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Validation of a Brief Questionnaire Against Direct Observation to Assess Adolescents' School Lunchtime Beverage Consumption

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ABSTRACT

Objective: Beverage consumption is an important determinant of youth health outcomes. Beverage interventions often occur in schools, yet no brief validated questionnaires exist to assess whether these efforts improve in-school beverage consumption. This study validated a brief questionnaire to assess beverage consumption during school lunch.

Methods: Researchers observed middle school students' (n = 25) beverage consumption during school lunchtime using a standardized tool. After lunch, students completed questionnaires regarding their lunchtime beverage consumption. Kappa statistics compared self-reported with observed beverage consumption across 15 beverage categories.

Results: Eight beverages showed at least fair agreement ($\kappa > 0.20$) for both type and amount consumed, with most showing substantial agreement ($\kappa > 0.60$). One beverage had high raw agreement but $\kappa < 0.20$. Six beverages had too few ratings to compute κ 's.

Conclusions and Implications: This brief questionnaire was useful for assessing school lunchtime consumption of many beverages and provides a low-cost tool for evaluating school-based beverage interventions.

Key Words: beverages, school, adolescent, drinking, diet, questionnaire validation (*J Nutr Educ Behav.* 2017; ■:1-5.)

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INTRODUCTION

Beverage consumption is an important determinant of youth health out-

comes such as obesity.¹ Because youth spend a large portion of their waking hours in schools, many healthy beverage interventions take place at

school.² To evaluate whether these strategies effectively change students' in-school beverage consumption habits, validated measures are needed. Although dietary recalls, plate waste measures, and direct observation are considered reference standards for assessing beverage consumption, these resource-intensive techniques are not feasible in many research or practice settings, and measurement tools are needed to assess beverage consumption in a rapid, low-cost manner.

Several brief questionnaires exist to assess beverage consumption, but each has limitations for assessing youths' in-school beverage consumption. The beverage intake questionnaire (BEVQ)-15 and -19 were developed for adult, not youth, populations.^{3,4} Paxton et al⁵ developed a school lunch recall for fourth-graders, but the tool does not assess beverages from non-cafeteria sources, which may comprise a large portion of beverages consumed at school.⁶ The Beverage and Snack Questionnaire⁷

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was developed for use with adolescents, but it does not capture intake of several beverage categories of interest to public health practitioners and policy makers, such as water.

To address these gaps in the literature, this study aimed to describe the development of a brief, self-administered questionnaire to assess adolescents' beverage consumption during school lunchtime and to examine the initial validation of the questionnaire against direct observations of students' beverage consumption.

METHODS

Participants and Recruitment

Data collection took place between December, 2012 and February, 2013. A convenience sample of 3 standard (ie, non-charter, non-magnet) public schools in the San Francisco Bay Area region of California was recruited. Eligible schools served students in grades 6–8. Because low-income and minority children tend to have less healthy beverage consumption habits than do higher-income and white children,⁸ eligible schools had at least 50% of students eligible for free or reduced-price meals through the *National School Lunch Program* and at least 50% of students of Latino or African American race/ethnicity. Schools were selected to represent a range of on-site beverage options, including milk and juice served as part of the *National School Lunch Program*, a variety of *à la carte* beverage choices, and different options for free water (traditional water fountain, water dispenser with cups, and water bottle-filling station). To recruit schools, research staff contacted school food service directors to assess interest and eligibility, mailed an informational letter to interested administrators, and made phone calls to explain study procedures and schedule a time for data collection.

At each study school, school staff recruited a convenience sample of 5–10 English-speaking students (total $n = 25$). Students' parents received an informational letter and provided written consent, and students gave written assent. All procedures were approved by the University of California, San Francisco Committee on Human Research.

Measures and Procedures

Based on a review of existing measures,^{4,5,7} the researchers developed a brief, self-administered questionnaire. The questionnaire was developed to evaluate a school-based cafeteria intervention⁹ and thus was focused on assessing students' beverage consumption during school lunchtime. This focus may also have increased accuracy, because youth can more accurately recall their consumption at a single meal compared with an entire 24-hour period.¹⁰ In addition, because youth report their dietary intake more accurately soon after consumption,¹¹ the questionnaire was designed for administration immediately after lunchtime.

To ensure face validity, several experts in dietary assessment as well as staff at California Food Policy Advocates, a public health organization with expertise in nutrition policy, provided input regarding the questionnaire (eg, whether appropriate beverages and portion sizes were used). Initial drafts were pretested with 3 middle school students and were revised based on their feedback, including adding instructions and reformatting so that each beverage appeared on a separate page. Next, a pilot of the validation procedures (see subsequent description) was conducted with 11 students at 2 eligible schools not included in the main validation study. Further revisions to the questionnaire were then made, including adding items asking for the name, flavor, and brand of each beverage item consumed.

The revised instrument was validated in a convenience sample of students ($n = 25$) from the 3 study schools. The instrument ([Supplementary Data](#)) included 14 closed-ended questions asking students to report whether they drank (yes/no) the following specific beverages during lunchtime: tap water from the cafeteria; tap water from outside the cafeteria; tap water from home; plain bottled water; flavored bottled water; plain milk; flavored milk; diet drinks; regular soda; regular sports drinks; 100% fruit juice; other sugary or sweetened drinks (eg, fruit-flavored drinks, sweetened coffee/tea); energy drinks; and any other beverages (write in the beverage type). For

each beverage consumed, students indicated the amount they consumed (a few sips, <1 glass or half a bottle, 1 glass or half a bottle, 2 glasses or 1 bottle, or >2 glasses or 1 bottle). Each item included images of the beverage type (eg, image of a milk carton) and of portion sizes (eg, image of a half-full glass).

Students also reported their demographic characteristics. Students completed questionnaires immediately after lunch in the cafeteria or another quiet location (eg, library). Questionnaires took approximately 5–10 minutes to complete. Students received a \$5 movie theater gift card for participating.

Trained research staff unobtrusively observed students' beverage consumption during lunchtime using a standardized tool ([Supplementary Data](#)). Research staff were paired to students 1:1; thus, the interrater reliability among observers was not assessed. Researchers recorded each beverage and the estimated number of ounces the student consumed (based on the observed starting and ending amounts in the container and/or the number of sips observed). For comparison with the questionnaire, the observer translated these estimates into questionnaire response options using the following conversions: <3 oz as response option 1 (a few sips); 3 to <8 oz as response option 2 (<1 glass or half a bottle), and 8 oz as response option 3 (1 glass or half a bottle). No students were observed to consume >8 oz of a given beverage (ie, no observations corresponded with the 2 highest response options).

Data Analysis

Research staff double-entered all data using the REDCap data entry system (Research Electronic Data Capture, Vanderbilt University, Nashville, TN).¹² For analyses, 3 new beverage categories were created: water from a free source at school (combination of all free water sources at school); all plain water (combination of water from a free source at school, tap water brought from home, and plain bottled water); and any sugar-sweetened beverage (combination of flavored water, soda, energy drinks, sports drinks, and other

sugary or sweetened beverages). All other beverages were assessed separately.

The researchers assessed validity by comparing their observations of students' beverage consumption with students' self-reported consumption. Raw percent agreement and kappa statistics (κ) were calculated to examine the agreement between observations and questionnaire data on the type of beverages consumed (yes/no for each beverage). Next, linear-weighted agreement and κ were calculated to examine agreement between the observed and reported amount consumed for each beverage.^{13,14} Following generally accepted interpretations,¹⁵ kappa scores between 0.21 and 0.40 were considered to indicate fair agreement, 0.41–0.60 moderate agreement, 0.61–0.80 substantial agreement, and 0.81–1.0 almost perfect agreement. Analyses were completed using Stata (version 13.1, StataCorp LP, College Station, TX).

RESULTS

Participants were predominantly minority; about half (48%) identified as Hispanic/Latino, 20% as black, 20% as white, 16% as Asian, and 16% as American Indian or Alaskan Native (Table 1). Most (83%) were born in the US and 36% reported that they primarily spoke a language other than English at home.

Of the 15 beverage categories assessed, 4 (all plain water, water from free school sources, flavored milk, and other sugary or sweetened beverages) demonstrated almost perfect agreement regarding whether the beverage was consumed (range of κ 's = 0.82–1.00), and 1 (plain milk) demonstrated substantial agreement (κ = 0.78) (Table 2). Agreement regarding consumption of flavored water and of any sugar-sweetened beverage was moderate (κ 's = 0.47 and 0.52, respectively). Agreement for whether other beverages were consumed was fair (κ = 0.24) and agreement for whether soda was consumed was low (κ = 0.00) despite high raw agreement. The 6 remaining beverages had too few ratings to compute accurate κ 's, because few or

Table 1. Demographic Characteristics of Middle School Students (n = 25) Participating in Observation and Questionnaire Data Collection About School Lunchtime Beverage Consumption

Characteristics	%	(n ^a)
Age, y (mean [SD])	12.5	0.9
Female	68	17
Race/ethnicity ^b		
Hispanic/Latino	48	12
Black	20	5
White	20	5
Asian	16	4
American Indian/Alaskan Native	16	4
Born in US	83	20
Language most often spoken at home		
English	64	14
Other language ^c	36	8

^aTotal n across categories may not sum to 25 owing to missing data; ^bCategories sum to >100% because students could select all race/ethnicity categories that applied; ^cIncludes Tagalog, Cantonese, and other.

no students consumed them during school lunchtime.

Most beverages showed high levels of agreement regarding amount consumed (Table 2). Of the 9 beverages with enough ratings to calculate κ , all but 2 had at least moderate agreement (range of weighted κ 's = 0.45–0.81). The remaining beverages showed fair agreement (flavored water: weighted κ = 0.31) or low agreement (soda: weighted κ = 0.00), despite high raw agreement.

DISCUSSION

This brief, self-administered questionnaire shows promise for assessing beverage intake during school lunchtime in a diverse sample of middle school students. The majority of beverage types demonstrated substantial or almost perfect agreement between observations and self-report for the type and amount of beverage students consumed during lunchtime. To the authors' knowledge, no other validated brief questionnaires assessed adolescents' beverage consumption during school lunchtime. Although other questionnaires were available for rapid assessment of beverage consumption in adults,⁴ usual beverage and snack consumption in adolescents,⁷ and certain food items eaten during school lunchtime among

elementary school students,⁵ this questionnaire was unique in providing a low-cost, expeditious way to collect information specifically on adolescents' school lunchtime beverage consumption across a range of beverage types. As such, this tool provides a new evaluation option for assessing the impact of school-based interventions to promote consumption of healthy beverages.

The questionnaire's validity might be enhanced with slight modifications to the instrument. For example, providing more detailed definitions of the beverage categories might improve accuracy. It is also possible that the nonspecific nature of the category of "other beverage" made it more difficult for students to respond accurately,¹⁶ and future iterations of this questionnaire could include additional beverage categories as appropriate to the population of interest to avoid many responses in that category.

This study had several limitations. The tool is specific to students' beverage intake during school lunch and may not be valid for assessing consumption in other settings. One-to-one direct observation of students necessitated a small sample size and precluded calculating interrater reliability among observers. Partly because of the small sample size, several beverages assessed in the questionnaire were consumed by few or no

Table 2. Agreement Regarding Type and Amount of Beverages Consumed Between Middle School Students' (n = 25) Self-report and Researchers' Direct Observation

Beverage	% (n) Consumed in Observation	% (n) Consumed in Self Report	Kappa for Whether Beverage Consumed	Raw Agreement for Whether Beverage Consumed (%)	Weighted Kappa ^e for Amount of Beverage Consumed	Weighted Raw Agreement ^e for Amount of Beverage Consumed (%)
All plain water ^a	28 (7)	36 (9)	0.82	92.0	0.81	96.0
Water from free source at school ^b	28 (7)	36 (9)	0.82	92.0	0.67	92.0
Flavored water	4 (1)	12 (3)	0.47	92.0	0.31	94.7
Plain milk	20 (5)	28 (7)	0.78	92.0	0.75	92.0
Flavored milk	16 (4)	12 (3)	0.83	96.0	0.75	94.7
Soda	0	4 (1)	0.00	96.0	0.00	96.0
Other sugary or sweetened beverages ^c	4 (1)	4 (1)	1.00	100.0	0.79	98.7
Other beverages	12 (3)	12 (3)	0.24	84.0	0.45	92.0
All sugar-sweetened beverages ^d	8 (2)	20 (5)	0.52	88.0	0.45	92.0
Tap water from home	0	0	Incalculable ^f	100.0	Incalculable ^f	100.0
Plain bottled water	0	0	Incalculable ^f	100.0	Incalculable ^f	100.0
100% fruit juice	0	0	Incalculable ^f	100.0	Incalculable ^f	100.0
Sports drinks	0	0	Incalculable ^f	100.0	Incalculable ^f	100.0
Energy drinks	0	0	Incalculable ^f	100.0	Incalculable ^f	100.0
Diet drinks	0	0	Incalculable ^f	100.0	Incalculable ^f	100.0

^aIncludes water from free source at school (fountain, dispenser, or water bottle–filling station), tap water brought from home, and unflavored bottled water; ^bIncludes water from water fountain, dispenser, or water bottle–filling station at school; ^cIncludes sweetened drinks such as fruit-flavored drinks (Capri Sun, Sunny Delight), sweetened coffee/tea, and *aguas frescas*; ^dIncludes flavored water, sports drinks, energy drinks, soda, and other sugary or sweetened beverages; ^eWeighted kappa and weighted agreement use a linear weighting function; ^fIncalculable owing to perfect agreement and no variation in responses.

students in the study. This lack of variation likely contributed to the low κ scores observed for items related to consumption of soda, flavored water, and other beverages, despite achieving high raw agreement. In addition, κ could not be computed for all beverage categories because some beverages were not consumed by students in the sample. Future research is needed to assess whether this instrument is valid for these beverages. Finally, although the researchers attempted to observe students unobtrusively (eg, they stood to the side of the cafeteria, did not speak with students), the students knew they were being observed and may have paid more attention to

their beverage consumption than they would otherwise.

This study also has several strengths. For example, the use of direct observation reduced the threat of common-method bias.¹⁷ The questionnaire included images of the beverage items and portion sizes, aiding comprehension and accuracy. The questionnaire also assessed, and demonstrated good agreement for, a range of beverage categories important for health, including water, sugary drinks, and plain and flavored milk. To the authors' knowledge, no other brief beverage consumption questionnaires for adolescents cover this range of beverage types.

IMPLICATIONS FOR RESEARCH AND PRACTICE

In this sample, a brief questionnaire was a useful tool for assessing the type and amounts of some of the beverages students commonly consume during school lunchtime, including plain and flavored water, plain and flavored milk, and sugar-sweetened beverages. This tool is a promising first step toward developing low-cost means for evaluating the effectiveness of school-based strategies to improve beverage consumption, including efforts to promote water consumption and reduce

sugar-sweetened beverage consumption. Future research could validate the tool for beverages that were not consumed by students in this sample, in larger samples, and in other populations.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at <http://dx.doi.org/10.1016/j.jneb.2017.06.006>.

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CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.