, according to a 2009 article published in "Diabetes Care." Type-2 diabetes, in turn, raises the risk of depression. The American Diabetes Association theorizes that the stress of managing diabetes, feelings of loss of control over blood sugar and other complications, such as nerve damage, all contribute to depression in patients with type-2 diabetes. Depressed patients with diabetes are at a higher risk for dementia, as well, according to a 2012 study published in "Archives of General Psychiatry." Research conducted by Susan E. Swithers, a professor at Purdue

University, suggests that drinking diet sodas leads to weight gain, partly because of overeating. In other words, a person drinking diet soda might feel so virtuous about drinking a zero-calorie beverage that he feels like he can eat more than he normally would. This is an important link because being overweight can increase the risk of depression. Depression also raises the risk of obesity, which increases the chances of chronic health problems such as heart disease (Sara Ipatenco, 2014).

### Stroke

In women, greater consumption of sugar-sweetened soda was associated with a higher risk of ischemic stroke whereas greater consumption of low-calorie soda was associated with a greater risk of hemorrhagic stroke (Adam *et al.*, 2012). Once consumed, soft drinks cause a rapid increase in blood glucose (sugar) and insulin, the hormone that removes glucose from the bloodstream. Over time, this can impair the body's ability to use insulin and cause inflammation. These two changes influence hardening of the arteries, the stability of fatty plaques in artery walls and blood clotting all risk factors for stroke. There's also concern than high-fructose corn syrup in soft drinks can cause metabolic changes that increase the likelihood of stroke (Leslie Beck, 2013).

### Pancreatic Cancer

Although soft drink consumption did not influence pancreatic cancer risk among men, consumption of sugar-sweetened soft drinks may be associated with a modest but significant increase in risk among women who have an underlying degree of insulin resistance (Schernhammer *et al.*, 2008). Drinking as little as two soft drinks a week appears to nearly double the risk of getting pancreatic cancer according to a new study. People who drank two or more soft drinks a week had an 87% increased risk -- or nearly twice the risk -- of pancreatic cancer compared to individuals consuming no soft drinks (Kathleen Doheny, ?).

### Rheumatoid Arthritis

Regular consumption of sugar-sweetened soda, but not diet soda, is associated with increased risk of seropositive RA in women, independent of other dietary and lifestyle factors (Hu *et al.*, 2014). The researchers found that women who drank one or more sugar-sweetened sodas a day were 63 percent more likely to develop RA than women who only drank less than one sugary soda a month. This risk appeared to be even stronger for women over 55 years old, suggesting the additive detrimental effects of soda over many years may cause chronic inflammation, which eventually leads to RA. This risk is likely the same for men, but showing this would require a larger study, since the incidence of RA is two to three times higher in women than in men (Joseph Bennington *et al.*, 2015).

### Cancer

Many studies have linked sugar intake with different types of cancer, such as:

**Breast cancer:** An epidemiological study in 21 modern countries that keep track of morbidity and mortality (Europe, North America, Japan and others) revealed that sugar intake is

a strong risk factor that contributes to higher breast cancer rates, particularly in older women.

**Throat cancer:** Throat cancer is a particularly hard cancer to beat—more than 90 percent of patients with invasive esophageal cancer die within five years of diagnosis. Research has revealed that those who drink soda might have a higher risk of developing esophageal cancer. They found a strong link between the accelerated rate of people drinking carbonated soft drinks and the growing number of cases of esophageal cancer over the course of two decades.

**Colon cancer:** According to another study, women who consume a high dietary glycemic load may increase their risk of colorectal (colon) cancer. Glycemic load is a measure of how quickly a food's carbohydrates are turned into sugars by your body (glycemic index) in relation to the amount of carbohydrates per serving of that food. The study consisted of more than 38,450 women who were followed for almost eight years. The participants filled out questionnaires about their eating habits, so researchers could examine the associations of dietary glycemic load, overall dietary glycemic index, carbohydrate, fiber, non-fiber carbohydrate, sucrose, and fructose with the subsequent development of colon cancer. They found that women who ate the most high-glycemic-load foods were nearly three times more likely to develop colon cancer (10 Diseases Linked To Soda, 1997). Levels of a by-product of a caramel food colour, 4-methylimidazole (4-MEI), are high enough in soft drinks and consumed in sufficient quantities in the US that they can increase the risk of developing cancer. In the new study, researchers built on an analysis of 4-MEI concentrations in 11 different soft drinks to estimate exposure to the chemical from caramel-coloured soft drinks. They then modelled the potential cancer burden related to the regular consumption of these drinks in the US. They claim that routine consumption of soft drinks containing this colour appears to pose 'excess cancer risks' that exceed the one case per 1 million exposed individuals, which is a common acceptable risk used by some US regulatory agencies. Specifically, the researchers found consumption of Malta Goya, Pepsi, Diet Pepsi and Pepsi One resulted in 4-MEI exposures of more than 29 µg/day with associated risks exceeding one excess case per 10,000 exposed individuals, suggesting 'that the risk can greatly exceed the threshold' (Rebecca Trager, 2015).

### Adiposity

The genetic association with adiposity appeared to be more pronounced with greater intake of sugar-sweetened beverages (Qi *et al.*, 2012).

### Menarche

Consumption of caffeinated and artificially sweetened soft drinks was positively associated with risk of early menarche (Mueller *et al.*, 2015). More frequent SSB (sugar-sweetened beverage) consumption predicted earlier menarche. At any given age between 9 and 18.5 years, premenarcheal girls who reported consuming >1.5 servings of SSBs per day were, on average, 24% more likely [95% confidence interval to attain menarche in the next month relative to girls consuming ≤2 servings of SSBs weekly, adjusting for potential confounders

including height, but not BMI (considered an intermediate). Correspondingly, girls consuming >1.5 SSBs daily had an estimated 2.7-month earlier menarche relative to those consuming ≤2 SSBs weekly. The frequency of non-carbonated fruit drink and sugar-sweetened soda, but not iced tea, consumption also predicted earlier menarche. The effect of SSB consumption on age at menarche was observed in every tertile of baseline BMI [26]. Girls who frequently consume sugary drinks tend to start their menstrual periods earlier than girls who do not, according to new research published online Jan 28 in *Human Reproduction* (Oxford University Press, 2015).

### Hypertension

Drinking two cans a day increased blood pressure by 5 mmHg, a rise which would cause 'significant problems' for patients with high blood pressure or heart disease (Madlen Davies for Mailonline, 2014). Diet soda drinkers are more likely to have high blood pressure than those who don't drink diet sodas on a regular basis. While there isn't one specific reason researchers point to that explains the link, one potential explanation is that drinking diet soda is linked to weight gain, and being overweight contributes to high blood pressure. Another possibility is that diet soda contains sodium, and a diet high in sodium can contribute to high blood pressure. A 12-ounce serving of the average diet cola contains 57 milligrams of sodium, which is 4 percent of the daily 1,500-milligram limit recommended by the American Heart Association. If you drink several diet sodas a day, these sodium numbers can really add up (Sara Ipatenco, 2015).

### Hyperuricemia

Higher consumption of sugar-sweetened soft drinks increased the risk of hyperuricemia in males with a linear trend and in females with no linear trend compared to lower consumption. However, there were no significant differences of serum uric acid level according to the three categories of soft drink consumption, in males or in females, whereas all subjects showed statistical significance of serum uric acid level within the categories. Estimated amount of soft drink intake was associated with serum uric acid level in males but not in females (Bae *et al.*, 2014).

### Impaired digestion (Gastrointestinal distress)

Gastrointestinal distress includes increased stomach acid levels requiring acid inhibitors, and moderate to severe gastric inflammation with possible stomach lining erosion. Drinking sodas, especially on an empty stomach, can upset the fragile acid-alkaline balance of your stomach and other gastric lining, creating a continuous acid environment. This prolonged acid environment can lead to inflammation of your stomach and duodenal lining (10 Diseases Linked To Soda, 1997). Drinking sodas, especially on an empty stomach, can upset the fragile acid-alkaline balance of the stomach and other gastric lining, creating a continuous acid environment. This prolonged acid environment can lead to inflammation of the stomach and duodenal lining which becomes quite painful. Over the long term, it can lead to gastric lining erosion (Judith Valentine, 2002). In some cases, drinking soda regularly can irritate your stomach and esophagus. When this occurs, it is referred to as

reflux or gastroesophageal reflux. This condition happens when your lower esophageal sphincter does not close or opens intermittently causing acid to rise up your throat, creating a bitter taste in your mouth and a burning in your throat and chest. A main ingredient in many sodas is phosphoric acid. Phosphoric acid can cause acid to rise in the stomach, resulting in acid reflux. Over time, drinking large amounts of soda containing phosphoric acid can damage your stomach and esophageal lining. Long-term damage to this tissue puts you at an increased risk for Barrett's esophagus, strictures, damage to the stomach lining and esophagus and esophageal cancer, explains the National Digestive Diseases Information Clearinghouse (Julie Boehlke, 2015).

### **Osteoporosis**

Soft drinks containing phosphoric acid are definitely linked to osteoporosis (a weakening of your skeletal structure) because they lead to lower calcium levels and higher phosphate levels in your blood. When phosphate levels are high and calcium levels are low, calcium is pulled out of your bones (10 Diseases Linked To Soda, 1997). A 1994 report published in the *Journal of Adolescent Health* summarizes a small study (76 girls and 51 boys) and points toward an increasing and "strong association between cola beverage consumption and bone fractures in girls." High calcium intake offered some protection. For boys, only low total caloric intake was associated with a higher risk of bone fractures. The study concluded with the following: "The high consumption of carbonated beverages and the declining consumption of milk are of great public health significance for girls and women because of their proneness to osteoporosis in later life." A larger, cross sectional retrospective study of 460 high school girls was published in *Pediatrics & Adolescent Medicine* in June 2000. The study indicated that cola beverages were "highly associated with bone fractures." In their conclusion the authors warned that, ". . . national concern and alarm about the health impact of carbonated beverage consumption on teenaged girls is supported by the findings of this study" (Judith Valentine, 2002).

### **Liver Damage**

Soda damages your liver. Consumption of too many soft drinks puts you under increased risk for liver cirrhosis similar to the increased risk faced by chronic alcoholics. Liver damage is normally associated with alcohol abuse but the new study has found that non-alcoholic drinks with a high sugar content can cause a condition called fatty liver disease (Chris Irvine, 2009).

### **Tooth Decay**

Soda dissolves tooth enamel. Soft drinks are responsible for doubling or tripling the incidence of tooth decay. Soda's acidity is even worse for teeth than the solid sugar found in candy (10 Diseases Linked To Soda, 1997). Normally the saliva is slightly alkaline, with a pH of about 7.4. When sodas are sipped throughout the day, as is often the case with teenagers, the phosphoric acid lowers the pH of the saliva to acidic levels. In order to buffer this acidic saliva, and bring the pH level above 7 again, the body pulls calcium ions from the teeth. The result is a very rapid depletion of the enamel coating

on the teeth. When dentists do cosmetic bonding, they first roughen up the enamel with a chemical compound—that chemical is phosphoric acid! Young people who must have all their yellowed front teeth cosmetically bonded have already done part of the dentist's job, by roughening up the tooth surface with phosphoric acid (Judith Valentine, 2002).

### **Kidney stones and chronic kidney disease**

Cola beverages, in particular, contain phosphoric acid and have been associated with urinary changes that promote kidney stones. Drinking 2 or more colas per day was associated with increased risk of chronic kidney disease (Saldana *et al.*, 2007). Soda, especially colas, contains high levels of phosphoric acid, which is closely linked with the development of kidney stones and other renal problems. A seminal study published in 2007 in the journal "Epidemiology" reckoned that drinking two or more colas per day was associated with increased risk of chronic kidney disease. The two-fold risk was there whether the soda contained common sugars or artificial sugars. Phosphoric acid gives food a tangy taste and beverages the acidic taste you've come to associate with soda. Phosphoric acid also has preservation qualities and acts as a mold deterrent. The acid, if consumed regularly, can tax kidneys as they do their job of filtering out waste material. Uncolas, to borrow from popular vernacular, aren't immune from affecting the health of your kidneys, either. That is, carbonated beverages that aren't colas can also cause damage. The sugars in them, particularly fructose in the form of high-fructose corn syrup, can have deleterious effects on your kidneys. In 2007, a group of kidney specialists reporting in the "Journal of the American Society of Nephrology" said excessive consumption of fructose-containing beverages was a risk factor for kidney disease, marked by high blood pressure, as well as inflammation and damage to the kidneys. Although most of the fructose in soda is taken up by your liver, up to 30 percent of it goes through your kidneys, which can cause an increase in levels of uric acid, a waste product created as the kidneys break down food. That action, the researchers said, is a major mechanism through which fructose-sweetened beverages cause cardiorenal disease (Angela Ogunjimi, 2013).

### **Peptic Ulcer**

peptic ulcer happens when acid from your stomach erodes parts of your stomach, intestine and esophagus. Ulcers are essentially sores that are inside your body – sores that may bleed and lead to serious health complications. Symptoms include pain in your abdomen, pain that is relieved by taking acid-reducing medicine, vomiting of blood, black stools and unexplained weight loss. Drinking sodas, especially those that contain caffeine, can irritate peptic ulcers (Judith Valentine, 2002). Most sodas contain citric acid as a preservative and flavor enhancer, which increases the beverage's acidity. Acidic foods can irritate ulcers that already have developed in your digestive system, but will not cause ulcers to form (Diane Marks, 2015).

**Chronic Dehydration:** Because of the high sugar, sodium and caffeine content in soda, it dehydrates the body and over a long period of time can cause chronic dehydration (Ten Reasons to Avoid Soda, 2011).

## Asthma

The amount of soft drink consumption is associated with an increased chance of asthma and or COPD. There exists a dose-response relationship, which means the more soft drink one consumes, the higher the chance of having these diseases (Tara Kelly, 2012).

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