

## ORIGINAL RESEARCH ARTICLE

# Consumption behavior of sugar-sweetened beverages among primary and secondary school students: a qualitative study based on teachers' perspectives

DOI: 10.29063/ajrh2025/v29i8s.14

Yiran Li<sup>1</sup>, Siyu Liang<sup>1</sup>, Yan Zhang<sup>2</sup>, Wenjia Li<sup>1</sup>, Jiali Duan<sup>3</sup>, Lulu Meng<sup>4</sup>, Ruoxiang Cao<sup>4</sup>, Xiaofeng Liu<sup>3</sup>, Liyu Huang<sup>3,5\*</sup> and Jie Li<sup>1,2</sup>

School of Public Health, Hebei Medical University, Shijiazhuang, Hebei, 050017, China<sup>1</sup>; Institute of Nutrition and Food Hygiene, Fengtai District Center for Disease Prevention and Control, Beijing, 100070, China<sup>2</sup>; Institute of Nutrition and Food Hygiene, Beijing Center for Disease Prevention and Control, Beijing, 100013, China<sup>3</sup>; Office of Research and Teaching Administration, Beijing Center for Disease Prevention and Control, Beijing, 100013, China<sup>4</sup>; School of Public Health, Capital Medical University, Beijing, 100069, China<sup>5</sup>

\*For Correspondence: Email: [lijie7111@sina.com](mailto:lijie7111@sina.com); [liyu\\_huang0526@126.com](mailto:liyu_huang0526@126.com)

## Abstract

This study investigates the factors influencing the consumption of sugar-sweetened beverages among primary and secondary school students in China from the perspective of teachers. A total of 56 teachers participated in face-to-face interviews, including both individual interviews and focus group discussions. Data were analyzed using the grounded theory approach with three levels of coding. The analysis yielded 39 subcategories, 15 categories, and five main categories: individual, interpersonal, environmental, societal, and policy levels. The six most frequently mentioned categories were teachers' knowledge and attitudes (128 references), school health education (96 references), drivers of sugary beverage consumption (56 references), students' individual awareness (53 references), the school food environment (40 references), and home-school collaboration (39 references). A core theme was identified: the multilevel factors of students' sugary beverage consumption based on teachers' perspectives. We conclude that school-based health education interventions and efforts to enhance home-school collaboration are crucial for reducing sugary beverage consumption among primary and secondary school students. (*Afr J Reprod Health* 2025; 29 [8s]: 143-155).

**Keywords:** Sugar-sweetened beverages, Grounded theory, Home-school collaboration

## Résumé

Cette étude examine les facteurs influençant la consommation de boissons sucrées chez les élèves du primaire et du secondaire, du point de vue des enseignants. Cinquante-six enseignants ont participé à des entretiens en face à face, comprenant des entretiens individuels et des groupes de discussion. Les données ont été analysées selon l'approche de la théorie ancrée avec trois niveaux de codage. L'analyse a permis de distinguer 39 sous-catégories, 15 catégories et cinq catégories principales : les niveaux individuel, interpersonnel, environnemental, sociétal et politique. Les six catégories les plus fréquemment mentionnées étaient les connaissances et attitudes des enseignants (128 références), l'éducation à la santé en milieu scolaire (96 références), les facteurs de consommation de boissons sucrées (56 références), la sensibilisation individuelle des élèves (53 références), l'environnement alimentaire scolaire (40 références) et la collaboration famille-école (39 références). Un thème central a été identifié : les facteurs multiniveaux de la consommation de boissons sucrées des élèves, du point de vue des enseignants. Les interventions d'éducation à la santé en milieu scolaire et les efforts visant à améliorer la collaboration famille-école sont essentiels pour réduire la consommation de boissons sucrées chez les élèves du primaire et du secondaire. (*Afr J Reprod Health* 2025; 29 [8s]: 143-155).

**Mots-clés:** Boissons sucrées, théorie ancrée, collaboration maison-école

## Introduction

According to statistics, the global obesity rate among children and adolescents in 2022 will be approximately four times the rate in 1990, and a total of 159 million children and adolescents

worldwide will suffer from obesity.<sup>1</sup> Sugar-sweetened beverages (SSBs), as a major source of added sugars in the diet,<sup>2</sup> are important drivers of the obesity epidemic in children and adolescents.<sup>3</sup> Numerous studies have shown that excessive intake of sugary beverages can lead to a variety of health

problems such as type II diabetes,<sup>4</sup> cardiovascular disease,<sup>5</sup> dental caries,<sup>6</sup> and depression.<sup>7</sup> SSBs have become an important public health problem that threatens the health of adolescents.

The children and adolescents' group are the main population group consuming sugary beverages,<sup>8</sup> and the level of consumption of sugary beverages among adolescents has shown an increasing trend globally.<sup>9</sup> From 1990 to 2018, the intake of sugary beverages among children and adolescents aged 3-19 years increased by 23% in 185 countries.<sup>10</sup> In the United States, a survey of sugary drink consumption among adolescents aged 2-19 years showed that nearly two-thirds of U.S. adolescents drink at least one sugary drink per day, and that boys consume more total calories from sugary drinks than girls.<sup>11</sup>

The CDC analyzed data from the 2021 National Survey of Children's Health and showed that 57.1% of children had consumed a sugary drink at least once in the previous week.<sup>12</sup> A national survey of children aged 6-17 years in China showed that about 49.7% of children consumed sugary beverages 1-5 times per week, and sugary beverage intake was estimated to be 181 g per day.<sup>13</sup> Schools are one of the important socialization sites for adolescents in their growth process, and they have unique advantages and influence in the development of students' healthy behaviors. On the one hand, schools influence students' actual eating behaviors through the shaping of the eating environment. Studies have shown that restricting the sale of sugary beverages on campus, as well as increasing the availability of drinkable water, can reduce students' consumption of sugary beverages.<sup>14</sup> In Canada, mandatory guidelines for the sale of many sugary beverages in public secondary schools were established, and mandatory provincial school nutrition policies predicted a more limited availability of SSBs in school vending machines and lower SSB intake among students.<sup>15</sup> On the other hand, schools, as educational institutions, are able to effectively improve the nutritional knowledge of children and adolescents by developing different educational formats to convey health content such as healthy eating and nutritious diets.<sup>16,17</sup>

As important implementers of school health education and direct observers of students'

behaviors, teachers' perceptions, attitudes, and educational behaviors play an indispensable role in the formation and change of students' health behaviors. Therefore, this study explores the relevant situations of students' consumption behavior of sugary drinks from the new perspective of teachers. Qualitative interviews were conducted in order to obtain comprehensive and in-depth views. This study aims to systematically explore their multilevel influences on children and adolescents' sugary drink consumption behaviors, and to provide a scientific basis for the development of health intervention strategies in schools..

## Methods

### *Study design*

This qualitative study applies grounded theory, which allows the researcher to begin to gather data information and construct a new theory. Considering that the researcher did not establish explicit hypotheses prior to the start of the study, a grounded theory approach is appropriate for this study, which aims to explore educators' perceptions and attitudes towards the SSBs consumption among primary and secondary school students, in order to propose key points for intervention measures based on the current situation at the teacher or school level.

### *Participants*

The study enrolled 56 participants from November 6, 2024 to November 27, 2024 in Beijing, China utilizing a multi-stage stratified cluster sampling with Fengtai and Daxing districts selected as typical urban and suburban settings, respectively (mainly based on the Beijing Urban Master Plan (2016-2035)). Three schools in Fengtai District were included as target participants through the assistance of the Fengtai District Education Committee, and five schools in Daxing District were included as target participants through the social contacts of the research team members. A total of eight schools agreed to participate in the study, which included three sections: primary school, middle school, and senior high school. The target participants were educational staff working in schools, including school leaders, classroom

teachers, health teachers, logistics staff, and other subject teachers.

### **Data collection**

A combination of face-to-face individual and group interviews was used in order to gain a more in-depth understanding of the overall situation of educational staff regarding students' consumption of SSBs through structured discussions. The semi-structured interview guide was negotiated based on the current literature and the key issues set in the focus of this study, revised with input from the research team staff and experts. The interview guide mainly included five major parts: the awareness of the dangers of SSBs, attitudes towards students' consumption of SSBs, the implementation of health education programs in schools, intervention recommendations, and resources and support. Prior to the start of the interviews, demographic information was collected through a simple structured questionnaire, including age, gender, education level, years of working experience, and type of position. The interview guidelines consist of open-ended questions, which are posed by an interviewer based on the interview outline, while the interviewee expresses their views one by one. Another interviewer records the key points.

To ensure consistency in the quality of the study, two uniformly trained researchers (Y.L. and S.L.) conducted the interviews in Chinese using an interview outline, and each interview lasted 30-60 minutes. Interviews were audio-recorded with consent and voice-transcribed by two interview transcribers within 48 hours of the interview. Seventy-one participants were recruited, and during the coding of the interviews, theoretical saturation was determined to have been reached when no new perspective or category was found to have emerged after the 56th participant. All participants signed an informed consent form prior to the interview.

### **Data analysis**

Demographic information was analyzed using descriptive statistics in SPSS Statistics24. Microsoft® Excel® LTSC MSO (16.0.14332.20824) was used to organize the interviews to form new transcripts. The transcripts

were imported into NVivo12Plus software and the qualitative data were analyzed using the three levels of coding of the grounded theory. Two coders independently created three levels of coding (open coding, principal axis coding, and selective coding) by repeatedly familiarizing themselves with the interview transcripts, took notes, and transcribed text to obtain categories, main categories, and core categories. The three levels of coding developed by the two coders were reviewed step-by-step by another coder (L.H.) who was fully involved in the study, carrying out a tiered scrutiny of the different coding themes. To improve the accuracy of the data analysis, Y.L. and S.L. discussed and updated the codes, categories, and themes until agreement was reached on the final version. In this study, in order to achieve the expected results, all analyses will be conducted in Chinese, and the original corpus, codes, categories, and themes will be translated into English by the bilingual researchers in order to ensure that the data and presentation are accurate.

### **Ethical considerations**

This study was a special research project of Capital's Funds for Health Improvement and Research (2024-2G-3019), entitled "A study of sugary beverage consumption behavior of primary and secondary school students based on the social ecological model", which was approved by the Academic Ethics Committee of the Beijing Center for Disease Prevention and Control (CDC) (protocol code: BJCDC2024031, date of approval: 14 September 2024).

### **Results**

The study presents the perspectives of school staff, including school leaders, teachers, and a small number of support personnel. A total of 56 participants took part in this survey, including 47 female and 9 male. The participants' ages ranged from 22 to 54 years, with most interviewees possessing a high level of education. All individuals present during the interview were current employees. (Table 1)

The 56 participants provided a total of 556 original reference points, which were open coded to form 39 subcategories and 15 categories, with the six most frequently cited categories being teachers'

**Table 1:** Demographic characteristics of participants (n=56)

Variables	Absolute Frequency	Relative Frequency (%)
<b>Gender</b>		
Female	47	83.93%
Male	9	16.07%
<b>Age(year)</b>		
20~	9	16.07%
30~	20	35.71%
40~	23	41.07%
50~	4	7.15%
<b>Employment Period (year)</b>		
<10	20	35.71%
10~	13	23.21%
20~	21	37.50%
30~	2	3.58%
<b>Education level</b>		
Junior college	5	8.93%
Undergraduate	39	69.64%
Master	12	21.43%
<b>School type</b>		
Primary school	19	33.93%
Middle school	22	39.28%
Senior high school	15	26.79%

cognition and attitudes (128 references), school health education (96 references), consumption drivers of sugar-sweetened beverage (56 references), students' individual cognition (53 references), school food environment (40 references), and home-school cooperation (39 references). Five main categories were formed through principal axis coding: individual level, interpersonal level, environmental level, societal level, and policy level. Eventually, a core theme was obtained through selective coding, which is multilevel influences on students' consumption of SSBs from teachers' perspectives.

### **Individual level**

#### **Individual cognition**

Participants indicated that students had basic understanding of the hazards of SSBs, but they could not stop consciously taking them. The inability to resist temptation, and poor self-control were the main reasons why students' knowledge and behavior were not aligned. Participants often

mentioned that although students were aware of the dangers of sugary drinks, the fact that sugary drinks did not cause their own health problems in the short term, led to their continued consumption of sugary drinks.

*“Overall, students are aware that sugary drinks are harmful, but it is difficult for students to refuse to consume sugary drinks, and a small percentage of students actively reduce their consumption of sugary drinks.” (10, B12)*

The perception of sugary drinks varies among different groups of students. Higher grades students were more aware of the hazards of sugary drinks than lower grades students. For controlling the consumption of sugary drinks, female students had higher self-control than male students, and overweight students have poorer self-control than normal-weight students.

*“The cognitive level of the third graders is only in some superficial cognition, and they do not know about the deeper ones, such as why and where sugary drinks are bad, and which foods contain sugar.” (9, B9)*

*“Students have a basic knowledge of the dangers of sugary drinks, but they can't control themselves from drinking them. Girls will have better control than boys. Obese students will have less self-control.” (44, B30)*

#### **Consumption drivers**

Taste seemed to be one of the main drivers of students' consumption of sugary drinks. Participants noted that students were more likely to choose sugary drinks because they tasted sweet and had a good flavor than water or sugar-free drinks. Among them, female students were more likely to choose freshly made milk tea beverages, while male students were more likely to prefer carbonated beverages.

*“Many students in the class like to drink cola, called “Fatty Happy Water”, and girls especially like milk tea.” (40, B26)*

Participants observed that students ingested coffee or functional beverages to help relieve fatigue and

refresh themselves after a day of studying. Students, especially male students, also consumed functional beverages to quench their thirst or replenish sugar after exercising. Importantly, students would ignore the amount of sugar in the drinks because of the nutritional function of the ingredients.

*“The students I come into contact with generally like to drink functional beverages; students feel tired or sleepy after a long day of studying, and they believe that drinking functional beverages will refresh them, and they believe that functional beverages contain less sugar, so they will not abstain from sugary beverages.” (41, B27)*

Participants said that students' disposable pocket money was a reason for purchasing sugary drinks. Higher grade students had more disposable pocket money than lower grade students and would have more autonomy to purchase sugary beverages.

*“Senior students are highly autonomous, have disposable pocket money, and will buy sugary drinks on their own.” (15, B16)*

Alternative beverages may be an effective way to reduce students' consumption of sugary drinks. Some students would replace sugary drinks by drinking water and tea. In contrast, the alternative drinks chosen by most students are drinks with higher sugar content such as honey water, pear water boiled with rock sugar and autumn pear paste.

*“Some students will drink tea, autumn pear cream, electrolyte drinks instead of sugary drinks.” (5, B5)*

*“For example, in the fall, when pomegranates are in abundance, I'll go and squeeze pomegranate juice instead of sugary drinks.” (41, B27)*

### **Psychological and behavioral constraints**

Sense of mood pleasure and excitement were important factors in students' reliance on sugary drinks. Participants observed that most students would choose to drink sugary beverages to relax, even if they were not stressed, the resulting sense of pleasure would lead to habitual dependence on sugary beverages, even to the extent of addiction.

*“Students get a sense of pleasure and euphoria after drinking sugary drinks, so they can't help themselves.” (37, B23)*

*“Drinking sugary beverages reduces water intake, interferes with class efficiency, and is addictive.” (41, B27)*

Participants noted that only a small proportion of students had high self-discipline and could restrain their sugary drink consumption behavior by not drinking or drinking less sugary drinks.

*“A small percentage of students are disciplined enough to make sure they don't drink sugary drinks.” (15, B16)*

### **Interpersonal level**

#### **Teachers' cognition and attitude**

Teachers had comprehensive understanding of the hazards of sugary drinks, and almost all of them understood that sugary drinks can cause overweight and obesity in adolescents and affect adolescent growth and development. In addition to this, dental caries, diabetes, bone diseases, neurological development, and psychological problems of retinal development were also commonly mentioned by participants. Some participants raised that obesity in adolescence leads to obesity in adulthood and increases the risk of diabetes.

*“Drinking sugary drinks can trigger overweight and obesity in children, affect children's self-confidence, psychology, vision, and affect retinal development, and obesity in adolescents can lead to obesity in adulthood, an increase in diabetes, and physical development.” (20, B2)*

The overwhelming majority of teachers were opposed to students' consumption of sugary drinks. Few teachers held the view that students could consume sugary drinks in moderation, limited to once a week. At the same time, participants indicated that it is almost impossible to prohibit students from consuming sugary drinks, and that as teachers they would supervise and regulate students' sugary drink consumption behavior.

*“My view is that while I am firmly opposed to it in terms of attitude, it is unrealistic to ban students from drinking sugary drinks in reality, and I can only try to persuade them to drink less. Within the range acceptable to the body, they can drink appropriately.” (37, B23)*

Teachers play a positive guidance role in health education. Teachers will give lessons to students and to explain real cases through class meetings, introduce the hazards of sugary drinks, and guide students to consciously boycott sugary drinks. When they see students drinking sugary drinks on campus, they will remind them of the hazards in time.

*“I do not encourage students to drink sugary drinks because there are students with high uric acid in our class, and the doctor also advises not to drink drinks and not to eat seafood, I will take these real-life examples guide them that drinking sugary drinks can cause health problems.” (40, B26)*

### **Parental role**

Parents are key influencers of students' health behaviors. Participants noted that parents should supervise and regulate their children's behavior and facilitate them to form good eating habits. At the same time, parents need to raise health awareness and set a good example. However, the negative role of some young parents or grandparents' indulgence can have a negative impact on children's eating behavior.

*“I hope that children will develop good eating habits, first of all, parents need to change their consciousness, parents need to develop good working and eating habits, in order to drive their children and act as a role model.” (32, B16)*

*“Parents themselves drink more sugary beverages, especially young parents, and their children follow their parents' lead and lack of family education.” (9, B9)*

### **Peer role**

Participants indicated that there is a dual impact of peers on students' consumption of sugary drinks.

On the one hand, students drinking sugary drinks will lead the neighboring children to drink with them, and peers will share good sugary drinks with each other. On the other hand, peers would also actively remind each other to over-consume sugary drinks.

*“Peer influence is strong, and classmates drinking will drive neighboring children to drink with them.” (54, B43)*

*“When some students overindulge in sugary drinks, peers or classmates also caution against consuming too much.” (10, B12)*

### **Home-school cooperation**

Most participants mentioned that parents and schools work together on health education is the best way to influence students. Schools would actively conduct publicity, education and positive guidance, and at the same time, parents need to cooperate with schools to reduce students' consumption of sugary drinks.

*“Publicity in schools is effective, asking children not to bring snacks and drinks into school, school lunches can fully ensure the dietary structure, and school drinking water facilities can ensure the need for drinking water. Parents also need to do a good job of publicity, under the guidance of parents, parents have the consciousness to control the consumption of sugary drinks, parents themselves do not drink, do not buy, and set an example for their children, in order to control the source.” (8, B8)*

### **Environmental level**

#### **School Health Education**

School health education is a direct way for students to obtain health knowledge. Schools increase students' interest in practicing and exploring sugary drinks-related content through the forms of courses such as health experiment classes and comprehensive practice classes. At the same time, teachers will incorporate sugary drinks-related content into school-based curricula such as biology, chemistry and physical education to explain health

knowledge. The school doctor will use display boards, pamphlets and other publicity to educate students about health. Finally, in class meetings, teachers will share real-life examples to warn students of the health hazards of sugary drinks. A series of school health education activities exert a positive influence in students' health behavior.

*“Schools will conduct integrated practical lessons, taking students to the market to investigate milk tea and sugary drinks, and study the sugar content and additives. Explore from all angles to raise students' interest and increase their impression.” (39, B25)*

*“Schools will create science pictures to put on bulletin boards for public education, for example, to make it clear that the amount of sugar in a particular bottle of drink is equal to a few cubes of sugar, and to display them accurately and visually.” (38, B24)*

*“It is important to have patients' presentations and real-life examples to share to give children impact and serve as a warning.” (29, A6)*

### **Food environment at school**

Beverage norms and restrictions on campus have reduced students' consumption of sugary drinks to a large extent. In Beijing's primary and secondary schools, there were specific policies restricting the sale of sugary drinks on campus, and participants reported that there were no places on campus where sugary drinks were available, and there was no way for students to purchase them. However, some participants indicated that schools did not have specific rules prohibiting students from bringing beverages on campus, giving students the opportunity to consume sugary beverages.

*“In the school setting, beverages are not served in the cafeteria and the sale of beverages is prohibited on campus, but there are no strict rules prohibiting students from bringing beverages on campus.” (10, B12)*

In addition, the school cafeterias are able to meet the nutritional needs of students by providing a combination of meat and vegetables, balanced nutrition, and including side dishes such as fruits

and yogurt. However, participants noted that students would be picky and partial eaters, for which the proposed solution was to ask for meat and vegetable dishes to be added at the same time if students needed additional meals to gradually change students' poor dietary behaviors.

*“Students eat in the classroom and are required not to be picky about what they eat; cafeteria meals include fruits, yogurt, etc.; and the cafeteria customizes recipes with meat and vegetables for balanced nutrition.” (19, A3)*

### **Food environment at home**

The home food environment has a fundamental impact on students' eating behavior. Parents' supply of sugary drinks determines whether students are exposed to or ingested such beverages. Reducing the accessibility of sugary beverages in the home environment could reduce the likelihood of students' intake of sugary beverages.

*“Students get into the habit of growing up with parents not offering sugary drinks and kids not drinking them voluntarily.” (32, B16)*

### **Societal level**

#### **Food culture**

China's food culture has influenced children and adolescents' consumption behavior of sugary beverages. The promotion of specific beverages on the Internet (e.g., “the first cup of milk tea in autumn”) and the festive atmosphere have made sugary beverages preferred by adolescents, and even rewarded by parents for their children's choices.

*“You need ambiance for New Year's Eve, so you can drink a little, and choose one with a simple ingredient list and no additives.” (50, B37)*

#### **Resource support**

Most of the participants expressed the need for help in terms of resource support, including personnel, material, and financial support, in order to better provide the intervention measures. School leaders hoped to have more professional external talents

and experts from health education organizations to provide education and training, and to set up a specialized and systematic curricula arrangement; classroom teachers also suggested adopting real negative cases to warn students, and made more innovative and close-to-student requests for the content of promotional materials, such as educational science videos and interesting classroom practices.

*“Schools need resources and support, health education classes are part-time for physical education teachers, additional health teacher staffing is needed, promotional materials for sugary drinks are needed, and CDC provides uniform training.” (16, B17)*

*“I would like to be able to test the height and weight of the students on a regular basis and give feedback on the results of the students' BMI at different times for comparison. For obese children, I hope to be able to give a targeted and personalized weight loss program to help them lose weight.” (43, B29)*

### **Policy level**

#### **Health promotion policy**

At the policy level, health promotion policies were repeatedly mentioned by participants, who emphasized the great role of health education activities in curbing the consumption of sugary beverages and proposed the use of real-life cases that are more relevant to influence students.

*“I think they can be targeted to let them know the diseases that can be caused by drinking sugary drinks for a long time. Because the harm caused by drinking sugary drinks is not something that will appear in a short period of time, there are too few real examples around the students, they should be made to know more about some clinical examples in medicine to give them a shock to be able to have a better effect.” (38, B24)*

In addition to this, most of the participants relied heavily on the nutrition facts table on the outer packaging of drinks, but they had a poor understanding of the criteria for sugar content and expressed the need for stricter age limits for drinks,

as well as higher requirements for warning labels reflecting health hazards in them.

*“I believe that warning labels should be provided on packages just as tobacco is controlled, and that sugar content of beverages should be graded so that the public is more intuitively aware of the sugar content.” (16, B17)*

*“Pay attention to nutrition labels, ingredient lists, and additives when shopping.” (34, B18)*

#### **Market supervision policy**

Participants signified that controlling the consumption of sugary beverages among adolescents is best controlled from the source, and that in addition to clear school rules and regulations prohibiting the consumption and carrying of sugary beverages, the sale of sugary beverages should be strictly prohibited in the areas around their schools. In addition, participants observed that too many beverages promotional products may increase the likelihood of students consuming them, and thus suggested the need for market regulation from a policy perspective.

*“The production is monitored at the root of production to produce healthy beverages, where no industrial syrups are added and natural sugars can be added.” (55, B44)*

*“Strengthening market regulation, many products are falsely advertised under the gimmick of sugar-free, but in fact still contain sugar.” (43, B29)*

*“The state sets standards to determine the sugar content to keep quality in check.” (3, B2)*

### **Discussion**

This study interviewed 56 school workers about their perceptions and attitudes towards students' consumption of sugary beverages, which provided a new perspective on the factors influencing the consumption of sugary beverages among primary and secondary school students. The study was coded at three levels using grounded theory, resulting in a core category that explores the multilevel influences on students' consumption of

sugary drinks based on teachers' perspectives, identifies practical barriers that need to be solved, and provides key-point information for the public health system to develop school-led health education interventions.

At the individual level, most of the students had some basic knowledge about the harms of sugary drinks, but lacked the willingness to actively reduce consumption at the action level, a result consistent with existing research.<sup>17</sup> Adolescents were able to identify the potential risks of unhealthy behaviors, but if they are no obvious health problems in the short term, they tended to underestimate the long-term hazards, resulting in a lack of motivation to change their behaviors. This phenomenon of “knowledge-doing inconsistency” may be related to the immature cognitive development of adolescents. Sweetness preference is the main driving force behind students' consumption of sugary drinks. SSBs significantly attract students with their sweet taste, and the sweetness of beverages positively affects satiety in beverage consumption,<sup>18</sup> thus enhancing students' preference for such beverages. Functional beverages have been shown to have sufficient nutritional effects<sup>19</sup> and are therefore favored by the student population. Students choose functional beverages to improve their physical or mental health after study fatigue or exercise, but they generally underestimate the sugar content of such beverages. Discretionary pocket money increases the risk of unhealthy eating behaviors among children and adolescents,<sup>20</sup> with senior students more likely to purchase sugary beverages on their own due to having more pocket money, while junior students may rely mainly on their parents for purchases. The pleasure and euphoria associated with sugary beverages make them a common choice for students to relax and may lead to dependence or even addiction, and some studies have shown that the direct effects of high-sugar foods on neurobehavioral adaptations may increase the risk of binge drinking and weight gain.<sup>21</sup> In view of the above individual-level influences, interventions should comprehensively consider the cognitive level of students, design age-level and group-specific health education programs, reinforce the long-term harms of sugary drinks, promote healthy alternative drinks, and explore more scientific

approaches to behavioral modification and psychological relaxation, all of which will be more effective in reducing students' consumption of sugary beverages and thus improving adolescent health.

At the interpersonal level, the results of this study showed that teachers had a comprehensive knowledge of the harms of sugary drinks, covering a wide range of negative effects on body weight, metabolism, bones, and the nervous system. However, although most of the teachers were against sugary drinks, they realized that a complete ban would be difficult to implement in reality. Therefore, it is particularly important for teachers to play the role of positive guidance in health education.<sup>22</sup> This study found that teachers deepened students' understanding of health risks and motivated them to adopt healthier eating behaviors in their lives through life examples and health lectures. This also suggests that health education needs to incorporate real-life examples and contextualized teaching to further enhance students' motivation for behavior change. Similarly, a healthy home environment and parental role modeling positively influenced students to reduce their intake of sugary drinks.<sup>23</sup> However, some young parents can negatively influence students' dietary choices due to their own poor eating habits or grandparents' spoiling behaviors, which is consistent with the findings of previous studies on the influence of family environment on children's health behaviors.<sup>24</sup> Meanwhile, peers play a complex and multidimensional role in the adolescent health behavior.<sup>25</sup> This study further validates the importance of home-school collaboration in student health education, as the combination of school-based and home-based interventions can effectively reduce the consumption of sugary drinks,<sup>26</sup> and some studies have predicted that long-term collaborative home-school intervention strategies can lead to substantial health and economic returns.<sup>27</sup>

At the environment level, school-based health education promotes the internalization of health knowledge through a multi-channel health education model that includes curriculum integration, example warnings, and diverse forms of communication. Several previous studies have shown<sup>28-30</sup> that school-based nutrition education

programs are effective in changing adolescents' health behaviors, which is consistent with the results of this study. Strictly controlling the sale of sugary beverages on campus provides a favorable school environment to support the reduction of students' consumption of sugary beverages, which further validates that the implementation of a healthy cafeteria policy and a food supply policy in schools can bring health benefits.<sup>16,31</sup> Creating healthy food environments at home where sugary beverages are “out of reach” significantly reduces the likelihood that students will consume sugary beverages, which is consistent with the role of “home accessibility” on children's dietary choices in previous studies.<sup>32</sup>

At the society level, this study found that adolescents' consumption behavior of sugary beverages was significantly influenced by food culture in the social dimension and promotional guidance from social media. Traditional Chinese food culture and media network induced a significant increase in consumption of beverages that included cultural symbolic characteristics. In previous research on parents' perception of their children's consumption of sugary drinks, it was also confirmed that nearly half of the parents were unable to control their children's consumption of sugary drinks exposed to online or social pressure.<sup>17</sup> This suggests that we need to focus on the deeper impact of social culture on individual behavioral choices, encourage positive and active healthy alternatives to beverages in social campaigns in response to adolescents' herd mentality, spread a healthy eating culture, and actively promote the formation of healthy eating habits in children. In addition to media-promoted interventions, resource support is significant. Schools face the problem of insufficient resource support in carrying out health education and interventions, and are in dire need of help in terms of personnel, material and financial resources. This includes looking forward to the introduction of external resources, such as the support of professional health education teams, the application of real-life counter examples, and promotional materials that are scientifically sound and relevant to students, as well as innovative curriculum formats. In the future, there is a need to further strengthen the cross-sectoral integrated health education network and to innovate

specialized education capacity. This need is also consistent with previous findings that the effectiveness of school health interventions is highly dependent on the investment of resources.<sup>33,34</sup>

At the policy level, this study shows that health promotion policies have an important role to play in curbing the consumption of sugary drinks among adolescents. Teachers generally emphasized the value and significance of health education activities, especially in demonstrating the health hazards of sugary drinks through real and negative examples. Existing health education programs are still limited in format and content design, and future policies should promote the development, sharing and interaction of resources to provide students with more scientific, realistic and powerful persuasive content. In addition, participants demanded more nutrient content tables and warning labels on the outer packaging of beverages, reflecting an increased demand for improved consumer knowledge of the risks of sugary beverages. Future interventions could draw on the successful experience of beverage grading in Singapore<sup>35</sup> to adopt more intuitive and clear labels of sugar content and health warnings,<sup>36</sup> which can enhance public awareness of the hazards of sugary drinks and create necessary constraints on their consumption behavior. From a market regulation perspective, this study reveals the importance of governmental legislative intervention in controlling the accessibility of SSBs. To address the problem of false advertising in beverages, there is an urgent need to strengthen market regulation through policy instruments, and to standardize “low-sugar” and “no-sugar” beverages in order to reduce the potential health hazards caused by adolescents' misjudgments. A sugar tax on SSBs has long been recognized as a necessary regulatory measure,<sup>37</sup> and a meta-analysis of SSB taxes introduced in jurisdictions around the world has been shown to be effective in reducing dietary intake of SSBs.<sup>38</sup>

## Study strengths and limitations

The study takes the perspective of teachers as a new angle, collecting teachers' views on the consumption behavior of SSBs among children and adolescents. It indicates that implementing health

education interventions in schools and enhancing collaboration between home and school are crucial for reducing the consumption of sugar-sweetened beverages among primary and secondary school students. This provides important theoretical support for public health departments in formulating health education and health promotion strategies, which can better guide subsequent intervention practices.

This study has a few of limitations. First, the participants were from Beijing, which is an economically developed region. There may be geographical or economic differences among other regions, so the generalizability of the findings may be limited. Second, this study relies on interview data, and teachers' descriptions may be influenced by subjective perceptions or social expectation bias. Third, the sample is not fully representative. As the direct subjects of sugary drinks consumption, students' real feelings and behavioral motivations may not be fully captured.

## Conclusion

In conclusion, reducing the consumption of sugary beverages among children and adolescents is a complex and systemic issue that requires the cooperation of multiple parties, including schools, families, society, and the government, to build a healthy and supportive environment and to promote the formation of good dietary behavior patterns among primary and secondary school students. Future studies can further explore the dynamic changes of the factors and their long-term intervention effects, in order to provide stronger empirical support for policy formulation.

## Acknowledgement

We would like to thank all participants.

## Funding

This research was funded by Capital's Funds for Health Improvement and Research (grant number: 2024-2G-3019).

## Institutional review board statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics

Committee of the Beijing Center for Disease Prevention and Control (protocol code: BJCDC2024031, date of approval: 14 September 2024).

## Informed consent

Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

## Data availability

The original contributions presented in this study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author(s).

## Conflicts of interest

The authors declare no conflicts of interest.

## Author contributions

Conceptualization, L.H. and J.D.; methodology, Y.L. and S.L.; validation, L.H. and J.L.; formal analysis, Y.L. and S.L.; investigation, Y.L., S.L. and W.L.; resources, Y.Z., J.D. and X.L.; data curation, Y.L. and S.L.; writing—original draft preparation, Y.L. and S.L.; writing—review and editing, L.H. and J.L.; visualization, Y.L.; supervision, Y.Z., L.M. and R.C.; project administration, L.M. and R.C.; funding acquisition, L.H. All authors have read and agreed to the published version of the manuscript.

## References

1. NCD Risk Factor Collaboration (NCD-RisC) (2024). Worldwide trends in underweight and obesity from 1990 to 2022: a pooled analysis of 3663 population-representative studies with 222 million children, adolescents, and adults. *Lancet (London, England)*, 403(10431), 1027–1050.
2. Sousa A, Sych J, Rohrmann S and Faeh D. The Importance of Sweet Beverage Definitions When Targeting Health Policies-The Case of Switzerland. *Nutrients* 2020;12(7):1976.
3. Calcaterra V, Cena H, Magenes VC, Vincenti A, Comola G, Beretta A, Di Napoli I and Zuccotti G. Sugar-Sweetened Beverages and Metabolic Risk in

- Children and Adolescents with Obesity: A Narrative Review. *Nutrients* 2023;15(3):702.
4. Tseng TS, Lin WT, Gonzalez GV, Kao YH, Chen LS and Lin HY. Sugar intake from sweetened beverages and diabetes: A narrative review. *World J Diabetes* 2021;12(9):1530-1538.
  5. Malik VS and Hu FB. Sugar-Sweetened Beverages and Cardiometabolic Health: An Update of the Evidence. *Nutrients* 2019;11(8):1840.
  6. Alhareky M. Taxation of Sugar-Sweetened Beverages and its Impact on Dental Caries: A Narrative Review. *Saudi J Med Med Sci* 2021;9(2):113-117.
  7. Hu D, Cheng L and Jiang W. Sugar-sweetened beverages consumption and the risk of depression: A meta-analysis of observational studies. *J Affect Disord* 2019;245:348-355.
  8. Miller C, Wakefield M, Braunack-Mayer A, Roder D, O'Dea K, Ettridge K and Dono J. Who drinks sugar sweetened beverages and juice? An Australian population study of behaviour, awareness and attitudes. *BMC obesity* 2019;6:1.
  9. Della Corte K, Fife J, Gardner A, Murphy BL, Kleis L, Della Corte D, Schwingshackl L, LeCheminant JD and Buyken AE. World trends in sugar-sweetened beverage and dietary sugar intakes in children and adolescents: a systematic review. *Nutrition reviews* 2021;79(3):274-288.
  10. Lara-Castor L, Micha R, Cudhea F, Miller V, Shi P, Zhang J, Sharib JR, Erndt-Marino J, Cash SB, Barquera S and Mozaffarian D. Intake of sugar sweetened beverages among children and adolescents in 185 countries between 1990 and 2018: population based study. *BMJ (Clinical research ed.)* 2024;386:e079234.
  11. Rosinger A, Herrick K, Gahche J and Park S. Sugar-sweetened Beverage Consumption Among U.S. Youth, 2011-2014. *NCHS Data Brief* 2017;(271):1-8.
  12. Hamner HC, Dooyema CA, Blanck HM, Flores-Ayala R, Jones JR, Ghandour RM and Petersen R. Fruit, Vegetable, and Sugar-Sweetened Beverage Intake Among Young Children, by State - United States, 2021. *MMWR. Morbidity and mortality weekly report* 2023;72(7):165-170.
  13. Gan Q, Xu P, Yang T, Cao W, Xu J, Li L, Pan H and Zhao W, Zhang Q. Sugar-Sweetened Beverage Consumption Status and Its Association with Childhood Obesity among Chinese Children Aged 6-17 Years. *Nutrients* 2021;13(7):2211.
  14. von Philipsborn P, Stratil JM, Burns J, Busert LK, Pfadenhauer LM, Polus S, Holzapfel C, Hauner H and Rehfues E. Environmental interventions to reduce the consumption of sugar-sweetened beverages and their effects on health. *The Cochrane database of systematic reviews* 2019;6(6):CD012292.
  15. Godin KM, Hammond D, Chaurasia A and Leatherdale ST. Examining changes in school vending machine beverage availability and sugar-sweetened beverage intake among Canadian adolescents participating in the COMPASS study: a longitudinal assessment of provincial school nutrition policy compliance and effectiveness. *The international journal of behavioral nutrition and physical activity* 2018;15(1):121.
  16. Teo CH, Chin YS, Lim PY, Masrom SAH and Shariff ZM. Impacts of a School-Based Intervention That Incorporates Nutrition Education and a Supportive Healthy School Canteen Environment among Primary School Children in Malaysia. *Nutrients* 2021;13(5):1712.
  17. Newman CM, Zoellner J, Schwartz MB, Peña J, Wiseman KD, Skelton JA, Shin TM and Lewis KH. Knowing Is Not Doing: A Qualitative Study of Parental Views on Family Beverage Choice. *Nutrients* 2023;15(12):2665.
  18. Jensen JD, Mielby LA and Kidmose U. Consumer preferences for attributes in sweet beverages and market impacts of beverage innovation. *Appetite* 2024;197:107329.
  19. Kowalska A, Leoniak K and Sołowiej BG. Consumers' attitudes and intentions toward functional beverages: a lesson for producers and retailers. *Decision* 2024; 51, 321-337.
  20. Ma L, Fang Z, Gao L, Zhao Y, Xue H, Li K and Wang Y. A 3-year Longitudinal Study of Pocket Money, Eating Behavior, Weight Status: The Childhood Obesity Study in China Mega-Cities. *International journal of environmental research and public health* 2020;17(23):9139.
  21. Edwin Thanarajah S, DiFelicantonio AG, Albus K, Kuzmanovic B, Rigoux L, Iglesias S, Hanßen R, Schlamann M, Cornely OA, Brüning JC Tittgemeyer M and Small DM. Habitual daily intake of a sweet and fatty snack modulates reward processing in humans. *Cell metabolism* 2023;35(4):571-584.e6.
  22. Mittal A, Rustagi N, Thirunavukkarasu P, Ghosh S and Raghav P. Improving adolescents' dietary behavior through teacher-delivered cancer prevention education: a school-based cluster randomized intervention trial in urban Rajasthan. *BMC Public Health* 2024;24(1):630.
  23. Cepni AB, Taylor A, Thompson D, Moran NE, Olvera N, O'Connor DP, Johnston CA and Ledoux TA. Exploring qualities of ethnically diverse parents related to the healthy home environment of toddlers. *Appetite* 2021;167:105608.
  24. Luque V, Mucarzel F, Hertogs A, Seed PT, Flynn AC, Poston L and Dalrymple KV. Associations between maternal diet, family eating habits and preschool children's dietary patterns: insights from the UPBEAT trial. *Nutrition journal* 2024;23(1):115.
  25. Zhang Y, Li R, Zhao Q and Fan S. The impact of peer effect on students' consumption of sugar-sweetened beverages- instrumental variable evidence from north China. *Food Policy* 2023; 115: 102413.
  26. Wang C, Hong X, Wang W, Zhou H, Wu J, Xu H, Zhou N and Zhao J. The Combination of School-Based and Family-Based Interventions Appears Effective in Reducing the Consumption of Sugar-Sweetened

- Beverages, a Randomized Controlled Trial among Chinese Schoolchildren. *Nutrients* 2022;14(4):833.
27. Li Z, Meyer CL, Xu H, Jackson-Morris A, Zhang M, Wu D, He H and Chang S, Ma G. The Return on Investment for the Prevention and Treatment of Childhood and Adolescent Overweight and Obesity in Beijing: A Modeling Study. *Nutrients* 2024;16(17):3006.
  28. Verdonchot A, de Vet E, van Rossum J, Mesch A, Collins CE, Bucher T and Haveman-Nies A. Education or Provision? A Comparison of Two School-Based Fruit and Vegetable Nutrition Education Programs in the Netherlands. *Nutrients* 2020;12(11):3280.
  29. Yu X, Huang X, Liang X, Ou Q, Sun L, Ren J, Wu Q, Chen H, Huang Q, Zhao H, Wei J, Wu F, Huang S and Wang L. The effects of nutrition education on nutritional knowledge and dietary behaviours in primary school students in Zhongshan city. *Journal of human nutrition and dietetics: the official journal of the British Dietetic Association* 2024;37(5):1361-1373.
  30. Ahmed KR, Kolbe-Alexander T and Khan A. Efficacy of a school-based education intervention on the consumption of fruits, vegetables and carbonated soft drinks among adolescents. *Public health nutrition* 2023;26(12):3112-3121.
  31. Reilly KL, Nathan N, Wiggers J, Yoong SL and Wolfenden L. Scale up of a multi-strategic intervention to increase implementation of a school healthy canteen policy: findings of an intervention trial. *BMC public health* 2018;18(1):860.
  32. Houghton CF, Waring ME, Wang ML, Rosal MC, Pbert L and Lemon SC. Home Matters: Adolescents Drink More Sugar-Sweetened Beverages When Available at Home. *J Pediatr.* 2018;202:121-128.
  33. Xu Y. Research on Optimized Allocation Model of Educational Resources in Colleges and Universities Based on Big Data. *Applied Mathematics and Nonlinear Sciences* 2024;9(1):1-12.
  34. Marković R, Ignjatović A, Višnjić A, Stojanović M, Andjelković Apostolović M and Otasević S. The methodology of health education programs in schools-Qualitative study. *Atencion primaria* 2024;56(12):103091.
  35. Shin S, Puri J and Finkelstein E. A randomized trial to evaluate the impact of Singapore's forthcoming Nutri-grade front-of-pack beverage label on food and beverage purchases. *The international journal of behavioral nutrition and physical activity* 2023;20(1):18.
  36. Miller C, Braunack-Mayer A, Wakefield M, Roder D, O'Dea K, Dono J and Ettridge K. "When we were young, it really was a treat; now sugar is just the norm every day"-A qualitative study of parents' and young adults' perceptions and consumption of sugary drinks. *Health promotion journal of Australia : official journal of Australian Association of Health Promotion Professionals* 2020;31(1):47-57.
  37. Bedi R. The Sugar Tax: A Leadership Issue for the Dental Profession and An Opportunity to Demonstrate that Oral Health is Part of General Health. *Contemp Clin Dent* 2018;9(2):149-150.
  38. Teng AM, Jones AC, Mizdrak A, Signal L, Genç M, Wilson N. Impact of sugar-sweetened beverage taxes on purchases and dietary intake: Systematic review and meta-analysis. *Obesity reviews : an official journal of the International Association for the Study of Obesity* 2019;20(9):1187-1204.