Impact of Health Education Based on the Knowledge-Attitude-Practice Model and Self-Efficacy Theory on Sugar-Sweetened Beverage Consumption Behavior Among Fourth-Grade Primary School Students: A Postprint

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Abstract

Background Adolescents are the future of the nation, and their physical condition will affect their health status in adulthood. Currently, children and adolescents generally have high intake of free sugars, posing potential impacts on their health.

Objective To explore the effect of health education based on the Knowledge-Attitude-Practice (KAP) model and self-efficacy theory on sugar-sweetened beverage intake behavior among fourth-grade primary school students, and to provide a theoretical basis for schools to implement health promotion initiatives and relevant departments to formulate sugar-sweetened beverage control strategies.

Methods From March to June 2023, a stratified two-stage cluster random sampling method was used. Two streets were randomly selected from 10 streets under the jurisdiction of Changning District, Shanghai. One primary school was randomly selected from each selected street. Subsequently, block randomization was used to allocate the two primary schools to a control group (n=262) and an intervention group (n=230) to implement a parallel controlled trial. The control group received routine health education, while the intervention group adopted a self-efficacy education and KAP education model centered on the "Weekly Sugar-Sweetened Beverage Intake Behavior Record Book." The intervention effect was evaluated before intervention and 4 months after intervention using a sugar-sweetened beverage questionnaire uniformly designed by the Shanghai Municipal Center for Disease Control and Prevention, including basic knowledge of sugar-sweetened beverages, weekly consumption and expenditure of 8 common beverages (carbonated drinks, freshly squeezed juice, non-freshly

squeezed packaged fruit/vegetable juice drinks, plant protein packaged drinks, lactic acid bacteria drinks, formulated milk drinks, tea drinks, and milk tea), and the Adolescent Health-Related Behavior Self-Efficacy Scale (Exercise Control Efficacy Subscale, Dietary Control Efficacy Subscale).

Results The study included 492 participants, with 262 in the control group and 230 in the intervention group. Regarding basic knowledge of sugar-sweetened beverages, the awareness rates of "frequently drinking sugar-sweetened beverages will not make me gain weight" and "when thirsty, sugar-sweetened beverages are the best choice for quenching thirst" in the intervention group were significantly different from those in the control group ($P<0.05$). Regarding weekly consumption and expenditure of the 8 common beverages, the intervention group showed lower weekly intake frequency ratios and weekly expenditure for carbonated drinks, freshly squeezed juice, non-freshly squeezed packaged fruit/vegetable juice drinks, and lactic acid bacteria drinks compared with pre-intervention ($P<0.05$). After the intervention, statistically significant differences were observed between the control and intervention groups in weekly expenditure for freshly squeezed juice, non-freshly squeezed packaged fruit/vegetable juice drinks, and lactic acid bacteria drinks ($P<0.05$). Regarding scores on the Adolescent Health-Related Behavior Self-Efficacy Scale, after the intervention, statistically significant differences were found between the control and intervention groups in dietary control efficacy subscale scores and total self-efficacy scores ($P<0.05$); the intervention group' s scores on the exercise efficacy subscale, dietary control efficacy subscale, and total self-efficacy scale after the intervention were higher than before the intervention ($P<0.05$). After the intervention, the proportion of participants in the intervention group with good self-efficacy for not drinking or drinking less sugar-sweetened beverages was higher than that in the control group ($P<0.05$).

Conclusion Health education combining the KAP model with self-efficacy theory can improve students' knowledge level, enhance their intention and effectiveness in controlling sugar-sweetened beverage intake, and facilitate the development of healthy habits and behaviors, which is worthy of continued exploration in future practice and application.

Full Text

A Study on the Influence of Health Education Based on the Knowledge-Attitude-Practice Model and Self-Efficacy Theory on Sugar-Sweetened Beverage Consumption Among Fourth-Grade Primary School Students

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Abstract

Background: Adolescents represent the future of our nation, and their current physical health status will significantly impact their well-being in adulthood. Presently, free sugar intake among children and adolescents is universally high, posing potential health risks. **Objective:** To investigate the impact of health education based on the Knowledge-Attitude-Practice (KAP) model and self-efficacy theory on sugar-sweetened beverage (SSB) consumption behaviors among fourth-grade primary school students, thereby providing a theoretical basis for school-based health promotion initiatives and policy development for SSB control. **Methods:** Between March and June 2023, we employed a stratified two-stage cluster random sampling method. Two streets were randomly selected from ten sub-districts in Changning District, Shanghai, and one primary school was randomly selected from each chosen street. The two schools were then cluster-randomized into a control group (n=262) and an intervention group (n=230) using block randomization for a parallel controlled trial. The control group received routine health education, while the intervention group participated in a self-efficacy and KAP education program centered on a "Weekly SSB Intake Behavior Logbook." Intervention effectiveness was evaluated before and four months after implementation using a standardized SSB questionnaire designed by the Shanghai CDC, assessing: (1) basic knowledge about SSBs; (2) weekly consumption patterns and expenditures for eight common beverage types (carbonated drinks, freshly squeezed juice, non-fresh standardized fruit/vegetable juice drinks, plant protein packaged drinks, probiotic drinks, formulated milk beverages, tea drinks, and milk tea); and (3) the Adolescent Health-Related Behavior Self-Efficacy Scale (including exercise control and dietary control subscales).

Results: A total of 492 students participated (control group: 262; intervention group: 230). Regarding SSB knowledge, the intervention group showed significantly higher awareness than the control group for items such as "Regularly drinking SSBs will not make me gain weight" and "SSBs are the best choice for quenching thirst" ($P<0.05$). For weekly consumption of the eight beverage types, the intervention group demonstrated significantly reduced frequency and expenditure for carbonated drinks, freshly squeezed juice, non-fresh standardized fruit/vegetable juice drinks, and probiotic drinks compared to baseline ($P<0.05$). Post-intervention comparisons between groups revealed significant differences in weekly expenditure for freshly squeezed juice, non-fresh standardized fruit/vegetable juice drinks, and probiotic drinks ($P<0.05$). For self-efficacy scores, post-intervention comparisons showed significant differences

between groups in dietary control efficacy subscale scores and total self-efficacy scores (P<0.05). The intervention group' s post-intervention scores for exercise efficacy, dietary control efficacy, and total self-efficacy were significantly higher than baseline (P<0.05). After the intervention, the proportion of students in the intervention group with good self-efficacy for avoiding or reducing SSB consumption was significantly higher than in the control group (P<0.05).

Conclusion: Health education integrating the KAP model and self-efficacy theory can improve students' knowledge, enhance their intention and ability to control SSB intake, and facilitate the development of healthy habits and behaviors. This approach warrants continued exploration in future practice and application.

Keywords: Adolescent health; Primary school students; Sugar-sweetened beverages; Nutritional knowledge; Health behavior; Self-efficacy

Introduction

Since 2000, global demand for sugar-sweetened beverages has continued to rise, with children and adolescents becoming the primary consumers. Research has linked SSB consumption to overweight and obesity [1-2], type 2 diabetes [3], cardiovascular disease [4], and increased risk of dental caries across age groups [5]. The "Healthy China 2030" initiative [6] advocates for "three reductions and three health improvements," including controlling added sugar intake, while the Chinese Dietary Guidelines (2022) [7] explicitly recommend avoiding or limiting SSB consumption. Nevertheless, the addictive nature of sweetened beverages should not be underestimated. Current research on child and adolescent health interventions in China has primarily focused on surveys of consumption status [8]. For minors, nutrition education that enhances cognitive understanding and promotes healthy lifestyle habits is crucial for behavior formation.

The Knowledge-Attitude-Practice (KAP) model is one of the most commonly used frameworks for explaining how knowledge and beliefs influence health behavior change [9], and has proven effective in health promotion education. Self-efficacy theory, a classic social cognitive theory, integrates cognition and behavior to help individuals determine their capacity to actively engage in specific programs [10], representing one' s belief in their ability to complete certain tasks or work [11]. This study aimed to combine the systematic education of the KAP model with behavioral empowerment strategies based on self-efficacy theory. Through engaging knowledge delivery, emotionally supportive skills training, and collaborative home-school health environment construction, we sought to explore the impact on improving primary school students' health cognition, motivation, and behaviors, ultimately fostering their capacity for autonomous health decision-making.

Methods

Study Design and Participants Between March and June 2023, we conducted a parallel controlled trial using stratified two-stage cluster random sampling. Streets served as the stratification variable; two streets were randomly selected from ten sub-districts in Shanghai' s Changning District, with one primary school randomly selected from each. The two schools were then cluster-randomized into control (n=262) and intervention (n=230) groups, with all fourth-grade students receiving the respective interventions. Inclusion criteria were: (1) normal mental status and communication ability; (2) absence of serious health problems; (3) adequate language comprehension to complete questionnaires; and (4) parental informed consent. Exclusion criteria included: (1) language communication barriers; (2) chronic diseases or other health issues; and (3) lack of guardian consent. The study was approved by the Ethics Review Committee of Shanghai Changning District CDC (Approval No.: 2023-02).

Intervention Protocol The 4-month intervention ran from March 1 to June 30, 2023. The control group received routine health education (lectures, posters, informational materials) with one on-site follow-up visit. The intervention group participated in a self-efficacy and KAP education program centered on a "Weekly SSB Intake Behavior Logbook," comprising: (1) Monthly engaging SSB science lectures and on-site guidance, including distribution of educational manuals, exercise guidelines, dietary consultation services, and classroom posters; (2) Collaboration with school health and psychology teachers to guide students in developing positive thinking and emotional management skills, fostering a trusting and friendly community environment that encouraged help-seeking; (3) Distribution of a self-designed "Weekly SSB Intake Behavior Logbook"(reviewed and revised by municipal CDC experts), requiring students to retrospectively record their weekly SSB intake truthfully, with full participation and supervision from parents and teachers—project staff conducted qualitative interviews every two months to review approximately 5% of logbooks with students, providing timely feedback to teachers and school health staff for any abnormal records; (4) Two parent education sessions featuring online lectures by Tencent News science popularization officers and clinical experts on SSB health hazards, supervision and encouragement techniques, and parental modeling of reduced SSB consumption; (5) Encouragement for teachers to praise students with complete logbooks and effective SSB control, providing rewards and opportunities to share sugar-control experiences in class to enhance peer exchange and mutual support; and (6) A year-end "SSB Knowledge Competition" and "Sugar Control Champion" award ceremony to further strengthen students' self-efficacy.

Evaluation Measures Based on a standardized SSB questionnaire designed by the Shanghai CDC, evaluation measures included: (1) Basic SSB knowledge, assessed through four items including "Regularly drinking SSBs will not make me gain weight" and "SSBs are the best choice for quenching thirst," with yes/no response options; (2) Weekly consumption frequency and expenditure for eight

common beverage types [12] (carbonated drinks, freshly squeezed juice, non-fresh standardized fruit/vegetable juice drinks, plant protein packaged drinks, probiotic drinks, formulated milk beverages, tea drinks, and milk tea), calculating weekly intake frequency (N times/day × 7 days) and weekly expenditure for each beverage; and (3) The Adolescent Health-Related Behavior Self-Efficacy Scale (20 items across two subscales: 11 items for exercise control efficacy and 9 items for dietary control efficacy), scored from 0 (no confidence) to 10 (complete confidence), with subscale totals converted to a 100-point scale−higher scores indicated greater confidence in controlling unhealthy behaviors, with scores $ $7 on the "control SSB intake" item indicating good self-efficacy for avoiding or reducing SSB consumption. The overall Cronbach' s α coefficient was 0.72.

Data Collection and Quality Control Before data collection, project staff provided unified training for investigators (primarily fourth-grade head teachers and health education staff) to clarify study objectives, significance, and procedures, standardizing all protocols to minimize information bias. A pilot survey was conducted with systematic class-level sampling, completing 60 pre-surveys across both groups to identify misunderstood or ambiguous items, which were then clarified or revised. During formal surveys, investigators provided detailed explanations of these items before students completed questionnaires independently, with opportunities to ask questions. Upon collection, staff immediately checked questionnaires for completeness and logical errors, prompting participants to correct any issues to reduce non-response bias. Data entry was double-verified by project staff to ensure accuracy and completeness.

Statistical Analysis Data were entered using Epidata 3.1 and analyzed with SPSS 26.0. Normally distributed continuous data were expressed as mean ± standard deviation ($\bar{x}\pm s$) and compared between groups using independent samples t-tests. Categorical data were expressed as percentages and compared using ^{2} tests. Statistical significance was set at $P<0.05$.

Results

Baseline Characteristics The study included 492 participants: 262 in the control group (137 boys, 52.29%; 125 girls, 47.71%) and 230 in the intervention group (120 boys, 52.17%; 110 girls, 47.83%).

SSB Knowledge Awareness Post-intervention, the control group showed significant improvements in awareness of "SSBs are nutritious" and "Some SSBs have zero energy, so drinking more doesn' t affect health" ($P<0.05$). The intervention group demonstrated significant improvements in all four knowledge items post-intervention ($P<0.05$), with significantly higher awareness than the control group for "Regularly drinking SSBs will not make me gain weight" and "SSBs are the best choice for quenching thirst" ($P<0.05$) .

Weekly SSB Intake Frequency In the control group, only carbonated drink consumption frequency decreased significantly post-intervention ($P<0.05$), with no significant changes for other beverages. The intervention group showed significant reductions in consumption frequency for carbonated drinks, freshly squeezed juice, non-fresh standardized fruit/vegetable juice drinks, and probiotic drinks ($P<0.05$). The proportion of students with zero weekly intake increased most substantially for freshly squeezed juice (52.17%), followed by probiotic drinks (42.22%), carbonated drinks (26.15%), and non-fresh standardized fruit/vegetable juice drinks (10.38%) [TABLE:2, TABLE:3].

Weekly SSB Expenditure The control group showed significantly reduced expenditure only for carbonated drinks post-intervention ($P<0.05$). The intervention group demonstrated significantly reduced expenditure for carbonated drinks, freshly squeezed juice, non-fresh standardized fruit/vegetable juice drinks, and probiotic drinks ($P<0.05$). Post-intervention comparisons revealed significant between-group differences in expenditure for freshly squeezed juice, non-fresh standardized fruit/vegetable juice drinks, and probiotic drinks ($P<0.05$) .

Self-Efficacy Scores Pre-intervention, no significant differences existed between groups in exercise efficacy, dietary control efficacy, or total self-efficacy scores ($P>0.05$). Post-intervention, significant between-group differences emerged in dietary control efficacy and total self-efficacy scores ($P<0.05$). The intervention group' s post-intervention scores for exercise efficacy, dietary control efficacy, and total self-efficacy were significantly higher than baseline ($P<0.05$). The proportion of students with good self-efficacy for avoiding or reducing SSB consumption was significantly higher in the intervention group post-intervention ($P<0.05$) [TABLE:5, TABLE:6].

Discussion

As living standards improve, dietary patterns have changed accordingly, with escalating free sugar consumption posing health risks. The Australian Gudaga cohort study found that over half of Indigenous Australian children in Sydney consumed SSBs at least weekly [13]. National surveys indicate approximately 15.8% of Chinese adolescents consume soda at least four times weekly [14]. Jia et al. [15] surveyed 1,172 students across five primary schools in Jiangxi and Shanxi provinces, finding nearly half expressed an "just want to drink" attitude, consistent with Shen's [16] findings that SSBs'special taste provides pleasure and may create addictive behaviors. Therefore, "sugar reduction"and "sugar control" education merit serious attention. SSB consumption is influenced by multiple factors including environmental (family, school, community) and individual (age, gender, psychology) factors [17], though these relationships remain incompletely understood [18-19].

Childhood and adolescence represent critical developmental stages for habit formation that directly and persistently impact individual health [20], with healthy dietary behaviors developing through knowledge enhancement, attitude change, and behavior transformation [21]. In social cognitive theory, health behaviors are influenced by outcome expectations [22]. Our findings revealed students had weak baseline knowledge about SSBs, uncontrolled weekly intake and expenditure, and low self-efficacy before intervention. Through coordinated family-school-CDC education and guidance, integrating the KAP model with self-efficacy theory, we addressed knowledge improvement, belief and attitude changes, dietary behavior modification, and potential psychological issues. Parents also played crucial supervisory and motivational roles in establishing healthy habits. After four months of follow-up, the intervention group showed significant improvements in SSB knowledge, beliefs about controlling intake, consumption behaviors, and self-efficacy scores compared to baseline, outperforming the control group.

These improvements may be attributed to four factors: First, the "Weekly SSB Intake Behavior Logbook" served as the primary intervention tool, with students completing it conscientiously under classroom education, teacher guidance, and parental supervision, reinforcing healthy behaviors. Second, we conducted a series of scientifically rigorous yet engaging health activities, including lectures by municipal experts on SSB health impacts to enhance knowledge, while training students to read nutrition labels for rational consumption. The district CDC created an SSB-themed adaptation of the popular children' s song "Dig, Dig, Dig" to improve understanding and retention. Third, we emphasized psychological support, equipping teachers and parents with supervision and praise techniques to address negative emotions promptly. Every two weeks, students with effective SSB control shared their experiences in class, strengthening peer communication, friendship, and intrinsic motivation. Fourth, the "SSB Knowledge Competition" and "Sugar Control Champion" award ceremony validated learning outcomes, promoted healthy lifestyles, and enhanced self-efficacy.

The KAP model systematically delivered health knowledge, enabling students to understand SSB composition and health hazards. Building on this knowledge, the model strengthened identification with healthy lifestyle concepts and cultivated ability to choose healthy beverages. When knowledge transforms into beliefs and beliefs drive behavior, students can confidently reduce sugar intake, thereby protecting their health. Self-efficacy enhanced students' self-management capacity, particularly when facing SSB temptations, providing confidence to make health-based choices independent of taste or advertising influences. Individuals with high self-efficacy can leverage strong internal drive and perseverance to translate SSB reduction plans into sustained actions, maintaining healthy beverage choices long-term. Thus, self-efficacy plays a crucial role in SSB consumption behavior, consistent with previous research [23].

In conclusion, health education integrating the KAP model and self-efficacy theory positively impacts primary school students' SSB knowledge, motivation

to control intake, and behavioral outcomes, warranting broader promotion and application. Limitations include: (1) potential systematic error from ambiguous scoring criteria in the self-efficacy assessment questionnaire; and (2) possible memory bias or parental influence effects when students self-reported weekly SSB consumption frequency and types.

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Author Contributions: HUANG Lili conceptualized the study and drafted the manuscript; JIANG Yan implemented the study and collected data; TANG Min, ZHANG Jialei, and HE Jiabei performed statistical analysis; ZHUANG Jianlin supervised manuscript quality, conducted project oversight, and assumed overall responsibility for the research.

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Note: Figure translations are in progress. See original paper for figures.