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Development of a Brief Questionnaire to Assess Habitual Beverage Intake (BEVQ-15): Sugar-Sweetened Beverages and Total Beverage Energy Intake

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Abstract

Introduction—Energy-containing beverages, specifically sugar-sweetened beverages (SSB), may contribute to weight gain and obesity development. Yet, no rapid assessment tools are available which quantify habitual beverage intake (grams, energy) in adults.

Objective—Determine the factorial validity of a newly developed beverage intake questionnaire (BEVQ) and identify potential to reduce items.

Methods—Participants from varying economic and educational backgrounds (n=1,596; age 43±12 yrs; BMI 31.5±0.2 kg/m^2) completed a 19-item BEVQ (BEVQ-19). Beverages that contributed <10% to total beverage, or SSB, energy and grams were identified for potential removal. Factor analyses identified beverage categories that could potentially be combined. Regression analyses compared BEVQ-19 outcomes with the reduced version's (BEVQ-15) variables. Inter-item reliability was assessed using Cronbach's Alpha. Following BEVQ-15 development, a subsequent study (n=70; age 37±2 yrs; BMI 24.5±0.4 kg/m^2) evaluated the relative validity of the BEVQ-15 through comparison of three 24-hour dietary recalls' (FIR) beverage intake.

Results—Three beverage items were identified for elimination (vegetable juice, meal replacement drinks, mixed alcoholic drinks); beer and light beer were combined into one category.

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Regression models using BEVQ-15 variables explained 91–99% of variance in the four major outcomes of the BEVQ-19 (all P<0.001). Cronbach's Alpha ranged 0.97–0.99 for all outcomes. In the follow-up study, BEVQ-15 and FIR variables were significantly correlated with the exception of whole milk; BEVQ-15 SSB (R^2=0.69) and total beverage energy (R^2=0.59) were more highly correlated with FIR than previously reported for the BEVQ-19. The BEVQ-15 produced a lower readability score of 4.8, which is appropriate for individuals with a fourth grade education or greater.

Conclusion—The BEVQ-19 can be reduced to a 15-item questionnaire. This brief dietary assessment tool will enable researchers and practitioners to rapidly (administration time of ~2 min) assess habitual beverage intake, and to determine possible associations of beverage consumption with health-related outcomes, such as weight status.

Keywords

Beverage intake; factor analysis; diet assessment; validity; questionnaire

Introduction

Consumption of energy-containing beverages, particularly sugar-sweetened beverages (SSB), may lead to weight gain and obesity (1–4). The National Health and Nutrition Examination Survey (NHANES) has not revealed a decline in obesity prevalence when comparing results from 1999–2006 to 2007–2008; 68.3% of all adults (20 years and older) were found to be overweight (Body Mass Index [BMI] 25–29.9 kg/m^2) or obese (BMI ≥ 30 kg/m^2) in 2007–2008 (5). Increased body weight and energy intake, along with poor health outcomes such as increased risk of type 2 diabetes, cardiovascular disease and hypertension, have been associated with high intakes of SSB, specifically soft drinks (6–9).

A recent Scientific Statement from the American Heart Association showed that the majority of added sugars (~50%) in American's diets come from SSB (10). Guidelines suggest that no more than one half of discretionary energy, based on the United States Department of Agriculture Food Guide, should be consumed from added sugars (10). This represents an added sugar intake level of no more than 80 calories (kcals) per day for the average female and 150 kcals per day for the average male, depending on energy requirements and physical activity energy expenditure (10).

The 2010 U.S. Dietary Guidelines emphasize obesity prevention, with a recommendation to consume less than 15% of total energy from solid fats and added sugars (which currently comprise approximately 33% of total energy intake) (11,12). It is suggested that SSB be replaced with non-caloric beverages such as water, or healthier alternatives such as milk (9,12). To determine the habitual intake of SSB and other beverages, as well as to evaluate the effectiveness of clinical and public health interventions which aim to address the Dietary Guidelines and the American Heart Association's SSB recommendations, a valid, reliable and rapidly administered beverage intake assessment tool is needed.

The most common methods to assess dietary intake are food diaries and recalls, which are resource-intensive (e.g., time, cost) for researchers and burdensome for respondents, and they are limited by only providing information on recent dietary intake (13–15). Therefore, it may be difficult to determine habitual intake, as well as changes in food or beverage consumption with these dietary assessment methods. Alternatively, food frequency questionnaires (FFQ) are an acceptable method for assessing habitual dietary intake, without the added costs typically incurred by dietary recalls (16–18). The availability of a brief, self-administered quantitative beverage intake questionnaire could greatly enhance research

targeting habitual beverage intake patterns in adults, particularly one that may be used with lower-literacy populations.

The purpose of this investigation is to refine a valid and reliable 19-item beverage intake questionnaire (BEVQ-19) (19) by determining the factorial validity of the BEVQ, evaluating the potential to reduce the length of this tool and reducing the reading level to be suitable across various populations. To our knowledge, only one investigation has focused on the variable reduction of a quantitative dietary questionnaire (20), and no studies have used exploratory factor analysis (EFA) to combine variables for the purpose of reducing the length of a quantitative dietary assessment tool. Exploratory factor analysis has been used in quantitative research to identify common dietary patterns (21), which proves useful for combining dietary variables that share similar nutritional characteristics within a questionnaire. Thus, our objective is to develop and evaluate a reduced version of the BEVQ-19 that can be used to accurately and rapidly assess habitual beverage intake across a wide variety of adult populations.

Methods

Subjects and Design

One-thousand five hundred and ninety six participants aged >18 years completed the BEVQ as part of their baseline assessment in three separate investigations between June 2008–December 2009. The investigations included individuals from a range of economic and educational backgrounds, geographic regions, ages, race/ethnicities and weight status. One investigation recruited 105 individuals from the general population of a small university community in Virginia using newspaper and email advertisements. The second investigation recruited 341 parents of children aged 2–17 years attending a medical clinic in one of two locations in Nebraska: an outpatient primary care facility serving Native Americans and a community practice affiliated with an academic medical center. The third investigation recruited 1,150 overweight and obese individuals within worksites across rural and urban areas of southwestern Virginia. The Virginia Tech Institutional Review Board approved the study protocols and all participants provided written informed consent. As part of these investigations, healthy adults underwent objective assessments of height and weight, and BMI was calculated. Information on self-reported gender, age, race/ethnicity, education and income was also collected, and all participants completed the BEVQ-19. All BEVQ were self-administered, without regard for education or income levels. Following development of the reduced BEVQ, adult participants (n=70) were recruited from the local Virginia Tech community for a subsequent investigation from August-December 2010 to evaluate validity of the shortened tool. Quality assurance included checking data sets for missing data, examining variable ranges for data entry errors, as well as randomly selecting participant data to double check entry accuracy.

Beverage Intake Questionnaire

The BEVQ-19 is a quantitative 19-item FFQ (19), in that it measures frequency of beverage items, as well as amounts consumed; semi-quantitative FFQ only measure frequency of food item intake (22). The frequency of food item consumption, which is the principal determinant of total intake, provides the most accurate picture of overall consumption (16). In contrast, food intake records (FIR) provide only recent dietary intake. The BEVQ-19 estimates habitual mean daily intake of water, total beverages and SSB (kcals, grams [g] consumed) across 19 beverage categories plus one open-ended section for “other” beverages not listed: water, regular soft drinks, diet soft drinks, juice, juice drinks, vegetable juice, whole milk, reduced fat milk, low fat/skim milk, sweet tea, coffee/tea with cream and/or sugar, black coffee/tea, light beer, regular beer, liquor, mixed alcoholic drinks, wine, meal

replacement drinks and energy drinks. The SSB category is comprised of regular soft drinks, juice drinks, sweet tea, coffee/tea with cream and/or sugar, mixed alcoholic drinks, meal replacement drinks and energy drinks. The beverage categories were originally established according to energy and macronutrient content using published food composition tables and the Nutrition Data System for Research software (19). Respondents are asked to indicate "how often" and "how much" of a beverage they consumed in the past month. Responses for the "how often" category range from "never or less than 1 time per week" up to "3+ times per day"; "how much" ranges from "less than 6 fl oz (¾ cup)" up to "more than 20 fl oz (2 ½ cups)." Beverage intake responses are able to range from 0 fl oz to 60 fl oz (e.g., 3 times per day, 20 fl oz each time) per day. Responses given for the "other beverage" category were scored in the appropriate beverage category at the investigator's discretion.

Development and Evaluation of the Reduced Beverage Intake Questionnaire

The initial step for developing the reduced BEVQ was to first examine cumulative frequencies to identify beverage categories that contributed <10% to total beverage energy and grams, or SSB energy and grams (i.e., not in the top 90% of kcal or gram consumption) from the BEVQ-19 data. To ensure that beverage categories consumed more among certain population segments were not eliminated, age-, gender-, race-, BMI-, education- and income-specific groups were individually assessed to determine if the same beverage categories were consistently contributing <10% to total beverage and SSB energy and grams. Next, EFA were performed on the remaining beverages to see if it was possible to combine items into categories that were logical from a nutritional perspective (e.g., regular and light beer) and to attest to the stability of the factor structure.

Validity of the reduced BEVQ was evaluated in the follow-up investigation. Participants (n=70) completed the self-administered reduced BEVQ and three 24-hour dietary recalls (FIR) within the same week; FIR consisted of two weekdays and 1 weekend day. Recalls were analyzed using nutritional analysis software (Nutrition Data Systems for Research [NDS-R] 2009, University of Minnesota, Minneapolis, MN). Relative validity was assessed by comparing beverage intake (g, kcal) assessed using the reduced BEVQ with the mean FIR beverage intake for each beverage category.

Data Analysis

Statistical analyses were performed using statistical analysis software (SPSS v. 12.0 for Windows, 2003, SPSS Inc., Chicago, IL). Descriptive statistics (mean±standard error of the mean [SEM]) are reported for demographic characteristics and mean total consumption of beverages and beverage categories (g, kcal). To identify beverage categories for potential removal from the BEVQ-19, first descending cumulative frequencies were used to determine the consumption level of each beverage category (e.g., percent of beverage kcals and grams). Next, a random half of the sample was used to conduct factor analyses to further refine the instrument by determining if beverage categories could be combined. Factor analyses were also used to provide evidence of a stable factor structure. The second half of the sample was used to cross-validate these findings. Lastly, independent sample *t* tests were used to assess the relative validity of the reduced BEVQ as compared to the BEVQ-19 outcomes (mean daily total beverage energy and grams, and mean daily SSB energy and grams). To perform this two-group comparison, data from 50% (randomly selected) of the sample using the reduced BEVQ was compared to outcomes in the remaining 50% of the sample using the BEVQ-19 data. Dividing the sample into halves creates variability and non-dependence in the data, versus comparing each participant's original consumption to the newly calculated reduced consumption (23) Stepwise multiple linear regression was used to examine the model fit and percent of variance explained by the reduced BEVQ compared to the BEVQ-19. Reliability analyses for differences among the reduced BEVQ and BEVQ-19

outcomes were assessed using Cronbach's Alpha to evaluate internal consistency/inter-item reliability, and Pearson's correlations to assess test-retest reliability.

To assess the relative validity of the reduced BEVQ in the follow-up investigation, paired sample *t* tests were used to compare the energy and g consumed of specific beverages determined by the reduced BEVQ with the mean FIR beverage intake for each beverage category. Associations among beverage intake variables determined by the two intake assessment tools were evaluated using correlational analyses (Spearman's R^2). The alpha level was set *a priori* at $P \leq 0.05$.

Results

Demographics

Participants with complete BEVQ-19 data were included (n=1,596) in the analysis to develop the reduced BEVQ. The percentage of unreported data for the following demographic characteristics was as follows: gender, 2% of the sample; race/ethnicity, 2%; education, 2%; income, 9%; age, 3%; BMI, 0.5%. Participants were primarily female (75% of sample) and Caucasian (65%) from varying economic and educational backgrounds (Table 1). Age ranged 18–93 yrs (mean 43±12 yrs) and BMI ranged 16–63 kg/m^2 (mean 31.5±0.2 kg/m^2). A large percentage of the sample was overweight/obese (84%), which may be attributed to much of the sample being recruited from rural health-disparate areas (24), and among individuals interested in weight management interventions.

Identification of "Low Consumption" Beverage Categories

Using descending cumulative frequencies for the four beverage outcomes (total and SSB energy and grams), four beverage categories consistently contributed <10% to total energy and grams and were thus identified for potential removal: energy drinks, vegetable juice, mixed alcoholic drinks and meal replacement drinks. Only beverage categories which contributed <10% to *both* total energy and total grams were considered for deletion. Upon further investigation of consumption patterns across specific demographic groups (age, gender, race, BMI, education and income) energy drinks were within the top 90% of consumed beverages for adults ≤35 years old. It is also possible that energy drinks were underreported in the initial validation and reliability assessment (19), as the phrase "sport drinks" was not included as an example in the energy drinks category. Therefore, the energy drink category was not removed from the reduced BEVQ. The remaining three "low consumption" beverage categories were removed (vegetable juice, mixed alcoholic drinks and meal replacement drinks) in the reduced version of the BEVQ.

Factor Analysis

Using EFA and the remaining 16 beverage categories, scree plots revealed six factors with eigenvalues ≥1 for both total energy and grams. Using principal axis factoring (PAF) as the extraction method, the Varimax-rotated 6-factor solution extracted one possible factor that could be combined into one category: beer and light beer (Table 2). Factor loadings for beer (g, kcal=0.846, 0.854) and light beer (g, kcal=0.620, 0.613) were acceptable, e.g., ≥0.3 (25). Beverages with absolute factor loadings of <0.3 were suppressed and not reported. The six factors for total energy explained 60% of variance, and the six total gram factors explained 51% of variance, which is comparable to other validation studies using EFA (26–28). As a result of the removal of consistent "low consumption" beverage categories and the EFA, the 15-item BEVQ (BEVQ-15) was produced (Figure 1). The EFA was conducted on a randomly selected 50% of the sample and cross-validated on the other half of the sample.

To evaluate the model fit in the successive reduction of the BEVQ-19 to the BEVQ-15, multiple linear regression models were utilized. The values presented represent the results of the EFA and are correlations of four different models with each of the four primary BEVQ-19 outcomes. Model 1 compares the BEVQ-19 to a questionnaire with the beer and light beer categories combined into one category (total beverage g, kcal R^2=1.00, R^2=0.999, respectively; P<0.01). Model 2 represents the omission of the vegetable juice category from the BEVQ (with beer categories combined) (total beverage g, kcal R^2=0.995, R^2=0.998, respectively; P<0.001). No results are available for SSB in the first and second models due to beer, light beer and vegetable juice not impacting SSB energy or gram outcomes (i.e., none of these beverage categories are SSB). Model 3 has the beer and light beer categories combined, and omits vegetable juice and mixed alcoholic drinks (total beverage g, kcal R^2=0.994, R^2=0.981; SSB g, kcal R^2=0.996, R^2=0.955, respectively; all P<0.001); Model 4 has vegetable juice, mixed alcoholic drinks and meal replacement drinks omitted, as well as beer and light beer categories combined, to give the BEVQ-15 (total beverage g, kcal R^2=0.988, R^2=0.964; SSB g, kcal R^2=0.978, R^2=0.912, respectively; all P<0.001). Trivial reductions in R^2 values were noted with each successive reduction of the BEVQ variables, and all correlations of the BEVQ-15 with the original BEVQ-19 outcomes were significant (Model 4).

Assessment of Reliability and Internal Consistency

Test-retest Pearson bivariate correlations between the BEVQ-19 and BEVQ-15 outcomes were significant between total beverage g and kcal (R^2=0.99 and 0.98, respectively; P≤0.01) and SSB g and kcal (R^2=0.99 and 0.96, respectively; P≤0.01). Absolute differences in outcomes between the 19- and 15-item BEVQ were minimal (total beverage intake, 39 g and 26 kcal; SSB intake, 24 g and 22 kcal).

Internal consistency for the BEVQ-15 was assessed by Cronbach's Alpha (29). All beverage outcomes were acceptable (e.g., ≥0.7) (30) as follows: total beverage intake (g, kcal=0.997, 0.991), SSB intake (g, kcal=0.994, 0.977).

Validity Testing

To evaluate the relative validity of the reduced version of the BEVQ (BEVQ-15), major outcomes were first compared with the full version (BEVQ-19). There were no significant differences between total beverage grams and SSB grams for the BEVQ-19 and BEVQ-15 (mean differences, 38±49 g and 27±29 g, respectively, P>0.05) (Figure 2a). There was no significant difference in total beverage energy between the BEVQ-19 and BEVQ-15 (mean difference, 28±19 kcal, P>0.05), but there was a significant difference, although minimal, between the BEVQ-19 and BEVQ-15 SSB energy (mean difference, 27±12 kcal, P=0.026) (Figure 2b).

Evaluation of Successive Reduction

Participants in the follow-up investigation to assess the relative validity of the BEVQ-15 were primarily younger adults (mean age 37±2 yrs) with a mean BMI of 24.5±0.4 kg/m^2. The sample was 60% female and 79% Caucasian. As presented in Table 3, responses between the BEVQ-15 and FIR were not significantly different for beverage intake (g) excluding 100% fruit juice, reduced fat milk, fat free milk and black coffee/tea (all < 58 g difference). Absolute differences in beverage energy between assessment tools were < 36 kcal across all categories, although this difference was significant for 100% fruit juice, reduced fat milk, fat free milk and black coffee/tea. Of the 17 beverage variables assessed (grams and energy for 15 individual beverage categories, plus SSB and total beverages), responses using the two assessment tools (BEVQ-15, FIR) were significantly correlated, with the exception of whole milk. The highest correlations were found (in descending order)

between beer, diet soft drinks, wine, regular coffee/tea and total SSB (range: R^2=0.76–0.69, P<0.001).

Readability and Administration Time

Using the Flesch-Kinkaid method (31) a readability score of 4.8 was produced, which indicates the BEVQ-15 is appropriate for individuals with a fourth grade education or greater. The original 19-item BEVQ produced a higher score of 6.9. During pilot testing of the BEVQ-15, average administration time was determined to be 2 min 15 sec (range: 40 sec – 4 min 26 sec). The BEVQ-19 took an average of 3 min 30 sec to complete (19).

Discussion

To examine the validity and reproducibility of a 15-item reduced version of a newly developed beverage intake questionnaire, four major beverage intake outcomes (mean daily beverage energy and grams, mean daily SSB energy and grams) were compared between the BEVQ-19, BEVQ-15 and FIR. Using multiple statistical procedures to assess the validity and reliability of the BEVQ-15, it was determined that the reduced tool possesses the ability to provide accurate and reliable information comparable to that of the full-length version (BEVQ-19). In addition, the new tool offers the advantages of a lower reading level, and a more rapid administration time. The lower reading level and shorter administration time of the BEVQ-15 is significant when assessing the habitual beverage intake of low-literacy populations, who may be at an increased risk for health disparities and poor dietary intake patterns (32).

In the initial validity and reliability study (19), which compared BEVQ-19 to FIR outcomes, mean differences between total beverage and SSB energy and SSB grams were significantly different. However, in this examination of the BEVQ-15 and FIR (Table 3), SSB and total beverage energy were not significantly different, and correlations between the two tools were higher for these variables (R^2~0.6–0.7) than that previously reported for the longer-length BEVQ. Correlations of the BEVQ-15 major outcomes with FIR outcomes were significant, with the exception of whole milk. The multiple linear regression models suggest minimal differences in outcomes of the BEVQ-15 as compared to the BEVQ-19.

Several modifications were made to the instructions based on participant feedback from a previous study utilizing the BEVQ-19 (19); modifications included adding instructions to 1) not record beverages used in cooking or other preparations, and to 2) count milk added to tea and coffee in the “tea/coffee with cream” beverage category, not in the milk categories. Additionally, the phrase “sports drinks” was added to the “energy drinks” category, and every other beverage category was shaded to improve response accuracy. Also, fluid ounces and cups were both listed for the “how much” category to provide multiple measuring methods. Although three beverage categories have been removed (vegetable juice, mixed alcoholic drinks and meal replacement drinks), respondents still have use of the “other beverage” category to record consumption of such beverages. Researchers and health professionals can score these individual items in the appropriate category at their discretion using published food composition tables (19).

Dietary Patterns

Upon further investigation of the newly created factors from the EFA, several dietary patterns, beyond the association of the beer and light beer categories, emerged: intake of water was negatively associated with regular soft drink intake (g); regular soft drinks, juice drinks and energy drinks (kcal) were all positively associated; and juice and whole milk intake (kcal) demonstrated high positive factor loadings (Table 2). However, these patterns

did not provide information on beverage categories which could be logically combined, from a nutritional perspective. According to the 2010 U.S. Dietary Guidelines (11), 36% of added sugar intake comes from regular soft drinks, energy and sports drinks; combined with the negative association of water intake to soft drink intake displayed by the BEVQ-15, it is likely water intake is being replaced by SSB in many American's diets. The BEVQ-15 may be a useful tool for determining adherence to the 2010 U.S. Dietary Guidelines and American Heart Association recommendations for SSB intake, and potentially for evaluating interventions which target changes in beverage intake patterns.

Strengths and Limitations

The ability to accurately assess the validity and reliability of a dietary questionnaire relies on having a large sample size (15) and utilizing multiple statistical methods, which has been achieved in this investigation. An important component of relative validity testing is comparing results of a questionnaire to a "gold standard," in this case the FIR (15,22), which was conducted following development of the reduced-length BEVQ.

The BEVQ is a quantitative questionnaire which bases its dietary outcomes on actual self-reported amounts (fluid ounces) of beverages. In comparison, semi-quantitative questionnaires only report the frequency of items consumed, often based on standard serving sizes. Quantitative questionnaires may provide more accurate outcomes because respondents are able to choose actual amounts consumed versus a standard portion size (22). Therefore, the BEVQ-15 is able to produce information on amounts (grams, kcal) consumed for individual beverage categories, as well as SSB and total beverages. Researchers and practitioners can quickly score the BEVQ-15, and provide immediate feedback regarding an individual's habitual beverage intake. This may be useful for comparing SSB intake to the recommended added sugar intake guidelines put forth by the American Heart Association (10). The consumption of added sugars, specifically SSB, has been associated with greater energy intake, higher body weight, lower intake of essential nutrients, hypertension and dyslipidemia (6,10,33). Thus, the ability to rapidly identify individuals with excessive SSB consumption, who may be at increased risk for these health conditions, may be of great clinical significance.

Several beverage intake questionnaires have been developed over the past decade (13,34–36); however, the available questionnaires were designed to measure beverage intake in children and adolescents, and most do not exclusively measure beverage intake (i.e., assess beverage and snack intake). The BEVQ-15 is the only beverage intake questionnaire available for use in a range of adult populations, including those with lower literacy levels. As the length of time to complete a FFQ is of great importance, having a questionnaire that solely assesses beverage intake including water and SSB, without the time constraints of additional measures, is advantageous.

Although this examination possesses several important strengths, it is not without some limitations that should be acknowledged. First, the initial data set contained a high percentage of women (75%); however, the follow-up study comparing the BEVQ-15 to FIR had a lower proportion of women to men (60 and 40%, respectively). Nevertheless, although the larger sample included a wide range of individuals in terms of economic and educational background, geographic area of residence, age, and race/ethnicity, the sample was primarily overweight or obese, which could limit the generalizability of findings. Second, future work is necessary to assess the ability to detect changes in beverage intake with the BEVQ-15, in order to determine if this tool could be used for dietary interventions which aim to reduce beverage energy or SSB intake. Finally, as with any self-reported dietary intake assessment, the data is subjective (FIR, BEVQ), and accurate comparisons of the BEVQ to the FIR depends on the participant's recollection of their habitual beverage consumption (22). Future

validation studies should include objective measures of dietary intake, for example biomarkers of SSB intake (37).

Conclusion

The 15-item BEVQ demonstrates acceptable validity and reliability as compared to the original 19-item BEVQ. Thus, the BEVQ-19 can be reduced to a shortened 15-item questionnaire, which is capable of examining the habitual beverage intake of adults including those with lower literacy levels. The validity and reliability of the BEVQ-15 makes it useful for large-scale investigations, as well as for use by practitioners. This low-resource tool will enable researchers and practitioners to rapidly assess beverage intake, and to determine possible associations of beverage consumption with health-related outcomes, such as weight status. As participants were from diverse backgrounds and were recruited from various settings (worksites, general population and medical centers), the BEVQ-15 may be suitable for measuring beverage intake in a range of adult populations. Future work is necessary to evaluate the ability of the BEVQ-15 to detect changes in beverage intake.

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Beverage Questionnaire (BEVQ-15)

Instructions:
In the past month, please indicate your response for each beverage type by marking an "X" in the bubble for "how often" and "how much each time".

1. Indicate how often you drank the following beverages, for example, if you drank 5 glasses of water per week, mark 4-6 times per week.
2. Indicate the approximate amount of beverage you drank each time, for example, if you drank 1 cup of water each time, mark 1 cup under "how much each time".
3. Do not count beverages used in cooking or other preparations, such as milk in cereal.
4. Count milk added to tea and coffee in the *tea/coffee with cream beverage category* **NOT** in the milk categories.

Participant ID _____

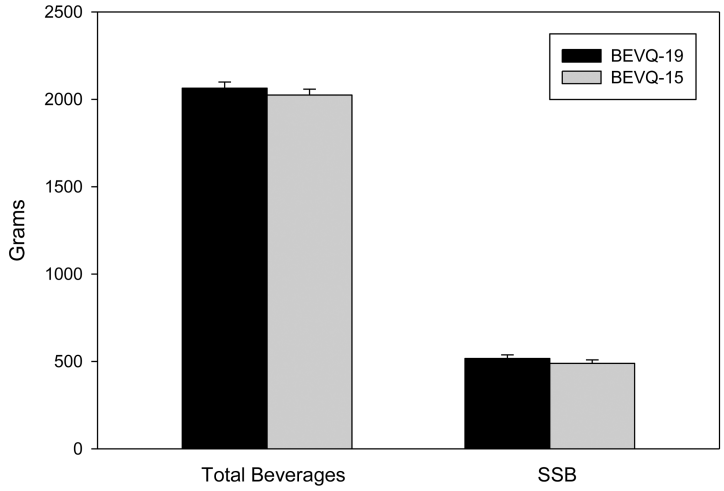
Date _____

	HOW OFTEN (MARK ONE)							HOW MUCH EACH TIME (MARK ONE)				
Type of Beverage	**Never or less than 1 time per week (go to next beverage)**	**1 time per week**	**2-3 times per week**	**4-6 times per week**	**1 time per day**	**2+ times per day**	**3+ times per day**	**Less than 6 fl oz (3/4 cup)**	**8 fl oz (1 cup)**	**12 fl oz (1 1/2 cups)**	**16 fl oz (2 cups)**	**More than 20 fl oz (2 1/2 cups)**
Water	o	o	o	o	o	o	o	o	o	o	o	o
100% Fruit Juice	o	o	o	o	o	o	o	o	o	o	o	o
Sweetened Juice Beverage/ Drink (fruit ades, lemonade, punch, Sunny Delight)	o	o	o	o	o	o	o	o	o	o	o	o
Whole Milk	o	o	o	o	o	o	o	o	o	o	o	o
Reduced Fat Milk (2%)	o	o	o	o	o	o	o	o	o	o	o	o
Low Fat/Fat Free Milk (Skim, 1%, Buttermilk, Soymilk)	o	o	o	o	o	o	o	o	o	o	o	o
Soft Drinks, Regular	o	o	o	o	o	o	o	o	o	o	o	o
Diet Soft Drinks/Artificially Sweetened Drinks (Crystal Light)	o	o	o	o	o	o	o	o	o	o	o	o
Sweetened Tea	o	o	o	o	o	o	o	o	o	o	o	o
Tea or Coffee, with cream and/or sugar (includes non-dairy creamer)	o	o	o	o	o	o	o	o	o	o	o	o
Tea or Coffee, black, with/ without artificial sweetener (no cream or sugar)	o	o	o	o	o	o	o	o	o	o	o	o
Beer, Ales, Wine Coolers, Non-alcoholic or Light Beer	o	o	o	o	o	o	o	o	o	o	o	o
Hard Liquor (shots, rum, tequila, etc.)	o	o	o	o	o	o	o	o	o	o	o	o
Wine (red or white)	o	o	o	o	o	o	o	o	o	o	o	o
Energy & Sports Drinks (Red Bull, Rockstar, Gatorade, Powerade, etc.)	o	o	o	o	o	o	o	o	o	o	o	o
Other (list):	o	o	o	o	o	o	o	o	o	o	o	o

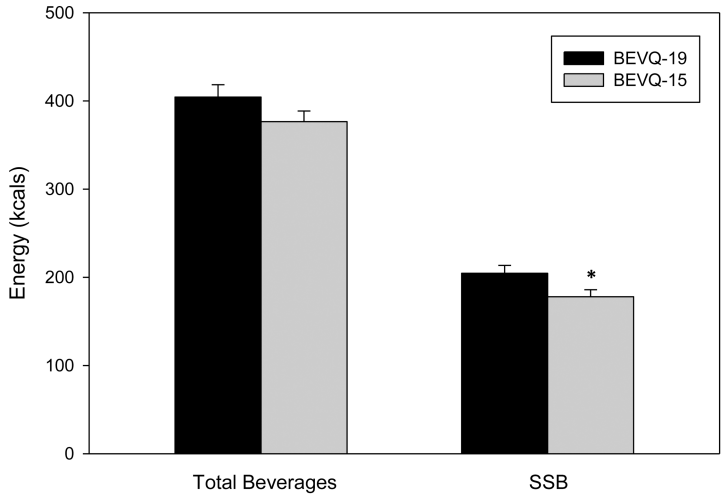
Virginia Polytechnic Institute and State University, 2010.

Figure 1.
The Brief 15-Item Beverage Intake Questionnaire (BEVQ-15)*†
*Scoring instructions are available from the corresponding author upon request.
†Sunny Delight, Sunny Delight Beverages Co., Cincinnati, Ohio; Crystal Light, Kraft Foods, Inc., Northfield, Illinois; Red Bull, Red Bull, Fuschl am See Austria; Rockstar, Rockstar Energy Drink, Las Vegas, Nevada; Gatorade, PepsiCo, Purchase, New York; Powerade, Coca-Cola Company, Atlanta, Georgia

2 (a). Comparison of BEVQ-19 and BEVQ-15: Total Beverage and Sugar Sweetened Beverage (SSB) Grams



2 (b). Comparison of BEVQ-19 and BEVQ-15: Total Beverage and Sugar Sweetened Beverage (SSB) Energy



*Significantly different from BEVQ-19 (P=0.026).

Figure 2.

a: Comparison of BEVQ-19 and BEVQ-15: Total Beverage and Sugar-Sweetened Beverage (SSB) Grams

b: Comparison of BEVQ-19 and BEVQ-15: Total Beverage and Sugar-Sweetened Beverage (SSB) Energy

Table 1

Participant Demographic Characteristics: Development of a Brief Beverage Intake Questionnaire

Total number of participants, n *	1,596
Male, n (%)	365 (23)
Female, n (%)	1,195 (75)
Age, n (%)	
18–39 y	625 (39)
40–59 y	818 (51)
≥60 y	116 (7)
Mean Age, yrs **	43±12
Race/Ethnicity, n (%)	
Caucasian	1,039 (65)
African American	338 (21)
American Indian/Alaskan Native	83 (5)
Hispanic	52 (3)
Asian	23 (1)
Other	31 (2)
BMI Status, n (%)	7 (1)
Underweight (<18.5 kg/m^2)	235 (15)
Normal Weight (18.5–24.9 kg/m^2)	515 (32)
Overweight (25–29.9 kg/m^2)	828 (52)
Obese (≥30 kg/m^2)	31.5±0.2
Mean BMI (kg/m^2) **	
Education Level, n (%)	
Did not complete high school	62 (4)
High school graduate	221 (14)
Some college	466 (29)
College graduate	481 (30)
Post college work	334 (21)
Household Income Level, n (%)	
≤ $14,999	78 (5)
$15,000 – $29,999	170 (11)
$30,000 – $49,999	317 (20)
$50,000 – $99,999	537 (34)
≥$100,000	356 (22)

* Slight differences from the total may be due to non-reported data.

** Values are expressed as Mean ± Standard Error of the Mean (SEM).

Table 2

Exploratory Factor Analysis: Mean Daily Total Beverage Grams and Energy

Mean Daily Total Beverage Grams						
Beverage Category*	Factors					
	1	2	3	4	5	6
Beer, g Light Beer, g	0.846 0.620					
Juice, g Juice Drinks, g Whole Milk, g		0.688 0.439 0.348				
Energy Drinks, g			0.632			
Regular Soft Drinks, g Water, g				0.495 −0.391		
Sweetened Coffee, g					0.466	
Sweet Tea, g						0.400
Mean Daily Total Beverage Energy						
Beverage Category	Factors					
	1	2	3	4	5	6
Beer, kcal Light Beer, kcal	0.854 0.613					
Juice, kcal Whole Milk, kcal		0.773 0.310				
Energy Drinks, kcal Juice Drinks, kcal Regular Soft Drinks, kcal		0.320	0.473 0.466 0.371			
Fat Free Milk, kcal				−0.403		
Sweetened Coffee, kcal					0.422	
Sweet Tea, kcal						0.381

*Beverage categories with factor loadings <0.3 were suppressed.

Table 3

Validity of a Reduced Beverage Intake Questionnaire (BEVQ-15): Comparison of BEVQ-15 with Mean Beverage Intake from Three 24-Hour Food Intake Recalls (FIR)

Beverage Category	BEVQ-15[a]	FIR[a] (Difference from BEVQ-15)[b]	Correlations[c] (R^2)
Water, g	722±51	781±60 (−59±58)	0.469***
100% Fruit Juice g kcal	90±14 51±8	55±12 (35±16*) 31±7 (20±9*)	0.415*** 0.415***
Juice Drinks g kcal	39±12 18±6	55±13 (−16±18) 26±6 (−8±8)	0.270* 0.269*
Whole Milk g kcal	23±11 17±8	6±4 (17±11) 4±3 (13±9)	0.129 0.129
Reduced Fat Milk g kcal	45±12 27±7	16±6 (28±11*) 10±4 (17±7*)	0.267* 0.267*
Fat Free Milk g kcal	76±16 28±6	44±13 (32±14*) 17±5 (12±5*)	0.305** 0.305**
Regular Soft Drinks g kcal	63±19 27±8	81±20 (−18±14) 36±9 (−8±6)	0.585*** 0.589***
Diet Soft Drinks g kcal	137±33 3±2	143±38 (−7±30) 1±1 (2±2)	0.759*** 0.713***
Sweet Tea g kcal	86±35 28±11	79±32 (7±33) 25±10 (2±11)	0.394*** 0.394***
Sweetened Coffee g kcal	157±28 42±7	137±24 (20±23) 38±7 (4±6)	0.653*** 0.646***
Regular Coffee/Tea g kcal	107±25 1±1	165±33 (−58±22**) 2±1 (−1±1**)	0.695*** 0.695***
Beer g kcal	89±17 31±6	194±68 (−105±58) 67±24 (−36±20)	0.758*** 0.758***
Liquor g kcal	18±5 43±11	14±5 (4±5) 34±11 (8±12)	0.522*** 0.522***
Wine g kcal	27±7 19±5	34±8 (−7±5) 24±6 (−5±4)	0.746*** 0.746***
Energy Drinks g kcal	41±13 18±6	40±17 (1±13) 18±8 (1±6)	0.598*** 0.599***
Total Sugar-Sweetened Beverages g kcal	382±56 135±21	392±46 (−10±46) 143±17 (8±17)	0.673*** 0.688***
Total Beverage g kcal	1688±106 350±39	1847±107 (−159±85) 335±39 (15±26)	0.510*** 0.558***

[a] Values expressed as Mean±Standard Error of the Mean (SEM).

[b] Mean differences according to a paired sample *t* test; slight differences may be noted from the preceding columns due to rounding, as whole numbers are presented in the table.

[c] Spearman's correlation.

* P<0.05.

** P<0.01.

*** P<0.001.