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Development and Validation of the Sugar-sweetened Beverages Knowledge Questionnaire (SSBKQ) for Undergraduate Students

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Abstract Excess sugar consumption is associated with numerous health concerns and sugar-sweetened beverages (SSB) represent a common source of excess sugar consumption that may be influenced by consumer knowledge of sugar and SSB. Few, if any, reliable and valid published measures of Thai SSB knowledge exist, however. This study aimed to develop and validate the sugar-sweetened beverages knowledge questionnaire (SSBKQ) to be appropriate for use with undergraduate students in Thai contexts. The items were created from reviewed literature and interviews with six members of the population. A sample of 402 undergraduate students aged between 17- 25 from three universities in Bangkok was recruited to respond the SSBKQ questionnaire and measures of SSB attitudes, SSB intentions, and SSB consumption. The final version of the SSBKQ containing 18 items demonstrated adequate internal consistency reliability (Cronbach's alpha = .70) and good two week test-retest reliability (r = .71) with evidence supporting criterion validity. SSBKQ scores were significantly ($p < .05$) and inversely correlated with SSB attitudes, SSB intentions, and self-reported SSB consumption, respectively. The results support the psychometric properties of the SSBKQ for research use with Thai undergraduate students.

Keywords: *sugar-sweetened beverages, nutrition knowledge, questionnaire validation, undergraduate students*

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1. Introduction

Excess sugar consumption is an important public health concern. Sugar-sweetened beverage (SSB) consumption represents a main source of excessive sugar intake [1,2]. SSB are defined as caloric drinks including soft drinks, soda, fruit drinks, punches, sports drinks, tea, and coffee drinks with added sugar, and sweetened milk [3].

Many studies have found that habitual SSB consumption is linked to several negative health symptoms, increased health risk, and several diseases, such as overweight and obesity, dental caries, type-2 diabetes, metabolic syndrome, hypertension, and cardiovascular disease [4,5,6,7,8]. In addition, several studies have explored various strategies to limit and reduce SSB consumption to promote good health [5,9,10]. Worldwide, governments and policy makers have supported attempts to reduce SSB consumption in an effort to reduce disease burden [11].

Health education to increase knowledge about SSB potentially contributes to decreased SSB consumption [12]. Therefore, knowledge about SSB has been assessed as a proximal outcome of several interventions to reduce SSB consumption [13,14,15]. Various studies have found associations between greater knowledge about SSB and lower levels of SSB consumption in emerging adult and adult samples [16,17,18]. Moreover, college students considering reducing their SSB consumption tended to have greater knowledge about SSB than those who had no plans to reduce SSB consumption [16].

The undergraduate years are a critical period for developing body image and good health habits, since emerging adults can make decisions about their health behaviors and social life independently from adult direction [19]. However, this developmental period can also pose risk for the formation of unhealthy attitudes or behaviors related to body image and health, such as eating unhealthy foods, binge drinking, or developing friendships with others who are concerned with their looks [19,20]. In addition, living closely with peers who have concerns about appearance and unhealthy routines is associated with unhealthy eating behaviors [21], which may set a course for chronic diseases in later life [22]. A longitudinal study examining SSB consumption from early adolescence through later adulthood demonstrated that SSB consumption in young adulthood continued on a stable course [23] and beverage consumption habits formed during this age were related to beverage choices in later life [24].

The objective of this study was to develop and validate the SSB Knowledge Questionnaire (SSBKQ), a measure of knowledge related to SSB, for undergraduate students within Thai contexts. Item contents were designed to assess knowledge of the negative health effects of SSB consumption, false beliefs about SSB/sugar, and other health information about SSB consumption. A reliable and valid measure of SSB knowledge would allow for accurate measurement of SSB knowledge and changes in SSB knowledge as a function of health education interventions, both of which may assist in the development of health education interventions and guidelines to reduce SSB consumption and promote health.

2. Materials and Methods

2.1. SSBKQ Item Development and Pilot Testing

The scope of the 18-item SSBKQ encompasses questions assessing three domains: knowledge of the negative health effects of SSB, false beliefs about SSB, and knowledge about sugar. Higher scores reflect greater knowledge.

Negative health effects of SSB represent 12 of the 18 items of the SSBKQ. Item contents were based on research evidence gathered from a review of the literature on the negative effects of SSB on health, especially symptoms and diseases linked to SSB consumption.

False beliefs about SSB represent 4 of the 18 items of the SSBKQ. False beliefs about SSB are beliefs that are not supported by evidence; for example, the belief that soda can reduce flatulence is not supported by evidence. The item contents were generated from information obtained from literature review and interviews with six Thai undergraduate students. Students were asked open-ended questions about what they have heard about SSB, the health benefits of SSB consumption, and the risks of SSB consumption to elicit beliefs, both accurate and inaccurate. Inaccurate beliefs that were identified by multiple students were included as items representing false beliefs.

Knowledge about sugar represents 2 of the 18 items of the SSBKQ. Item contents included knowledge of recommended daily sugar consumption limits and knowledge of the (non) nutritional value of sugar, since SSB the largest source of added sugar in diets with poor nutrition [25,26].

The items were carefully worded to avoid overstatement and misunderstanding. Precise language was used to convey the links between SSB and negative health effects (such as *SSB can cause…, SSB is associated with…,* or *SSB increases risk for...*) and clear temporal conditions (such as *long term SSB consumption* or *habitual SSB consumption*) were specified in each item. Items, translated from Thai to English, are presented in Table 1.

The instructions for the SSBQK included a definition of SSB and examples of SSB. Participants were instructed to respond to each question with one of three response options: *true, false,* or *don't know*. One point was earned for each correct answer, while 0 points were earned for incorrect answers, *don't know*, or blank answers. The number of correct answers was summed to produce a possible range of scores from 0-18, with higher scores reflecting greater SSB knowledge.

The SSBKQ items were reviewed by three experts in relevant disciplines regarding adolescents' and emerging adults' health behaviors (medicine, health behavior education, and public health) for content, format, and construction to strengthen the content validity of the measure. To check language clarity, the items were pilot-tested with undergraduate students ($N = 5$) who were asked whether they understood the meaning of the items to determine whether their understanding was congruent with the objective of the study. Their feedback was applied to revision of the items; however, the core content of the items was not changed. In this step, three items from an original pool of 21 items were excluded because their content was not based on a fully validated, easy-to-understand mechanism, such as items about cancer ("regular consumption of SSB increases risk of pancreatic cancer").

Table 1. The Sugar-Sweetened Beverages Knowledge Questionnaire (SSBKQ) $N = 402$.

Item	True/false	Discrimination index	Item difficulty
1. World health organization (WHO) has recommended limiting sugar consumption to 8 teaspoons daily.	F	0.27	0.12
2. Regular SSB consumption will make you look older than your age.	T	0.55	0.50
3. In general, SSB contains larger amount of sugar than the amount recommended by WHO in daily consumption.	T	0.36	0.60
4. Habitual SSB consumption increases belly fat accumulation.	T	0.31	0.80
5. Pharmacists recommend drinking soda with salt when you have diarrhea.	F	0.26	0.33
6. Habitual SSB consumption can be a cause of liver fat accumulation.	T	0.51	0.34
7. Habitual SSB consumption can be a cause of tooth decay.	T	0.30	0.89
8. Habitual SSB consumption increases a risk of gout.	T	0.25	0.10
9. Habitual SSB consumption can be a cause of type 2 diabetes.	T	0.23	0.94
10. SSB consumption makes you feel full.	F	0.34	0.34
11. Sugar contains vitamins and minerals.	F	0.37	0.42
12. Habitual SSB consumption increases a risk of metabolic syndrome.	T	0.46	0.43
13. Habitual SSB consumption can be a cause of sweet addiction.	T	0.37	0.87
14. Habitual SSB consumption increases a risk of dementia.	T	0.44	0.24
15. Soda can help reduce flatulence.	F	0.25	0.46
16. Soda can be a cause of bone decay.	T	0.37	0.65
17. Habitual SSB consumption increases a risk of heart disease.	T	0.56	0.42
18. Habitual SSB consumption increases a risk of hypertension.	T	0.49	0.63

Discrimination index (item-total correlation), Item difficulty (% correct response).

2.2. Participants

Participants included 402 undergraduate students, 147 male (37 %) and 255 female (63%), aged between 17 to 25 years old (mean age = 20.34, *SD* = 1.62). Participants were recruited from three universities in Bangkok. Most participants (55%) were studying national and applied sciences, and the rest (45%) were studying humanities or social sciences.

2.3. Ethical Consideration

This type of study was considered exempt from Institutional Review Board consideration in accordance with the institutional guideline.

2.4. Procedures

Faculty at three Thai universities permitted the researcher to recruit students from their undergraduate classrooms. Despite the fact that this type of research is considered exempt from Institutional Review Board consideration in Thailand, participants were provided with an informed consent statement describing the nature and purpose of the study prior to completion of the SSBKQ and other study measures. To ensure that participants felt free to answer honestly, they were informed that their responses would not be used for evaluation or judgment and that their scores would be kept anonymous, analyzed in the aggregate only, and used only for the current research purposes. Undergraduate students individually completed a packet of study measures in a classroom setting during a regularly scheduled class period. The first author was present during administration and available to answer participant questions about the research. The researcher returned to each classroom two weeks later for a second administration of the research packet.

2.5. Measures

In addition to the newly developed 18-item SSBKQ described above, participants completed several other measures related to SSB knowledge as well as basic demographic items. Measures of SSB attitudes, SSB intentions, and SSB consumption were included, translated from English to Thai.

Attitudes toward SSB and intentions to consume SSB were measured by the items created by Kassem, Lee, Modeste and Johnston [27], which were developed from constructs of the theory of planned behavior [28]. Each of these scales consists of three items. For SSB attitudes, each of the three items asks the participant to rate perceived qualities of SSB on a 7-point scale (from bad to good, harmful to beneficial, and unsatisfying to satisfying). For SSB intentions, each of the three questions asks the participant to rate the probability that he or she will consume SSB in the future. Scores can range from 3 to 21, for both SSB attitudes and SSB intentions. Higher scores indicate that a person has favorable attitudes toward SSB and strong intentions to consume SSB. Kassem et al reported Cronbach's alphas of .93 and .94 for SSB attitudes and SSB intentions, respectively. Cronbach's alpha was .84 for SSB attitudes and .83 for SSB intentions in the present sample.

SSB consumption was measured by a modified version of the Beverage Questionnaire (BEVQ-15) [29], adapted for Thai contexts. This self-report scale asked participants to report the frequency and quantity of consumption for each of 17 kinds of beverages. The original BEVQ-15 was modified by removing water, low fat milk, reduced fat milk, beer, wine, and liquor beverages, separating energy drinks and sports drinks, and adding common Thai beverages, including sweetened and unsweetened herbal drinks as well as functional drinks (i.e., drinks featuring collagen or amino acids, etc.). Test-retest reliability of was .98 for the original questionnaire and .91 for the present study.

2.6. Analysis

Internal consistency reliability of the SSBKQ was estimated by Cronbach's alpha. Test-retest reliability was conducted to examine stability over time (two weeks). Item discrimination indices (analyzed by item-total correlation) were computed to assess the ability of each item to discriminate between those who perform well on the measure and those who don't. Suggested values of the item discrimination index are between .2 and .8 [30]. An item difficulty index, represented as the percentage achieving the correct answer, was computed for each item. The recommended item difficulty range for a binary response set is between .2 (less than .2 indicates the item is too difficult) and .8 (more than .8 indicates the item is too easy) [30].

In addition to the content validity check provided by experts during the development of the SSBKQ, criterion validity was assessed by examination of Pearson's correlations between the SSBKQ scores and concurrently administered measures of SSB attitudes and SSB intentions. Criterion-related validity was assessed via examination of Pearson's correlation between the SSBKQ and concurrently measured self-reported SSB consumption.

3. Results

The final SSBKQ consisted of 18 items (Table 1), including 12 items related to knowledge about negative health effects of SSB, 4 items related to false beliefs about SSB, and 2 items of other knowledge about SSB. The highest possible score is 18 and the lowest possible score is 0. Actual scores for the sample ranged from a minimim score of 1 to a maximum score of 16, with a mean score of 9.06 (SD = 2.96). Cronbach's alpha coefficient for the 18-item scale was α =.70 for this sample. Test-retest reliability was r = .71 at two weeks., Although four items fell outside of the recommended range for item difficulty (two items were very difficult, with correct responses by less than 20% and two items were very easy, with correct responses by more than 80%), the purpose of this study was to create a measure that assesses the full range of knowledge of SSB. Additionally, the item discrimination indices, or item-total correlation for each item, were within the accepted range (between .2 and .8) for all items

[30]. Therefore, all 18 items, including the two difficult and two easy items, were retained in the SSBKQ. Table 1 displays item-total correlation and item difficulty indices for each item of the SSBKQ.

Bivariate correlations between the SSBKQ scores and SSB attitudes, SSB intentions, and SSB consumption scores were significant ($p < .05$), in the expected direction (negative), and small to moderate in magnitude. SSBKQ scores were inversely related to SSB attitudes ($r = -.33$, $p < .01$), SSB intentions ($r = -.15$, $p < .01$), and SSB consumption ($r = -.11$, $p < .05$). Table 2 displays the full correlation matrix.

Table 2. Correlations among SSB knowledge, SSB attitudes, SSB intentions, and SSB consumption ($N = 402$)

	SSB knowledge	SSB attitudes	SSB intentions
SSB attitudes	-.33**	-	-
SSB intentions	-.15**	.54**	-
SSB consumption	-.11*	.39**	.45**

*$p < .05$, **$p < .01$.

4. Discussion

The SSBKQ was evaluated for reliability and validity. Findings offer evidence of adequate internal consistency reliability for research purposes, good test-retest reliability, and support for content, convergent, and criterion validity assessed concurrently. Cronbach's alpha coefficient ($\alpha = .70$) and discrimination indices suggested reasonable internal consistency reliability and the test-retest coefficient ($r = .71$) suggested stability over time, with a range of item difficulty (.10 - .94) that is desirable for assessing knowledge levels that may vary widely.

Content validity was established by expert review in the early stages of scale development. For criterion validity, the SSBKQ showed a significant negative correlation with measures of closely related theoretical constructs of SSB attitudes and SSB intentions as measured concurrently. Similarly, evidence of concurrent criterion-related validity was observed by a significant negative correlation between SSBKQ and self-reported SSB consumption. The results from this study are consistent with prior studies. Jordan, Piotrowski, Bleakley, and Mallya [31] and Zoellner and colleagues [17] found a negative association between SSB knowledge and attitudes toward SSB, which suggests that greater knowledge about the negative health effects of SSB is related to less favorable attitudes toward SSB. Moreover, Boles, Adams, Gredler, and Manhas [13] and Robles et al. [32] similarly found an association between SSB knowledge and intention to consume SSB, which suggests that greater SSB knowledge is associated with greater intentions to reduce SSB consumption. An inverse association between SSB knowledge and SSB consumption was also found by Park and colleagues [12]. Likewise, Jasti, Rubin, and Doak [16] showed that lower levels of SSB knowledge were associated with higher level of SSB consumption. The SSBKQ was comprised mostly of items worded as "true" statements; that is, the correct answer for most items in the questionnaire was "true." Use of negative terms, such as *no*, *not*, or *don't*, in item wording may affect participant's responses unfavorably, as these types of statements may confuse participants or may hint at the correct answer [33]. However, the rate of correct responses did not appear to be affected, as shown by the wide range in rates of correct responses for both items with *true* as correct responses and items with *false* as correct responses.

Although the results of this study offer evidence in support of the reliability and validity of the SSBKQ as a measure of SSB knowledge among Thai undergraduate students, there are several limitations of this study. First, the participants of this study were recruited by convenience sampling from universities in Bangkok. This may limit generalization for use with undergraduate students in other areas of Thailand. Since the SSBKQ was developed with undergraduate students, the validity of use with participants with lower education levels in the same age group or participants in older or younger age groups has not been established. Finally, as some items of the questionnaire were developed specifically for use in Thai contexts, based on some beliefs that may only be found in the Thai population, the measure may not be valid, in its current form, for use in other cultural contexts.

Additional research will be required to validate the SSBKQ with other populations or in other cultural contexts, including different age groups and educational levels (e.g., high school students, graduate students). Moreover, experimental studies using the SSBKQ to assess the effects of health education interventions on SSB knowledge would be required in order to examine the measure's sensitivity (to psychological and contextual intervention) and to investigate whether an increase in SSB knowledge has a causal impact on SSB consumption factors (e.g., SSB attitudes or SSB intentions) and, ultimately, on SSB consumption behavior. As the empirical knowledge base on the health effects of SSB is dynamic and can change over time, the SSBKQ items should be revised to be updated with the empirical literature.

5. Conclusions

The SSBKQ demonstrated good evidence of reliability and validity for use as a measure of SSB knowledge with Thai college student participants. The SSBKQ may be very useful in future studies as brief measure of SSB knowledge in Thai undergraduate populations and offer valuable information for studies assessing the impact of health education interventions to reduce SSB consumption.

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