



The Impact of Carbonated Soft Drink Consumption on Ocular Health-A Review

Sushant Kumar Shah^{1*}, Priya Patnaik², Yashwanth BA³

^{1,2,3} Department of Optometry, Acharya Institute of Allied Health Sciences, Bengaluru

*Corresponding Author: sushantshah@acharya.ac.in

ABSTRACT

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Carbonated soft drinks (CSDs), widely consumed globally, have been linked to numerous health issues such as obesity, diabetes, and including ocular complications. The composition of these beverages, including high sugar content and additives, contributes to oxidative stress in ocular tissues. Elevated glucose levels from excessive sugar intake may damage the ocular surface's glycocalyx, weakening and increasing susceptibility to infections. CSDs also contribute to obesity and type 2 diabetes, both of which are risk factors for significant eye diseases like glaucoma, age-related macular degeneration, and cataracts. While occasional consumption of CSDs may not have severe consequences, excessive intake poses long-term risks for both systemic and ocular health. The review calls for increased awareness about these potential risks, emphasizing the need for further research specifically targeting the direct effects of CSDs on the eyes. Public health campaigns should consider incorporating information on the ocular impacts of sugary drink consumption alongside well-known risks to general health, thereby encouraging healthier lifestyle choices to protect vision.

INTRODUCTION

Carbonated soft drinks (CSDs) are specific type of soft drinks composed with carbonated water and flavouring, sweetened with sugar or other non-sugar sweeteners, caffeine, citric acid and several other chemicals.¹ The popularity such drinks have surged over the year, especially among young adults.² Soft drinks are consumed worldwide approximately 1.39 times daily on average with over 50% adolescents in most countries drink them daily with 25 % of adolescents drinking 2 or 3 times a day.³ The consumption of CSDs has been linked to several health risks, such as obesity, diabetes, cardiovascular disease, including eye disorders.² The increase in consumption of these drinks and their potential impact on overall health, this issue has gained the interest in the public health sector. However, there is a noticeable gap in the literature about impact of carbonated soft drink on ocular health.

Ocular health is affected by various factors, such as genetics, nutrition, environmental conditions, and lifestyle choices.^{4,5} Among these, essential nutrients, such as vitamins A, B₁₂, C, D omega-3 fatty acids, and antioxidants plays a vital role in maintaining visual function and preventing ocular diseases.⁴ On the other hand, poor eating habits, characterised by increased sugar consumption and decreased nutritional intake, which is a case in CSDs, might result in systemic diseases that negatively impact ocular health.⁵ The harmful effects of CSDs on overall health are well known, but their impact on eye health hasn't been studied much. Very few studies have explored how these beverages might affect the eyes, leaving a gap in understanding.

Composition of Carbonated Soft Drinks

Carbonated drinks, like energy drinks, juices, carbonated water, and coffee, are among the most popular beverages worldwide.⁶ These drinks get their fizz from carbon dioxide gas, which is added under high pressure. The key ingredients include water, carbon dioxide, caffeine, sweeteners, flavouring, colour, and acids.⁷ The sweeteners can either be regular sugars like sucrose or fructose, or low-calorie alternatives used in diet versions. Some of carbonated drinks may have no added flavours, while others are flavoured with natural extracts or artificial flavours.⁸ Carbonated drinks are made by mixing the flavour base with a sweetener and water to create a syrup. This syrup is then combined with carbonated water, bottled or canned, and sealed to keep in the fizz.⁷

Direct Effects on Ocular Health

Oxidative Stress:

Excess sugar constituent, can cause oxidative stress in the eye, affecting the cornea, lens, and retina. This oxidative stress leads to conditions like corneal edema, cataracts, and retinal aneurysms. The mechanism involves the buildup of glucose in the lens, triggering metabolic pathways that increase osmotic pressure, causing the lens to swell and form cataracts. In the retina, oxidative stress contributes to diabetic retinopathy.⁹

Glycocalyx Damage:

Elevated glucose levels negatively affect the glycocalyx, crucial for maintaining ocular surface integrity, resulting in increased susceptibility to infections and compromised barrier function.¹⁰ Osmotic stress from excess glucose weakens both the glycocalyx and tight junctions, making the eye more vulnerable to damage.¹¹

Corneal Neuropathy:

Diabetes-related changes in corneal nerve morphology can lead to reduced sensation and healing capacity, increasing the risk of corneal erosions and infections.¹²

Indirect Effects on Ocular Health

Diabetes and ocular implications

One of the major indirect effects of CSDs consumption is its contribution to type 2 diabetes.¹³ Diabetes is a well-known risk factor for several serious eye diseases, including diabetic retinopathy, which affects the retina and can lead to blindness if untreated.¹⁴ Additionally, poorly controlled diabetes increases the risk of developing cataracts earlier in life.¹⁵ Therefore, regular consumption of these



beverages poses a significant risk to long-term eye health through its connection to diabetes.

Obesity and Ocular Diseases

Excessive consumption of sugary carbonated drinks is closely linked to obesity¹⁶, another risk factor for various eye conditions. Obesity has been associated with glaucoma¹⁷ and age-related macular degeneration (AMD)¹⁶, two major causes of vision loss. Obesity can which is linked to higher retrobulbar adipose tissue volume which increases the pressure from adipose tissue, this can alter ocular blood flow, potentially leading to optic nerve damage and glaucoma.¹⁷ In obese people, factors like increased inflammation and metabolic dysfunction from excess body fat contribute to the development of AMD.¹⁸

Mechanism of carbonated soft drinks in inducing the adverse effect

Carbonated soft drinks contribute to oxidative stress, glycocalyx damage, obesity, and diabetes through several mechanisms. The high sugar content in these beverages promotes oxidative stress by generating reactive oxygen species, leading to cellular damage. Glycocalyx integrity, crucial for maintaining the epithelial barrier, is compromised, especially in individuals with high glucose levels, as seen in diabetes.¹⁰ The sugar content in soft drinks also promotes insulin resistance, contributing to obesity and diabetes through excessive calorie intake and altered glucose metabolism.¹⁷

DISCUSSION

Overall, CSDs may be harmful to ocular health, both directly through mechanism such as oxidative stress and indirectly by contributing to diseases such as diabetes and obesity. While occasional or moderate consumption may not have a significant impact, excessive consumptions of these drinks over time can lead to the mentioned problems.¹⁷ However, the limited specific study on soft drinks and eye health makes it difficult to make reliable conclusions, but currently available information suggests an association that needs further study. Raising awareness about the potential risks of carbonated soft drink consumption on eye health is important. Public health campaigns should not only address the risks of obesity and diabetes but also emphasize the less common, but still significant, impact on vision and eye health. One of the major drawbacks of current research is the lack of studies that directly explore the effects of CSDs on ocular health. Most evidence is based on studies the explored the broader impact of sugar, diabetes, and obesity. This gap in research makes it difficult to fully understand the risks posed by soft drinks to eye health. There are several ways CSDs could affect ocular health, including increased oxidative stress, inflammation, dehydration, and systemic conditions like diabetes. While these mechanisms are possible, more research is needed to confirm their direct impact on the eyes.

CONCLUSIONS AND RECOMMENDATION

Occasional intake might not pose a significant risk, but long-term, frequent consumption carbonated soft drinks, due to their high sugar content and other additives, may have harmful effects on ocular health. While research specifically linking soft drinks to eye diseases is limited, the indirect risks posed by diabetes and obesity are well established. Given the growing global consumption of these beverages, more research is needed to fully understand the potential risks to eye health. Raising awareness about these potential risks and encouraging healthier lifestyle choices can help protect both systemic and ocular health in the long term.

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