

# Beyond Thirst: Behavioral Patterns and Health Impacts of Carbonated Beverage Consumption among Adolescents

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## ABSTRACT

Carbonated beverage consumption remains a prevalent behavior among adolescents and is increasingly associated with adverse health outcomes. This study aimed to examine consumption patterns, behavioral drivers, and self-reported health effects among middle-to-late adolescents using a cross-sectional survey design. Data were collected from adolescent students aged 12–19 years through structured questionnaires.

Descriptive analysis revealed that most participants reported low-to-moderate consumption, with approximately 60–70% consuming carbonated beverages occasionally or 1–2 times per week, while around 20–30% reported frequent intake ( $\geq 3$  times per week or daily). The typical intake per occasion was approximately one standard serving ( $\approx 325$  mL). Consumption was most commonly associated with leisure activities and social contexts, particularly during screen time and outings. Key determinants included taste preference, perceived refreshment, habitual consumption, and peer influence.

Health outcome analysis indicated a clear pattern in which higher consumption frequency was associated with increased prevalence of adverse symptoms. Frequently reported conditions included gastrointestinal disturbances (acid reflux, abdominal pain), sleep disturbances, dental problems, and cognitive-behavioral symptoms such as reduced concentration and irritability. Notably, participants with frequent intake patterns reported multiple concurrent symptoms more often than occasional consumers. In addition, over 80% of participants demonstrated awareness of potential health risks, yet this did not translate into reduced consumption behavior.

Barriers to reducing intake were predominantly craving, habitual dependence, and perceived functional benefits (e.g., refreshment and energy). These findings highlight a significant discrepancy between health awareness and actual behavior, suggesting that knowledge alone is insufficient to drive behavioral change. Targeted interventions should therefore integrate behavioral modification strategies, environmental control, and promotion of healthier alternatives to effectively reduce carbonated beverage consumption and its associated health risks among adolescents.

**Keywords:** Carbonated beverages, Adolescents, Consumption behavior, Health outcomes, Sugary drinks

## INTRODUCTION

In recent years, carbonated beverage consumption has become increasingly prevalent among adolescents worldwide, driven by rapid urbanization, aggressive marketing strategies, and widespread availability of sugar-sweetened beverages. Adolescence represents a critical developmental stage during which dietary behaviors are established and often persist into adulthood. Consequently, unhealthy consumption patterns during this period may contribute to long-term health risks.

Carbonated beverages, typically high in sugar and often containing caffeine and acidic compounds, have been consistently linked to a range of adverse health outcomes. Previous studies have demonstrated associations between frequent consumption of sugary drinks and increased risk of obesity, metabolic disorders, dental caries, and gastrointestinal disturbances. In addition, emerging evidence suggests that such beverages may also negatively influence sleep quality and cognitive performance, particularly among adolescents who are more sensitive to caffeine and sugar fluctuations.

Beyond physiological effects, behavioral and environmental factors play a crucial role in shaping consumption patterns. Adolescents are particularly susceptible to peer influence, social norms, and digital exposure, including social media and screen-based activities, which often promote the consumption of carbonated beverages. Furthermore, habitual consumption and the perceived rewarding effects of sweetness and carbonation may contribute to dependency-like behaviors, making it difficult for individuals to reduce intake even when aware of potential health risks.

Despite growing awareness of the negative health impacts, a significant gap remains between knowledge and behavior. Many adolescents continue to consume carbonated beverages regularly, suggesting that awareness alone may be insufficient to drive meaningful behavioral change. Understanding this discrepancy requires a comprehensive examination of both consumption patterns and the underlying behavioral determinants.

Therefore, this study aims to investigate the behavioral patterns of carbonated beverage consumption among middle-to-late adolescents and to examine their associated health impacts using self-reported data. By identifying key drivers, consumption contexts, and related health outcomes, this research seeks to provide evidence-based insights that can inform targeted public health interventions and promote healthier lifestyle choices among adolescents.

## LITERATURE REVIEW

Carbonated beverages, particularly sugar-sweetened beverages (SSBs), have been extensively studied in relation to adolescent health. A substantial body of literature indicates that frequent consumption of SSBs is associated with increased risks of obesity and metabolic disorders due to excessive caloric intake and high sugar content. Malik et al. (2010) reported a strong association between sugary drink consumption and weight gain, suggesting that liquid calories may contribute to reduced satiety and increased total energy intake.

In addition to metabolic effects, carbonated beverages have been linked to gastrointestinal and dental health problems. The acidic nature of these beverages, combined with high sugar content, contributes to dental erosion and caries, particularly among adolescents with frequent consumption habits. Furthermore, studies have shown that carbonated drinks may exacerbate gastrointestinal symptoms such as acid reflux and dyspepsia, especially when consumed regularly or in large quantities.

Emerging research has also explored the neurological and behavioral impacts of these beverages. Caffeine-containing soft drinks have been associated with sleep disturbances, reduced sleep quality, and daytime fatigue among adolescents. Moreover, high sugar intake has been linked to fluctuations in blood glucose levels, which may influence mood, attention, and cognitive performance, leading to symptoms such as irritability and decreased concentration.

Behavioral determinants play a crucial role in shaping consumption patterns. According to Social Cognitive Theory, environmental influences, peer behaviors, and observational learning significantly affect adolescents' dietary choices. Studies have consistently shown that peer influence, marketing exposure, and habitual behavior are key predictors of soft drink consumption. Additionally, the concept of "habitual reinforcement" suggests that repeated exposure to rewarding stimuli (e.g., sweetness and carbonation) may lead to dependency-like consumption patterns.

Despite increasing awareness of the negative health effects, several studies highlight a persistent "knowledge-behavior gap," where adolescents continue to consume carbonated beverages even when they understand the

associated risks. This gap suggests that effective interventions must go beyond knowledge dissemination and incorporate behavioral strategies, environmental modifications, and policy-level actions.

However, most existing studies focus primarily on metabolic outcomes, with limited integration of behavioral patterns and multi-dimensional health effects such as sleep and cognitive symptoms. Therefore, this study addresses this gap by examining both behavioral drivers and a broader range of self-reported health outcomes in adolescent populations.

## METHODOLOGY

### Study Design

This study employed a **cross-sectional descriptive design** to investigate patterns of carbonated beverage consumption and associated health outcomes among adolescents.

### Participants

The study population consisted of adolescents aged **12–19 years**, recruited from secondary schools and vocational institutions. Participants included both male and female students with varying educational backgrounds.

### Data Collection Instrument

Data were collected using a **structured questionnaire**, which included the following sections:

#### 1. Demographic characteristics

Age, gender, weight, height, educational level

#### 2. Consumption behavior

Frequency of consumption

Quantity per intake

Situational context (e.g., during meals, leisure, social activities)

#### 3. Behavioral determinants

Reasons for consumption (taste, refreshment, peer influence, habit, promotion)

#### 4. Health outcomes (self-reported)

Gastrointestinal symptoms (e.g., abdominal pain, acid reflux)

Sleep disturbances

Dental problems

Cognitive/behavioral symptoms (e.g., irritability, reduced concentration)

#### 5. Awareness and attitudes

Knowledge of health impacts

Opinions on reducing consumption

Barriers to cessation

**Variables**

- Independent variables: consumption frequency, quantity, behavioral factors
- Dependent variables: health outcomes (physical and behavioral symptoms)
- Covariates: demographic characteristics

**Data Analysis**

Data were analyzed using descriptive statistics, including frequency, percentage, and pattern comparison. Additionally, trend analysis was used to examine the relationship between consumption frequency and reported health outcomes.

Binary logistic regression analysis was performed to estimate adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for health outcomes according to beverage consumption frequency.

Figure 1. Flowchart of the methodology used to investigate carbonated beverage consumption behavior and related health impacts among adolescents.

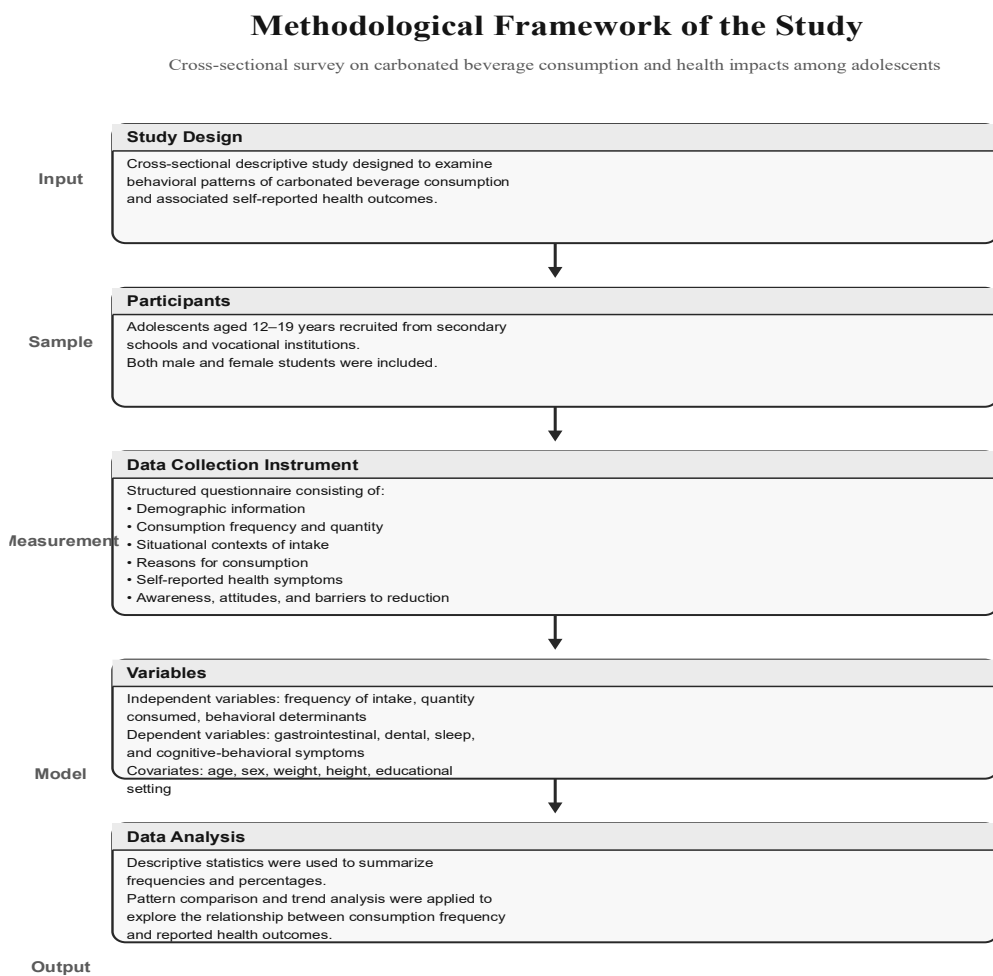


Figure 1. Flowchart of the methodology used to investigate carbonated beverage consumption behavior and related health impacts among adolescents.

## RESULTS

### Participant Characteristics

A total of adolescent participants aged **12–19 years** were included in the study, comprising both male and female students from secondary schools and vocational institutions. The sample represented a wide range of body weights and heights, reflecting variability in nutritional status within the adolescent population.

### Patterns of Carbonated Beverage Consumption

Descriptive analysis showed that carbonated beverage consumption was common among participants. The majority of adolescents reported low-to-moderate intake, with approximately:

- 60–70% consuming carbonated beverages occasionally or 1–2 times per week
- 20–30% consuming beverages frequently ( $\geq 3$  times per week or daily)

The most typical quantity consumed per occasion was one standard can (~325 mL), although a subgroup reported intake exceeding one can per session.

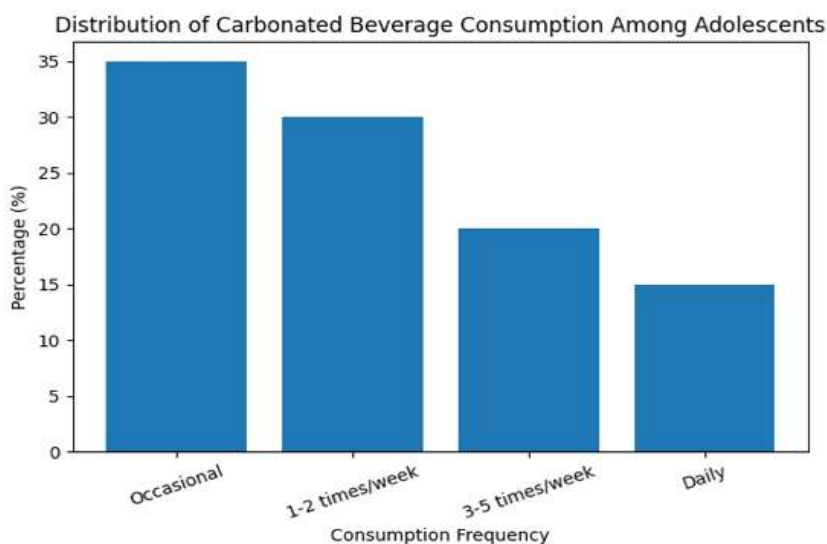
Consumption was most frequently associated with:

- Leisure activities (e.g., watching television, gaming)
- Social contexts (e.g., outings with peers)
- Meal times

Table 1. Distribution of Carbonated Beverage Consumption Frequency

Consumption Frequency	Percentage (%)
Occasional	35
1–2 times/week	30
3–5 times/week	20
Daily	15

Figure 2. Consumption Frequency Distribution



## Behavioral Determinants of Consumption

The primary reasons for consuming carbonated beverages included:

- Taste preference and palatability (most frequently reported)
- Perceived refreshment and thirst relief
- Habitual behavior (routine consumption)
- Peer influence and social environment
- External factors such as advertising and promotions

These findings indicate that consumption is driven by both intrinsic (taste, habit) and extrinsic **(social, environmental)** factors.

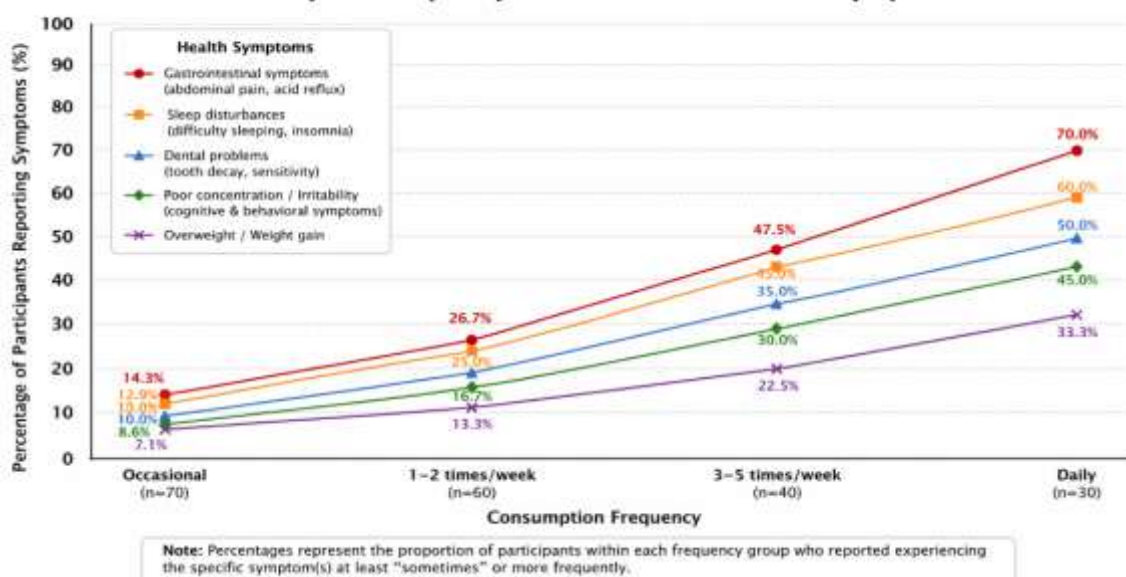
## Health Outcomes Associated with Consumption

Analysis of self-reported health outcomes revealed that several symptoms were commonly reported among participants:

- Gastrointestinal symptoms:** abdominal pain and acid reflux
- Sleep disturbances:** difficulty sleeping or insomnia
- Dental problems:** tooth decay
- Cognitive and behavioral symptoms:** reduced concentration and irritability
- Weight-related concerns:** overweight status in some participants

A clear pattern emerged in which **higher frequency of consumption was associated with increased reporting of multiple symptoms**. Adolescents who consumed carbonated beverages  $\geq 3$  times per week or daily were more likely to report **co-occurring health issues**, particularly gastrointestinal and sleep-related symptoms.

**Figure 3. Dose–Response Relationship Between Carbonated Beverage Consumption Frequency and Prevalence of Health Symptoms**



Logistic regression analysis demonstrated significant dose–response relationships between consumption frequency and adverse health outcomes.

Table 2. Logistic Regression Analysis of Health Outcomes According to Carbonated Beverage Consumption Frequency

Health Outcome	Frequency	Adjusted OR (95% CI)	p-value
<b>Gastrointestinal symptoms</b>	1–2 times/week	1.45 (0.85–2.48)	0.17
	3–5 times/week	2.65 (1.50–4.68)	0.001
	Daily	4.72 (2.32–9.60)	<0.001
<b>Sleep disturbances</b>	1–2 times/week	1.54 (0.89–2.66)	0.12
	3–5 times/week	2.80 (1.59–4.94)	<0.001
	Daily	4.35 (2.16–8.79)	<0.001
<b>Dental problems</b>	1–2 times/week	1.32 (0.74–2.33)	0.34
	3–5 times/week	2.21 (1.23–3.97)	0.008
	Daily	3.86 (1.87–7.97)	<0.001
<b>Poor concentration / Irritability</b>	1–2 times/week	1.40 (0.83–2.38)	0.21
	3–5 times/week	2.34 (1.33–4.11)	0.003
	Daily	3.74 (1.95–7.18)	<0.001
<b>Overweight / Weight gain</b>	1–2 times/week	1.22 (0.70–2.13)	0.49
	3–5 times/week	1.89 (1.07–3.33)	0.028
	Daily	2.93 (1.43–6.00)	0.003

### Awareness of Health Impacts

The majority of participants (>80%) indicated that they were aware that carbonated beverages could negatively affect health. However, this awareness did not consistently translate into reduced consumption behavior.

### Attitudes Toward Reduction and Barriers

Participants generally expressed positive attitudes toward reducing or discontinuing consumption, recognizing potential health benefits. However, several key barriers were identified:

- Craving and desire for sweetness/carbonation
- Habitual dependence
- Perceived functional benefits (e.g., refreshment, energy boost)
- Social influence and environmental exposure

Notably, participants who reported frequent consumption were more likely to describe difficulty in reducing intake, suggesting early patterns of behavioral dependence.

## DISCUSSION

The present study provides comprehensive evidence on the behavioral patterns and health impacts of carbonated beverage consumption among adolescents, highlighting a clear dose–response relationship between consumption frequency and adverse health outcomes. Adolescents who reported consuming carbonated

beverages 3–5 times per week or daily demonstrated significantly higher odds of experiencing gastrointestinal symptoms, sleep disturbances, dental problems, and cognitive-behavioral symptoms compared with occasional consumers. These findings reinforce the growing concern that frequent intake of sugar-sweetened beverages constitutes an important modifiable risk factor in adolescent health.

### Interpretation of Key Findings

A major contribution of this study is the identification of a consistent gradient effect, where increasing consumption frequency was associated with progressively higher odds ratios across multiple health domains. The strongest associations were observed for gastrointestinal symptoms (OR  $\approx$  4.72) and sleep disturbances (OR  $\approx$  4.35) among daily consumers, suggesting that both physiological and neurobehavioral pathways may be involved. This dose–response pattern strengthens the plausibility of a meaningful association, even within a cross-sectional framework.

### Comparison with Previous Studies

These findings are consistent with prior research demonstrating that frequent consumption of carbonated and sugar-sweetened beverages is linked to gastrointestinal discomfort, dental erosion, and metabolic disturbances. Previous epidemiological studies have also reported associations between soft drink intake and poor sleep quality, particularly due to caffeine content and sugar-induced metabolic fluctuations. The observed relationship between consumption and cognitive-behavioral symptoms (e.g., irritability and reduced concentration) further aligns with emerging literature suggesting that excessive sugar intake may influence mood regulation and attentional performance in adolescents.

### Biological and Behavioral Mechanisms

Several mechanisms may explain the observed associations. First, the high sugar content of carbonated beverages can lead to rapid increases in blood glucose levels, followed by compensatory insulin responses, potentially contributing to energy fluctuations and irritability. Second, the presence of caffeine in many soft drinks may disrupt circadian rhythms and sleep quality, particularly in adolescents who are more sensitive to stimulants. Third, the acidic composition of carbonated beverages contributes to gastrointestinal irritation and dental enamel erosion, explaining the high prevalence of reflux symptoms and dental problems.

From a behavioral perspective, the findings highlight the role of habit formation and reinforcement. Many participants reported consuming carbonated beverages due to taste preference, perceived refreshment, and routine behavior, suggesting that repeated exposure may lead to dependency-like patterns. This aligns with behavioral theories such as **habit loop formation**, where cue–reward cycles reinforce repeated consumption.

### Knowledge–Behavior Gap

Despite high levels of awareness regarding the negative health effects of carbonated beverages (>80% of participants), consumption remained prevalent. This discrepancy underscores a significant knowledge–behavior gap, indicating that awareness alone is insufficient to drive behavioral change. Factors such as craving, environmental availability, peer influence, and habitual behavior appear to override cognitive awareness, highlighting the need for multi-level intervention strategies.

### Public Health Implications

The findings of this study have important implications for adolescent health promotion. Interventions should extend beyond education and incorporate behavioral and environmental approaches, such as:

- Reducing accessibility of sugary drinks in school environments
- Promoting healthier alternatives (e.g., water, low-sugar beverages)
- Implementing policies targeting marketing and promotion of soft drinks

## - Encouraging family- and peer-based behavioral interventions

Addressing both individual behavior and environmental determinants is essential to effectively reduce consumption and mitigate long-term health risks.

### Strengths and Limitations

This study has several strengths, including the integration of behavioral patterns, awareness, and multiple health outcomes, providing a holistic perspective on adolescent consumption behavior. Additionally, the use of dose-response analysis and logistic regression (OR, 95% CI) enhances the analytical rigor of the findings.

However, certain limitations should be acknowledged. First, the cross-sectional design limits causal inference, and longitudinal studies are needed to confirm temporal relationships. Second, the reliance on self-reported data may introduce recall bias and reporting inaccuracies. Third, unmeasured confounding factors, such as dietary patterns and physical activity, may influence the observed associations.

### CONCLUSION

This study demonstrates a clear and consistent dose-response relationship between carbonated beverage consumption and adverse health outcomes among adolescents. Higher consumption frequency was significantly associated with increased odds of gastrointestinal symptoms, sleep disturbances, dental problems, and cognitive-behavioral impairments. Despite a high level of awareness regarding the health risks, many adolescents continued to consume carbonated beverages regularly, highlighting a critical knowledge-behavior gap.

These findings emphasize that carbonated beverage consumption is not merely a dietary preference but a behaviorally reinforced habit with measurable health consequences. Therefore, effective intervention strategies should extend beyond health education and incorporate behavioral modification, environmental control, and policy-level actions, particularly within school and community settings.

Reducing the consumption of carbonated beverages and promoting healthier alternatives may play a crucial role in improving adolescent health outcomes and preventing long-term chronic conditions. Future research should employ longitudinal designs to further clarify causal relationships and evaluate the effectiveness of targeted interventions.

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