

Review Article

Consumption of sugar sweetened beverages and their health impact on children

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ABSTRACT

Consumption of sugar-sweetened beverage is a major contributor to sugar-based calories in the daily diet of many children. Children (up to 18 years) have different nutritional needs and metabolic pathways than adults. Although many studies explored the health effects of sugar-sweetened beverages among adults, few studies included children in their analysis. The purpose of this review was to evaluate and summarize the current global trends in the consumption of sugar-sweetened beverages and the health effects of consumption of sugar-sweetened beverages in children. The review identified several health effects related to children's sugar-sweetened beverage consumption, such as childhood obesity, metabolic syndrome, early menarche, and dental caries. A decline in children's Consumption of sugar-sweetened beverages was noted in Australia, Canada, Norway, USA, and UK between 2000-2010 but increased in countries such as Mexico and South

Korea, and the trend remained stable in China and Russia. Several influencing factors for children's sugar-sweetened beverage consumption were identified, including parents' perception and attitude towards sugar-sweetened beverage, Children's gender differences, and socio-economic status (SES). More longitudinal studies are required to determine the cause-effect relationship between sugar-sweetened beverage consumption and the reported health effects. Researchers should also consider the influence of social and behavioral factors identified in this review when planning intervention programs for children.

Abbreviations

Cardiovascular disease (CVD); Insulin-like growth factor-1 (IGF-1); Socio-economic status (SES).

Keywords

Sugar-sweetened beverage, sweetening agents, carbonated beverage, child, obesity.

SUMMARY

1. *Introduction*
2. *Trends in Consumption of sugar-sweetened beverage*
3. *Health impacts of consumption of sugar-sweetened beverage on children*
4. *Factors influencing children's Consumption of sugar-sweetened beverage*
5. *Discussion*
6. *Conclusion*

1. Introduction

According to the World Bank, approximately 26% of the world population is between 1-14 years old¹. Early childhood experiences related to diet impact children's overall health and the likelihood of developing chronic diseases in their adult life². For example, childhood obesity is a strong predictor of cardiovascular diseases in adult life³. Globally, an estimated 41 million children were obese in 2016⁴. The number of children with obesity increased several folds over the last 40 years in the United States⁵. A healthy diet is one of the leading predictors of children's physical and mental growth, and an unhealthy diet containing extra sugar may have a negative impact on their health.

A sugar-sweetened beverage is any beverage that contains added sugars, such as cane sugar (table sugar/sucrose), high fructose corn syrup, fructose-based fruit juice concentrates, or other sweetening agents^{6, 7}. By this definition, drinks such as sodas, sweetened fruit juices, energy drinks, sports drinks, sweetened teas, and sweetened coffee are considered sugar-sweetened beverages. Regular consumption of sugar-sweetened beverages can be a significant contributor to sugar-based calories in the daily diet. For example, a 20-ounce cola contains over 16 teaspoons of added sugar, which is around double the daily recommendation (240 calories)⁶. Research suggests that consumption of sugar-sweetened beverages is positively correlated with an increase in weight⁸. Consumption of sugar-sweetened beverages was reported to be associated with obesity and type 2 diabetes mellitus among adults⁹⁻¹¹. Most studies investigating the health-related effects of soft drinks were done on the adult population, and fewer studies were conducted on children⁹⁻¹¹. Children differ vastly from the adult population in terms of nutrition requirements¹². Besides, children's food choices are often driven by the lifestyle choices of their

parents¹³. It is crucial to evaluate the health effects of the consumption of sugar-sweetened beverages on children. This review aimed to evaluate and summarize the current global trends in sugar-sweetened beverage consumption and its health effects on children.

Comprehensive literature research was conducted by using two online searching tools (PubMed and SciFinder). MeSH Search terms were used with the "AND" operator ("Sweetening Agents"[Mesh] AND "Carbonated Beverages"[Mesh]) AND "Child"[Mesh]. Only peer-reviewed articles published in the last ten years (2009-2019) were considered for this review because we wanted to include only the recent evidence. Studies that conducted research on children aged between 0-18 years were included. We included original research and review articles (literature review, meta-analysis). Any article that did not include research on children was excluded. We utilized a qualitative approach to synthesize the review. The typical workflow of the literature review is shown in **Figure 1**.

Initially, 151 articles were found, and after careful screening of titles, abstracts, and full-text, 34 articles were finally selected for review. The majority of the original studies (excluding review articles) compiled in our studies were mainly conducted in the three continents (North America, Western Europe, Australia). Fifteen original studies were conducted in the USA, ten studies were conducted in European nations, two studies were conducted in Australia, and one study was conducted in Canada.

2. Trends in Consumption of sugar-sweetened beverage

Our review highlights that there were differences in studies estimating the consumption of sugar-sweetened beverages among children. Mesirov et al. reported that between 2001-02 and 2009-10, in the USA, there was a decline in the consumption of sugar-sweetened beverages in children from 24.4% to 21.1% of daily energy intake¹⁴. Ford et al. reported that between 2003-04 and 2011-12, in the USA, children's consumption of sugar-sweetened beverages declined 57 kilocalorie/day (kcal/d)¹⁵. Reedy et al. showed that soft drinks were pizza, and grain desserts were the three primary sources of daily calorie intake for children in USA between

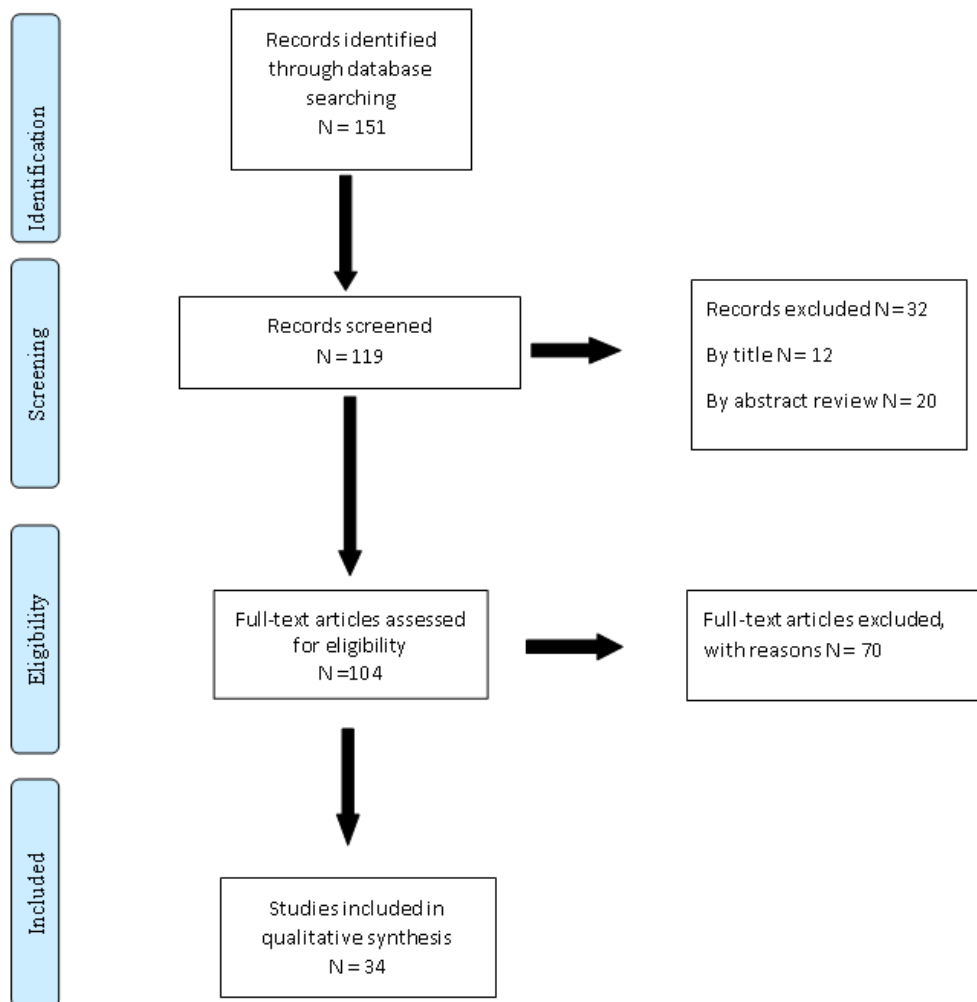


Figure 1. Workflow of the current literature review. Here, N: number of articles

2003-006¹⁶. In a review article, Della Corte et al. reported that global consumption of sugar-sweetened beverages increased from 1990 to 2000 with a peak in 2000 and then had a gradual decline from 2000 to 2010 in Australia, Canada, Norway, USA, and UK¹⁷.

The researchers also reported that in other countries such as China, Russia (excluding Australia, Canada, Norway, USA, and the UK), consumption of sugar-sweetened beverage among children remained stable from 1990 to 2010, and in countries such as Mexico and South Korea, consumption of sugar-sweetened beverage increased after 2000¹⁷. Gibson et al. indicated that soft drinks were supplying 18% of total daily sugar consumed by the children in the UK between 2008-2012¹⁸. Ruiz et al. reported that in Spain, total sugar intake was 19% of the children's total energy requirement.

Sugar-sweetened beverages were 54% and 18% of total daily intrinsic sugar and total daily free sugar consumption in children, respectively¹⁹.

3. Health impacts of consumption of sugar-sweetened beverage on children

Multiple studies have indicated a positive relationship between consuming sugar-sweetened beverages and obesity in children²⁰⁻²³. One study suggested that children between ages 2.5-4.5 who consume sugar-sweetened beverages regularly were 2.4 times more likely to become overweight or obese than children who did not consume sugar-sweetened beverages²⁴. Bortsov et al.'s research reported that sugar-sweetened beverage consumption was associated with higher levels of total cholesterol,

LDL (low-density lipoprotein), and triglycerides in children²⁵. Laverty et al. reported that sugar-sweetened beverage consumption was positively associated with children's BMI and body fat percentage⁶³. Mirmiran et al. conducted a study in Iran and reported that sugar-sweetened beverage consumption was associated with an increased risk of metabolic syndrome among children²⁶. Mueller et al. and Carwile et al. reported that consuming sugar-sweetened beverages was associated with early menarche among the studied children^{27, 28}. Consumption of sugar-sweetened beverages has also been linked to high uric acid levels in the body due to the presence of a high concentration of fructose, which eventually raises uric acid levels²⁹. Hennessy et al. asserted that sugar-sweetened beverage intake was positively associated with the onset of asthma in children³⁰. Multiple studies in our review reported strong evidence of an association between consumption of sugar-sweetened beverages and developing dental aches and caries^{23, 31-34}. **Table 1** enlists the health effects of consumption of sugar-sweetened beverages reported in the reviewed articles.

4. Factors influencing children's Consumption of sugar-sweetened beverage

Evidence from several studies suggests a strong correlation between parent's consumption of sugar-sweetened beverage behavior and that of their children³⁵⁻³⁷. Parents' attitudes toward sugar-sweetened beverages influenced their children's

frequency of soft drinks consumption in European families³⁵. Hebestreit et al. reported that parents' dietary habits, including sugar-sweetened beverage consumption, positively influenced their children's consumption of sugar-sweetened beverages³⁵. Similar findings were reported by an Australian study that parent's perception toward sugar-sweetened beverage remained a critical influencing factor in children's consumption frequency of sugar-sweetened beverage³⁶. A Dutch study also reported children's sugar-sweetened beverage consumption to be positively associated with their parents' consumption³⁷. A Swiss study reported coherent findings that parents' and their children's perceptions of sugar-sweetened beverages' healthiness were strongly related. Both parents and children considered added sugar, caffeine content, and artificial sweeteners to determine the beverage's healthiness³⁸. A study conducted on Swedish children found a higher consumption among male children³⁹. Similarly, Osowski et al. found that male children consumed more sugar-sweetened beverages than female children⁴⁰. Pabayoy et al. reported that children from low socio-economic status (SES) were more likely to consume sugar-sweetened beverages than children from higher SES⁴¹. Distance to grocery may be an important factor to consider. Authors of a study also reported that the children living within 1 kilometer of the grocery store were more likely to consume sugar-sweetened beverage than the children living farther⁴¹. Park et al. found that children who consumed sugar-sweetened beverage during their infancy were more likely to consume

Table 1. Major health effects of sugar-sweetened beverage on children health

References	Major Health Effects
Bucher et al ²⁰ .	Adiposity in children
Morgan et al ²¹ .	Obesity in children limitation of sugar-sweetened beverage can reverse the course of obesity
Nissinen et al ²² .	Obesity in children leading to adulthood obesity
Lim et al ²³ .	Obesity in children increased risk of dental caries
Bortsov et al ²⁵ .	Higher level of total cholesterol, ldl, plasma triglyceride
Mueller et al ²⁷ .	Risk of early menarche in young girls
Carwile et al ²⁸ .	Frequent consumption of sugar-sweetened beverage was associated with early menarche
Liena and Forner ³¹ .	Increased risk of dental caries
Lee and Messer ³² .	Increased risk of dental caries
Yuen et al ³³ .	Increased incidence of toothache and caries
S et al ²⁹ .	Increased level of serum uric acid level and high blood pressure

Table 2. Influencing factors related to children’s consumption of sugar-sweetened beverage

References	Major influencing factors
Hebestreit et al. ³⁵ .	Parents consumption of sugar-sweetened beverage influenced children’s consumption of sugar-sweetened beverage
Pettigrew et al. ³⁶ .	Children’s consumption of sugar-sweetened beverage was influenced by parents’ attitude to Consumption of sugar-sweetened beverage
Elfhag et al. ³⁷ .	Parents’ consumption of sugar-sweetened beverage influences children’s consumption of sugar-sweetened beverage
Bucher et al. ³⁵ .	Parents’ perception on sugar-sweetened beverage influences children’s perception on sugar-sweetened beverage
Pabayo et al. ⁴¹ .	Children with low socio-economic status consumed more sugar-sweetened beverage
	Children living within 1 kilometer of grocery store consumed less sugar-sweetened beverage
Osowski et al. ⁴⁰ .	Male children consumed more sugar-sweetened beverage than the female children
Park et al. ⁴² .	Children’s’ intake of sugar-sweetened beverage increases as they grow older

sugar-sweetened beverage at six years of age⁴². **Table 2** enlists the factors influencing children’s consumption of sugar-sweetened beverage. **Table 3** enlists the list of the 30 reviewed articles with location, objectives, methodology and findings.

5. Discussion

Our study reviews the association between sugar-sweetened beverage consumption with childhood obesity and other chronic conditions (asthma, metabolic syndrome, dental caries) from our selected articles. Childhood obesity is a significant risk factor for chronic diseases, such as cardiovascular disease, type 2 diabetes mellitus, and health conditions as fatty liver disease, breathing problems, muscle and joint pain⁴³. Our study reports that sugar-sweetened beverage consumption is associated with increased levels of atherogenic LDL particles, triglycerides, and total cholesterol levels²⁵, which is explainable. A higher level of LDL stimulates the formation of arterial plaques. The plaques are responsible for accumulating cholesterol, fats, and other substances in blood vessel walls, which may cause cardiovascular diseases (CVDs)⁴⁴. It also increases the inflammatory marker, i.e., C-reactive protein, which plays a crucial role in developing atherosclerosis and increases the risk for CVD⁴⁵. Consumption of sugar-sweetened beverages increases the risk of developing type-2 diabetes

mellitus in children later in their life⁴⁶. Research also shows that children’s sugar-sweetened beverage consumption continues and even increases in adulthood if not intervened earlier in their life⁶³. Consumption of sugar-sweetened beverages rich in fructose can cause an increased level of uric acid in children²⁹.

An increased uric acid level may cause gout, arthritis, kidney stones, and a potential risk factor for developing hypertension²⁹. Association between children’s dental caries and Consumption of sugar-sweetened beverages is a common finding by several studies^{23, 31-34}. According to the World Health Association, dental caries is a common non-communicable global health condition among children⁴⁷. A sugar-sweetened beverage containing sweetening agents demineralizes the enamel and dentine part of the teeth^{47, 48}. Consumption of sugar-sweetened beverages causes a rapid increase in the concentration of circulating insulin in the blood, which leads to a higher concentration of bioavailable sex hormones and insulin-like growth factor-1 (IGF-1) linked to early menarche²⁸. However, the process of early menarche is a complicated relationship between a child’s biological factors and socio-environmental factors⁴⁹. Therefore, more studies should be conducted in this regard.

Parents' perceptions and attitudes towards sugar-sweetened beverages positively influenced their children’s attitudes toward sugar-sweetened

Table 3. Comprehensive review of the selected articles with study location, objectives, study design and major findings

Reference	Year	Study location	Research objective	Study design	Major findings
Pettigrew et al ³⁶ .	2015	Australia	Investigated the relationship between a broad range of predictor variables and the frequency with which Australian children consume sugar-sweetened beverage.	CS	Frequency of consumption of sugar-sweetened beverage was influenced by parents' attitudes to sugar-sweetened beverage, children's pestering behaviors, and perceived social norms relating to children's consumption of these products.
Lee et al ³² .	2010	Australia	Studied intake of sugar-sweetened beverage of children and the associated risk.	CS	Dental caries was associated with increased frequency of consumption of sugar-sweetened beverage.
Pabayo et al ⁴¹ .	2012	Canada	Identified sociodemographic and environmental correlates of sweetened beverages among children of pre-school age.	L	Socio-economic factors were associated with sugar-sweetened beverage in children.
Hebestreit et al ³⁵ .	2017	Sweden, Germany, Hungary, Italy, Cyprus, Spain, Belgium and Estonia	Determined association between children's and parental dietary patterns (DP), and whether the number of shared meals or sugar-sweetened beverage availability during meals strengthened this association.	CS	Availability of sugar-sweetened beverage and negative parental role modeling were associated with children's consumption of sugar-sweetened beverage.
Nissinen et al ²² .	2009	Finland	Investigated associations of BMI and overweight in adulthood with consumption of sugar-sweetened beverage in childhood.	L	The increase in consumption of sugar-sweetened beverage was associated with BMI of the children.
Ruiz et al ¹⁹ .	2017	Spain	Assessed sugar intake in Spanish diet.	CS	Only moderate percentage of participants adhered to recommended consumption of sugar-sweetened beverage.
Liena et al ³⁴ .	2015	Spain	Assessed the association between caries history and the number of early carious lesions and the frequency and timing of cariogenic food and sugar-sweetened beverage intake.	CS	Increased consumption of sugar-sweetened beverage was associated with dental caries among children.
Llena et al ³¹ .	2009	Spain	Analyzed association between caries experience and the consumption of potentially cariogenic foods in children.	CS	Consuming of sugar-sweetened beverage was reported to be associated with dental caries.
Schäfer Elinder et al ³⁹ .	2014	Sweden	Assessed gender differences in health behaviors among children.	L	Female children consumed less sugar-sweetened beverage than male children.
Osowski et al ⁴⁰ .	2011	Sweden	Studied how children's meal patterns are reported by the children and their parents.	CS	Male children consumed more sugar-sweetened beverage than females.
Bucher et al ²⁰ .	2015	Switzerland	Investigated which beverage attributes shape adults' and children's health perceptions.	Exp	Perceptions of parents and children were strongly related to the children's attitude to consumption of sugar-sweetened beverage.

Table 3. Continued

Reference	Year	Study location	Research objective	Study design	Major findings
Gibson et al. ¹⁸ .		UK	Explored associations between free sugars intake and nutrient intake.	CS	Inverse associations between consumption of sugar-sweetened beverage and nutrient densities in children was reported.
Lavery et al. ⁶³ .	2015	UK	Examined associations between sugar-sweetened beverage and artificially sweetened beverage consumption and changes in adiposity.	L	Consumption of sugar-sweetened beverage was associated with BMI and percentage body fat increases in children.
Mueller et al. ²⁷ .	2015	USA	Examined hypothesis that consumption of caffeinated soft drinks in childhood is associated with higher risk of early menarche.	L	Consumption of sugar-sweetened beverage was associated with risk of early menarche in a US cohort of children.
Hennessy et al. ³⁰ .	2015	USA	Examined how parent's beliefs about beverage attributes and exposure to sugar-sweetened beverage advertising are associated with parents and their children's consumption of sugar-sweetened beverage.	CS	Parents' attitude towards consumption of sugar-sweetened beverage was associated with children's attitude and consumption frequency of sugar-sweetened beverage.
Ford et al. ¹⁵ .	2016	USA	Examined changes in intakes of sugar-sweetened beverage in childhood.	CS and Retro	Significant decreases in consumption of sugar-sweetened beverage was noted between 2003-04 and 2011-12.
Carwile et al. ²⁸ .	2015	USA	Explored if sugar-sweetened beverage intake was associated with age of menarche.	Prosp	Increased consumption of sugar-sweetened beverage was associated with earlier menarche.
Morgan et al. ²¹ .	2013	USA	Reviewed literatures on sugar-sweetened beverage high fructose corn syrup and childhood obesity.	Review article	Consumption of sugar-sweetened beverage contributed to obesity among children.
Mesirow et al. ¹⁴ .	2014	USA	Described recent trends in consumption of sugar-sweetened beverage among US children.	CS and Retro	There was a decline in consumption of sugar-sweetened beverage towards total energy intake among children in USA between 2001 and 2010.
Park et al. ⁴² .	2014	USA	Examined whether sugar-sweetened beverage intake during infancy predicts sugar-sweetened beverage intake at 6 years of age.	L	sugar-sweetened beverage intake during infancy increased the likelihood of consuming sugar-sweetened beverage at 6 years of age.
Yuen et al. ³³ .	2011	USA	Explored behavioral factors associated with toothache among African American adolescents living in rural South Carolina.	CS	Consumption of sugar-sweetened beverage was related to toothache in children.
Cunningham et al. ⁶⁴ .	2011	USA	Assessed relationship between children's access to sugar-sweetened beverage, purchases and total consumption of these beverages, and their weight.	L	There was limited evidence of relationship between obesity and frequency of children's consumption of sugar-sweetened beverage with availability of sugar-sweetened beverage at school setting.

Table 3. Continued

Reference	Year	Study location	Research objective	Study design	Major findings
Bortsov et al ²⁵ .	2011	USA	Explored the association of sugar-sweetened and diet beverage intake with CVD risk factors and metabolic control in youth with type 1 diabetes.	CS	sugar-sweetened beverage intake was associated with higher levels of CVD risk factors in youth with diabetes.
Reedy et al ¹⁶ .	2010	USA	Identified top dietary sources of energy, solid fats, and added sugars among 2- to 18-year-olds in the United States.	Cross sectional	sugar-sweetened beverage was one of the major calorie providers for the age groups.
Fiorito et al ⁶⁵ .	2010	USA	Identified changes in beverage intake during childhood and assess sugar-sweetened beverage and nutrient intake from ages 5 to 15 years.	Cross sectional	Consumption of sugar-sweetened beverage among children was associated lack macro and micro-nutrients in diet.
Lim et al ⁶⁶ .	2009	USA	Examined association between consumption of sugar-sweetened beverage and obesity in a cohort of low-income African American preschool children.	Cross sectional	High consumption of sugar-sweetened beverage was significantly associated with increased risk for obesity.
Fernandes et al ¹² .	2009	USA	Measured sugar-sweetened beverage availability, purchases, and consumption by the children.	Qualitative	More consumption of sugar-sweetened beverage at school was associated with overall higher total consumption of sugar-sweetened beverage.
Lim et al ²³ .	2009	USA	Assessed whether high consumption of sugar-sweetened beverage was a risk factor for dental caries in low-income African American children.	Qualitative, and cross sectional	Consumption of soft drinks was associated with dental caries.
Della Corte et al ¹⁷ .	2019	N/A	Reviewed the global trend in consumption of sugar-sweetened beverage among children.	Review article	- Consumption of sugar-sweetened beverage increased from 1990-2000, peaked in 2000, and then gradually declined from 2000 in USA, Canada, UK, Australia. - Consumption of sugar-sweetened beverage in other countries remained stable between 1090-2010
Della Torre et al ²⁰ .	2016	N/A	Systematically analyzed methodology of studies investigating the influence of sugar-sweetened beverage.	Review article	Positive association between consumption of sugar-sweetened beverage and risk of obesity was reported.
Bremer et al ²⁴ .	2012	N/A	Commentary	Review article	sugar-sweetened beverage enriched with fructose increased adiposity, and uric acid formation in children.
Brand-Miller et al ⁶⁷ .	2017	N/A	Investigated changes in intakes of sugar-sweetened beverage in children.	Review article	Reduction in consumption of sugar-sweetened beverage in Australia within study period (1995-2012)

CS – Cross sectional; L – Longitudinal; Prosp – Prospective study; Retro – Retrospective study;

KEY POINTS

- ◆ Consumption of sugar-sweetened beverages is associated with childhood obesity, metabolic syndrome, dental caries among children
- ◆ Male children consume more sugar-sweetened beverages than female children
- ◆ Parent's perceptions and attitudes towards sugar-sweetened beverages influence children's attitudes towards these beverages as well
- ◆ Children living in low socio-economic status consumes more sugar-sweetened beverage than children living in higher socio-economic status

beverages and consumption of sugar-sweetened beverage³⁵⁻³⁸. It is established among social scientists and public health researchers that parents' behavior and attitude directly influence their children's health as well as their health behavior⁵⁰. Parents who are educated and have more knowledge of healthy living can help their children develop a healthy lifestyle³⁰. Our review also highlights gender differences in the pattern of children's consumption of sugar-sweetened beverages. Male children consumed an increased number of sugar-sweetened beverages than female children³⁸⁻⁴⁰. Gender difference in health behavior, especially eating behavior, is an established fact in social and health science, which starts from early childhood^{51, 52}. Our review underscores that children from low SES consumed more sugar-sweetened beverages than children from higher SES⁴². Children living in low SES often have poor health behaviors⁵³. The influence of SES on children's health behavior is a complex interaction of multiple interrelated factors⁵⁴. Research shows that individual level, family level, and neighborhood-level factors play an intricate role in determining health behavior among the children⁵⁴. Children living in low socio-economic status experience more diet-related disparities⁵⁵. Therefore, intervention programs should specifically target children in low SES to improve their diet-related behaviors, including consuming sugar-sweetened beverages⁵⁶.

Sugar-sweetened beverage constitutes a major portion of children's daily energy intake in most parts of the world. In Australia, Canada, Norway, USA, and UK a declining trend was observed in the consumption of sugar-sweetened beverages in the last decade. However, there was a lack of similar

trends in other countries, and in contrast, the consumption of sugar-sweetened beverages on average was increasing in some countries, such as Mexico and South Korea, and in countries such as China and Russia, the trend remained stable. Moreover, there is no evidence of whether this decline in Australia, Canada, Norway, USA, and UK continues in the current decade and how it will continue in the next decade. Although these countries are classified as high and high middle-income countries, there are many socio-cultural differences in these nations, including the diet of the population⁵⁷⁻⁵⁹. The decline in consumption of sugar-sweetened beverages among children in these countries might be due to public interest, higher number of research studies, availability of public health funding, and government initiatives¹⁷. Three large continents Asia, Africa, and South America were barely presented in the reviewed studies. Many countries in these three continents are classified as lower-income, lower-middle-income countries where many people live in low SES⁵⁷. Due to globalization and urbanization, there is a change in people's diet structure in these countries, and children constitute a large percentage of these countries' demographic structure^{60, 61}. Therefore, more research must be conducted in these geographical areas on children's consumption of sugar-sweetened beverages.

Although our review revealed several important information related to children's consumption of sugar-sweetened beverages, it has some limitations. Our study qualitatively reviewed the collected articles instead of conducting a meta-analysis. It only reviewed articles that included information for the children. We also did not thoroughly analyze the

trend of children's consumption of sugar-sweetened beverages from the reviewed articles. We found that most of the studies evaluating the relationship between consuming sugar-sweetened beverage and their health effects among children were cross-sectional studies. Longitudinal cohort studies are required to strengthen the existing evidence of poor health outcomes with the consumption of sugar-sweetened beverages⁶². Only PubMed and SciFinder were used to identify and locate articles. However, the acceptability of these repositories among researchers and reviewing only peer-reviewed articles can partially compensate for this limitation.

6. Conclusion

Our review highlights that sugar-sweetened beverage consumption in children is associated with multiple health conditions and is influenced by several social and behavioral factors. The rise in consumption of sugar-sweetened beverages among children is alarming as it not only affects their physical and mental health in their childhood but is also a strong predictor of health into their adulthood. We recommend that more longitudinal studies be conducted to determine the cause-effect relationship between sugar-sweetened beverage consumption and its health effects. For intervention research, we recommend researchers consider parents'/guardians' role on their children and include parents in the study since their perception and attitude toward sugar-sweetened beverage can help influence their children's habit of consumption of sugar-sweetened beverage, as suggested by the substantial evidence summarized in this review.

Competing interests

The authors declare that they have no competing interests

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The information and table in the article are freely available to all readers. Upon request, the corresponding author can share the literature review matrix.

RK worked on conceptualization, literature search, literature review, formatting, manuscript writing and supervised the project; MAS performed the literature review, manuscript writing; HK helped with the manuscript writing, formatting; SK contributed to the literature review, manuscript writing, MT helped with the literature search, literature review and SZ with conceptualization, manuscript writing. All authors significantly contributed to manuscript and approved its final form.

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