Short Title: Validity and reliability of behavior and theory-based psychosocial determinants measures

Validity and reliability of behavior and theory-based psychosocial determinants measures, using audience response system technology in urban upper elementary school children

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Abstract

Objective: To examine validity and reliability of a questionnaire administered with audience response system (ARS).

Design: Cross-sectional study.

Setting: Two New York City public elementary schools.

Participants: Fourth and fifth grade students.

Main Outcome Measures: Food, Health & Choices questionnaire (FHC-Q) assessed energy balance related behaviors (EBRBs) including fruits and vegetables; sugar-sweetened beverages; processed packaged snacks; fast food; physical activity; recreational screen time, and associated psychosocial determinants (three or more questions per outcome scale). Previously validated reference instruments were used for relative validation. ARS format was compared to paper-and-pencil format. All measures were administered in a classroom setting.

Analysis: Pearson correlation coefficients between the reference instruments and the FHC-Q were calculated. Internal consistency reliabilities were evaluated with Cronbach's alpha. Spearman's rank correlation, intra-class correlation, and percent agreements were used for test-retest reliability between paper-and-pencil and ARS; and between two ARS FHC-Q administrations.

Results: Correlations for EBRBs with reference instruments ranged 0.38-0.61 ($p < 0.01$). Cronbach's α ranged 0.77-0.92 for EBRBs and 0.74-0.90 for psychosocial determinants. Test-retest reliability correlations ranged 0.36-0.87 ($p < 0.001$). Percent agreements for knowledge questions ranged 69.8%-84.8%.

Conclusions and Implications: The ARS FHC-Q has acceptable validity and reliability for collecting data on EBRBs and associated psychosocial determinants for upper-elementary students.

Keywords: instrument development; validation; reliability; energy balance related behaviors; childhood obesity; elementary school; food and activity behaviors; theory-based psychosocial factors

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INTRODUCTION

Energy balance related behaviors (EBRBs), such as consuming energy-dense snacks and excessive sedentary behavior are important contributors to the current high rates of childhood obesity.^{1,2} EBRBs considered to be contributors to childhood obesity that are also within the food choice control of children include fruit and vegetables, sugar-sweetened beverages, processed packaged snacks, and fast food consumption, as well as physical activity and recreational screen time behaviors.^{1,3} Schools have been an ideal setting for intervention studies targeting EBRBs to reduce risk of childhood obesity because students spend a considerable amount of time at school and programs can reach a large number of children in a short period of time.⁴⁻⁷ In addition to behavior outcomes, theory-based psychosocial determinants are often targeted as potential mediators of behavior change. The assumption is that psychosocial determinants cause or mediate the targeted behavior changes in interventions.⁸⁻¹⁰ Determinants from the theory of planned behavior,¹¹ social cognitive theory,¹² health belief model,^{13,14} and self-determination theory^{15,16} have been frequently used in school-based nutrition and/or physical activity interventions.^{10,17} Studies sometimes use psychosocial determinants from multiple theories and develop their own conceptual frameworks.¹⁰ Thus, to evaluate the effectiveness of interventions, valid and reliable measures are required for both EBRBs and their associated psychosocial determinants.^{17,18}

School-based intervention studies targeting EBRBs have commonly used self-report questionnaires to assess diet and physical activity behaviors because questionnaires are inexpensive, easy to administer and are widely accepted for use in group settings (e.g. schools)^{19,20} whereas diaries or recalls are associated with high subject burden and high administrative and data analysis costs.²¹⁻²³ Further, diaries or recalls provide more information

than is needed for evaluation of a particular set of behaviors in intervention studies, such as EBRBs.²⁴⁻²⁶

A number of questionnaires have been developed for use with upper elementary school children^{20,27-31} and adolescents.^{25,32-34} However, the questionnaires for upper elementary school children have various limitations in their assessment of multiple EBRBs and related theory-based psychosocial determinants. For example, one focused more on food groups (grains, protein food, dairy products, fruit & vegetables, and fat, oils & sweets),²⁷ and one only assessed fruits and vegetables consumption not including other EBRBs and format was more similar to a 24-h recall with write and draw questions.³⁰ Three studies included a limited number of EBRBs (one with fruit & vegetables consumption and physical activity,²⁹ which included only two fruit and vegetable questions that were adapted from another study;²⁷ one included soft drinks, fruit juices, breakfast, dieting, and physical activity behaviors;²⁰ and one included sweetened beverages and fruit & vegetables consumption²⁸), and one study only assessed psychosocial determinants.³¹ One relevant instrument measuring EBRBs in this age group was specifically designed to provide very comprehensive and detailed descriptive information on populations of children in 6 European countries.^{20,35} This instrument was based on a social ecological model with 150 questions assessing behaviors along with determinants and environmental factors. However, it only included a limited number of dietary behaviors (soft drinks, fruit juices, breakfast, and dieting), without questions on other EBRBs such as fruit and vegetables, processed packaged snack or fast food consumption.^{20,35} Given the limited availability of validated instruments for assessing, in a parsimonious fashion, a range of major EBRBs in upper elementary school children, there is a need for an instrument to comprehensibly measure multiple EBRBs as well as their associated potential psychosocial determinants of change for use in intervention studies.

New technologies such as computerized frequency questionnaires have recently been introduced to assess diet and physical activity behaviors as a way to decrease the research burden of processing paper-based surveys in large studies.³⁶ One of such potentially useful technologies is audience response system (ARS). ARS is an interactive method where multiple choice questions are put onto PowerPoint™ slides and projected. Audience members use handheld clickers to enter their chosen answer for each question. The responses are collected by a wireless receiver device and processed by an electronic software.³⁷ ARS has been used in a variety of settings, most often for educational purposes such as in-class assessments of learning, especially in college and graduate school settings.^{38,39} ARS also has been used in the assessment of a health education program with low-income urban minority children (ages 9-11 years) and was found to be a feasible tool for survey data collection without additional confounding effects of ARS on schoolchildren's learning.³⁷ Students completing an ARS-administered survey reported increased attention and participation compared to children who completed the survey in a paper-and-pencil format.³⁴ For study participants, ARS can be a novel and exciting tool, that also maintains participants' confidentiality in group settings.⁴⁰ For researchers, ARS can be an efficient method to collect data from an audience that automatically saves the data into a computer database, which could reduce data entry errors and time for data management.

The purpose of the current study was to conduct validity and reliability testing of the Food, Health & Choices Questionnaire (FHC-Q) administered with ARS technology for assessing EBRBs and associated psychosocial determinants in upper elementary school children (4th -5th grade, 9-11 years old). Specific objectives of the study were to answer the following research questions (1) Did a questionnaire measuring EBRBs and psychosocial determinants have valid constructs? (2) Did the target population understand the questions? (3) Did students

answer the questions consistently over time (stability)? (3a) Did students answer the questions similarly between paper-and-pencil format and ARS? (3b) Did students answer questions consistently using ARS over time? (4) Did multiple questions within the same construct generate consistent results as a scale (internal consistency)?

METHODS

Study Design, Participants, and Setting

This study was conducted as part of the formative evaluation of Food, Health & Choices intervention. Convenience samples were recruited for the purpose of instrument validation and reliability tests. An invitation was sent to principals and teachers of two New York City (NYC) public elementary schools where the principals agreed to participate in the main study for the following school year. Two schools agreed, and four 4th-grade and four 5th-grade classes from school 1, and four 4th grade classes from school 2 participated in the study (Figure 1).

Demographic characteristics are presented in Table 1. The majority of students were 10 years or younger (88.4%) and Black or Hispanic (95.9%). Gender was evenly distributed. Passive parental consent forms were distributed to students' families and students provided assent to participate after the procedure for administering the instrument was explained to them in class. No parental or student refusal was received. Class teachers were present and assisted with classroom management. The study was approved by the Institutional Review Boards of Teachers College Columbia University and the New York City Department of Education.

Food, Health & Choices Questionnaire development

To measure EBRBs and targeted psychosocial determinants, a paper-and-pencil version of the questionnaire was first developed. Behaviors and psychosocial determinants assessed in

the Food, Health, & Choices Questionnaire (FHC-Q) were initially derived from a comprehensive review of the literature.^{3,41-46} To understand types and amounts of food usually consumed by the target population, pilot studies were conducted during the 2010-2011 school year involving 24-hour diet recalls, an open-ended food questionnaire, and school lunch observations. Types of food reported and observed as commonly consumed by the sample were included in the FHC-Q and were consistent with national data.⁴⁷⁻⁴⁹ Furthermore, design, language, and format of the questionnaire were informed by the EatWalk survey,⁵ the Creature-101 questionnaire,⁵⁰ the Beverage and Snack Questionnaire (BSQ)²⁵ and the School Physical Activity and Nutrition (SPAN) questionnaire.²⁷ Four questions on frequencies of sugar-sweetened beverages and 6 questions on frequencies of processed packaged snacks were adapted from the BSQ.²⁵ Two frequency questions about recreational screen time were adapted from the SPAN questionnaire.²⁷ Visual images and portion size questions were taken from the EatWalk survey and the Creature-101 questionnaire.^{5,50}

EBRBs in the FHC-Q included fruit and vegetables, sugar-sweetened beverages, processed packaged snacks, fast food, physical activity and recreational screen time behaviors. Eating behavior questions captured the frequency of food eaten per week and the portion size usually eaten at one time. Physical activity and recreational screen time related questions captured the frequency of activities performed per week and the duration usually taken each time doing the activity. The frequency questions were asked with the stem “In the past week, I ate...(or I did...)” and the portion size or duration questions were written with the stem “How much did you usually eat/drink at one time...” or “How long each time did I...” Each behavior scale consisted of 4-14 questions. Behavior scales and questions are presented in Table 3.

Psychosocial determinants were selected from the conceptual framework of the Food, Health & Choices intervention, which is based on social cognitive theory⁵¹ and self-determination theory.¹⁵ Motivational and self-regulation factors from these theories are significant mediating variables for behavioral changes in youth and adults.^{10,52} Specific questions were derived from previous studies^{5,50} and pilot tests. The psychosocial determinants that were emphasized and measured in FHC-Q were: outcome expectations, self-efficacy, and goal-setting skills from social cognitive theory and competence, and autonomous motivation from self-determination theory. Additionally, habit strength was measured based on evidence that it could potentially be a significant mediator^{46,53} or moderator⁴³ of EBRB changes in children. A knowledge question for each of the 6 EBRBs (i.e. how many ounces of sugar-sweetened beverages are recommended by experts as a daily limit for someone your age?) was also included to see whether or not students correctly remembered what they learned. To assess students' patterns of social desirability in answering questions, a 9-question social desirability scale was included. The scale was modified from the Children's Social Desirability (CSD) scale instrument.⁵⁴ Three questions assessed student demographics (i.e., age, gender, and ethnicity).

During the development and pilot phases, multiple *content validation* processes were established via reviews by graduate and doctoral level nutrition students and professors, including several registered dietitian nutritionists, and an expert in the field of instrument development and evaluation. Feedback was received multiple times through doctoral seminar sessions, regular research team meetings, or by conference calls. Several revisions were made through these processes. Two cognitive tests were performed to ensure students in fifth grade understood each type of question used. Main revisions were made on the order of questions and using age-appropriate language. As a result, questions with colorful images were inserted in-

between text-only questions, while maintaining consistencies of question categories (e.g. putting questions on outcome expectations together). The language in instructions and questions became more student-friendly and appropriate for upper elementary school children. In addition, several questions that were not related to target EBRBs and psychosocial determinants (e.g. questions asking about milk, breakfast, and water) were removed.

Audience Response System Procedures Development

The ARS technology was incorporated during the 2011-2012 school year after recognizing potential benefits of using it: 1) by having a research staff read each question out loud, students were more likely to follow the directions and all students had the same pace of answering the questions; 2) colorful pictures and visuals could be used on the slides without incurring high printing costs; and 3) student responses were entered automatically to the computer, which saved research staff time and effort from manually entering data into the computer. The FHC-Q was administered in classroom setting, using the EZ-VOTE Meridia® ARS software, which was an add-in tool within the PowerPoint® program. Pairs of trained research staff visited each participating class to administer the questionnaire. Instructions and questions were read aloud to each class of students by one research staff following a standardized protocol and prompted by a PowerPoint® slideshow (see Figure 2). The other research staff managed the computer to change the slide for each question and trouble-shoot when technical difficulties occurred with the software. Students used individual wireless clickers to enter their responses. The clicker responses were automatically captured by the ARS receiver and saved into a computer; thereafter, the data were exported to Excel® spreadsheets.

Data Collection

Three independent subsets of data were collected as described in Figure 1, and overall demographic characteristics of the participants are described in Table 1.

Validation Procedure. To answer the first research question, “Did a questionnaire measuring EBRBs and psychosocial determinants have valid constructs as intended?”, *relative validity* and *confirmatory factor analyses* were conducted. For the second research question, “Did the target population, upper elementary school children, understand the questions?”, *face validity* was conducted with a group of children. Procedures for each data collection are described below. *Relative validity* was established with previously validated food and activity behavior measurement instruments (reference questionnaires) that captured the same behaviors of the questions. In particular, Beverage and Snack Questionnaire (BSQ),²⁵ was used for sugar-sweetened beverages, processed packaged snacks, and fruit and vegetables, the Physical Activity Questionnaire-C (PAQ-C)⁵⁵ was used for physical activity, and the School Physical Activity and Nutrition Questionnaire (SPAN)²⁷ was used for recreational screen time questions. There were 2-8 questions in each behavior scale in the FHC-Q, and 2-10 questions in the reference questionnaires. Because all reference questions only included frequencies of the behaviors, scales of the frequency questions from the FHC-Q were used. Detailed information on the number of questions and examples are listed in Table 2. Subset 1 students (Figure 1) from 4 classes completed the FHC-Q first and reference questionnaires, two weeks later. The FHC-Q took place over two 45-minute class periods and the reference questionnaires were administered in one class period.

Face validity was conducted with semi-structured group interviews. The interviewers asked if children understood each behavioral question correctly as described and how they processed their thoughts when answering the questions. Nine 4th grade students (5 girls, 4 boys)

were randomly selected from the Subset 2, and pulled out from the class after they completed the survey on the second (retest) day. These students were from the classes where students took the ARS FHC-Q first and then took the paper-and-pencil version two weeks later. The research staff presented the questionnaire to the students and asked them to look at the questions by section (e.g. Was it clear that these questions about the portion size ask you how much you ate at one time, meaning not for the entire day, but each time you ate these foods? How did you figure out the size of fruit for the question?). Then, the staff asked students how they answered each question and how they figured out the answer choice (e.g. “How did you figure out the answer choice when you read the question [number]”). The research staff were trained to let the students freely talk about how they answered the questions, and give all participants opportunities to respond, without additional prompts or leading the answers. Qualitative field notes taken during the interviews were collected and compiled as data.

Confirmatory factor analysis was performed to evaluate psychometric structures of the FHC-Q, using data from all participants who completed ARS FHC-Q.

Reliability Procedure. To answer questions “Did students answer the questions similarly between paper-and-pencil format and ARS?”, “Did students answer ARS FHC-Q questions consistently over time?”, and “Did the scales consisted of multiple questions generate consistent results within the scales?”, test-retest reliability and internal consistency reliability tests were performed. Subset 2 (n=98) students participated in *ARS vs. paper-and-pencil FHC-Q test-retest reliability*, which was to determine whether or not changing the format of the survey from paper-and-pencil to ARS affected how students answered the questions. Half of Subset 2 took the ARS version first and the paper-and-pencil version two weeks later, and the other half of students took the paper-and-pencil version first and the ARS version two weeks later. Paper-and-pencil FHC-Q

was administered in two 45-minute class periods. Research staff read instructions aloud at the beginning of the questionnaire, reviewing items and response formats in the different sections of the questionnaire, and remained present in class to assist students as needed while completing the questionnaire. Teachers also helped with classroom management during the survey.

Administration procedure for ARS FHC-Q is described in the previous sections. Subset 3 (n=93) participated in *ARS vs. ARS test-retest reliability* completing the same ARS FHC-Q twice, two weeks apart. Data from all participants who completed ARS FHC-Q were used to evaluate internal consistency reliability of each scale.

Data Analysis

To test relative validity between FHC-Q and reference questions, Pearson correlation coefficients were used for scale data of each behavior. Acceptable correlation coefficient was 0.4. Content analysis was used for qualitative field notes data from cognitive interviews.⁵⁶ Each line was analyzed, using Dedoose® qualitative data analysis online software version 6.2.10 (SocioCultural Research Consultants, LLC., Los Angeles, CA), and common themes derived from the data were summarized.

For confirmatory factor analysis, constructs from the theoretical conceptual framework were used as a structure of the analysis model. In total, 6 behavioral and 17 psychosocial determinants factors were included in the model and tested separately for behaviors and for mediating variables using Mplus version 7.11 (Muthén & Muthén., Los Angeles, CA) Structural Equation Modeling program. Because all response options were Likert-type generating ordinal data, the data were treated as categorical in Mplus and latent class factor analyses were performed. Weighted least squares means and variance adjusted (WLSMV) was used for estimation. Multiple indices including Root Mean Square Error of Approximation (RMSEA), the

comparative fit index (CFI), the Tucker-Lewis Index (TLI), and Chi-Square test were used to evaluate the model fit. The Chi-Square statistic is too sensitive to sample size, so other fit indices are commonly used for judging model fit. $RMSEA \leq 0.06$, $CFI > 0.90$, and $TLI > 0.90$ were used as cut-offs for acceptable fit.⁵⁷

To assess test-retest reliability, intraclass correlation coefficients (ICCs) were calculated for continuous data using a two-way random effects model, type consistency, and single measure.⁵⁸ Correlation coefficients were classified as “excellent” (≥ 0.81), “good” (0.61-0.80), “moderate” (0.41-0.60) or “poor” (≤ 0.40).^{20,34} Acceptable correlation coefficient was set as 0.4 or higher.⁵⁹ Individual questions for habit strength and behavioral intention were evaluated with Spearman’s rank correlations. Dichotomous data for knowledge questions were evaluated with percent agreements. Cutoffs for percent agreement were “excellent” (90-100%), “good” (75-89%), “moderate” (60-74%), or “poor” ($< 60\%$).^{20,34}

For all scales, internal consistency reliability analyses were performed using Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM SPSS, inc., Chicago, IL). A Cronbach’s alpha coefficient greater than 0.7 indicates adequate reliability.⁶⁰

RESULTS

Validity

Relative validity. Correlation coefficients of behavior between the FHC-Q and reference questionnaires were all significant. Scale correlations were 0.38 for fruits and vegetables and 0.55 to 0.61 for the other behaviors, and correlations for individual questions ranged from 0.22 to 0.72. Detailed results are presented in Table 2.

Face validity. Several themes emerged from the field notes on students' cognitive testing: "Recall", "Understanding", "Accurate report", "Preference", and "Types of food eaten". There were 3 sub-themes under "Recall": "Approximation", "Exact recall", and "Habits", and 4 sub-themes under "Understanding": "Understood", "Did not understand", "Used pictures", and "Guessed". Students "Understood" most of the behavioral questions in the FHC-Q. How they figured out the answers was mostly by "Recall" of what they ate or did for physical activity in general, or in the recent past (e.g. in the past week as indicated in the questions). Light physical activity was the only problematic behavior question that some of the participants stated they "Did not understand". For example, one of the notes reported that "one student said that he did not understand what 'up and moving' meant on the light activity question, so he guessed the answer." Another staff reported that students counted talking as a light activity because "my mouth moves so I counted talking as light activity", which was coded as "Did not understand" the question. Examples and pictures were thus added to clarify the meaning of questions. Some students reported that they answered the questions based on their "Exact recall", and about half the students reported that they used "Approximation".

Confirmatory factor analysis. The latent class factor analysis fit indices for behaviors were RMSEA = 0.049 (Confidence Interval: 0.043, 0.055), CFI = 0.918, and TLI = 0.912, indicating a good model fit. For psychosocial determinants variables, questions related to amotivation and controlled motivation were found to be problematic, having low factor loading scores and negative residual error values, so those questions were eliminated from the model. The fit indices for the final latent class analysis for psychosocial determinants were following: RMSEA = 0.044 (Confidence Interval: 0.041, 0.048), CFI = 0.911, and TLI = 0.906, indicating a good model fit. The final structure of the behavioral and psychosocial determinants variables are

presented in Table 3 & 4. A total of 45 behavior questions and 71 psychosocial determinant questions were included, and all reliability tests were based on this final structure.

Reliability

ARS vs. paper-and-pencil test-retest reliability. ICCs ranged from 0.75 to 0.87 for behaviors ($p < 0.001$) and 0.39-0.85 for psychosocial determinants ($p < 0.05$ to $p < 0.001$; Table 5). The overall ICC for the self-determination scale was 0.56. Among the sub-scales, autonomous motivation had the lowest ICC (0.39, $p = 0.013$), indicating a poor correlation between ARS vs. paper-and-pencil versions of FHC-Q. Overall psychosocial determinants scales had ICCs ranges from 0.36 to 0.85 ($p < 0.001$), indicating poor to excellent correlations between two versions. Generally, overall scales were more stable over time, compared to the sub-scale scores (e.g. overall outcome expectation vs. outcome expectation for fruit and vegetables). Correlation results showed that habit strength and behavioral intention questions per each behavior category had poor to moderate reliability between ARS and paper-and-pencil versions of FHC-Q. Overall scores for these two variables were also more stable over time, compared to the results from each individual question. Percent agreements on the knowledge questions ranged from 75.3% to 78.6%, indicating good agreement between the two methods.

ARS vs. ARS test-retest reliability. Intraclass correlations assessing test-retest reliability for behavior scales ranged from 0.59 to 0.81, indicating moderate to excellent reliability. ICCs for continuous psychosocial determinant scales ranged from 0.51 to 0.68, indicating moderate to good reliability. Sub-scales and individual item reliability scores for habit strength and behavioral intention ranged from 0.24 to 0.81, indicating poor to excellent reliability (Table 5). For knowledge questions, percent agreement data showed moderate to good agreements (69.8% to 84.8%) between the two ARS survey administrations.

Internal consistency reliability. Cronbach's alphas ranged from 0.77-0.92 for behavior scales (Table 5), indicating good internal consistency. For psychosocial determinants, Cronbach's alpha were 0.87 for self-determination, 0.82 for outcome expectation, 0.90 for self-efficacy, 0.79 for habit strength, and 0.74 for behavioral intention scales, also indicating good internal consistency. For psychosocial determinants sub-scales, Cronbach's alphas ranged from 0.44-0.83. Finally, Cronbach's alpha for the social desirability scale was 0.68.

DISCUSSION

The current study examined the validity and reliability of the Food, Health & Choices Questionnaire in measuring a range of commonly practiced EBRBs involving both diet and physical activity and their associated psychosocial determinants. To our knowledge, this is the first study to examine the use of Audience Resource System technology to collect data on EBRBs and related determinants and compare it to the traditional paper-and-pencil format.

In terms of *behaviors, validity analyses* showed that all the behavioral scales were significantly correlated with the reference instruments, with the validity for four of the five behavioral scales considered as "moderate" to "good," and one considered as "poor."⁵⁹ Results of this scale should be interpreted with caution. Several individual items within the scales showed lower validity, suggesting use of the scales provides better validity.

In comparing with the other instruments for this population, the validity coefficients ($r=0.4-0.6$ for food groups) were slightly lower than a questionnaire for this age group that was compared with the criterion of 4-day food records, which resulted in correlations for food groups that were almost all in the good range ($r=0.6-0.8$).²⁵ However, the validity coefficients were higher than a questionnaire comparing foods to 7-day records ($r=0.3-0.4$)²⁸ and similar to one

comparing behaviors to 1-day food interviews (most were between $r=0.3$ and 0.7).²⁰ Confirmatory factor analyses showed good model fit indices for psychometric structures of the behavior questions. The internal consistency of the scales (Cronbach alphas) ranged from good to excellent. In addition, the correlations between the use of the paper-and-pencil and ARS formats were also good to excellent, as were the stability of the use of ARS. These results suggest the FHC- Q is a valid and reliable instrument for assessing EBRBs that can be administered using either ARS technology or the paper-and-pencil format.

In terms of *theory-based psychosocial determinants*, *validity* was examined with confirmatory factor analyses, which showed good model fit indices for the psychometric structures. Measures of *reliability* (Cronbach alphas) were significant for all the psychosocial determinants, where both scales and subscales had good to excellent internal consistency (alpha =0.7-0.9 and 0.6 to 0.8, respectively). These findings are higher than other questionnaires designed to measure psychosocial determinants for EBRBs in similar populations where reliability coefficients of 0.5-0.6 were found for attitudes and 0.2-0.4 for knowledge in one case;²⁸ and 0.5-0.7 for psychosocial variables in another, focused on outcome expectations and social norms in relation to soft drinks, fruit juice and breakfast, active transport to school, and TV viewing.²⁰ For a 102-item instrument designed to measure 15 personal, social and environmental correlates of fruit and vegetable intake only Cronbach alphas ranged from 0.5 to 0.9 for the 15 constructs measured and test-retest intraclass correlation coefficients were mostly in the good range ($r=0.6-0.8$).³¹ Thus FHC-Q has similar psychometric properties to other questionnaires, but has the advantage of asking a full range of commonly practiced EBRBs and their associated psychosocial determinants.

In comparing the use of ARS technology and the paper-and-pencil format to collect data, results showed reliability coefficients that were excellent for outcome expectations, moderate for the self-determination, self-efficacy and behavioral intention scales, and poor for habit strength. For the subscales of the psychosocial determinants for each of the individual behaviors, there was a wider range of reliability coefficients: those for outcome expectations were mostly good and those for self-efficacy and self-determination were moderate. Those for habit strength and behavioral intention were in the poor to moderate range. This was probably due to the fact that each of these subscales had only one question. Percent agreement on knowledge questions was mostly in the good range (75%-89%). Similar results were found for the stability of the ARS administrations over time. The psychosocial scales in the FHC- Q hang together psychometrically, thus the questionnaire has good to excellent internal consistency and moderate test-re-test reliability whether it was administered using ARS technology or in the paper-and-pencil format.

There were several limitations to the current study. The FHC-Q depended on students' self-reports, and the reference measures for the relative validity for the FHC-Q behavioral questions were also based on self-report frequency questionnaires, which probably had their own measurement errors. The FHC-Q was intended to evaluate the effectiveness of an intervention targeting specific EBRBs and psychosocial determinants related to two theories commonly used for interventions: social cognitive theory and self-determination theory. It is not intended to measure total calories or nutrients, or exact frequencies or servings/durations of diet and physical activity behaviors. Therefore, scores from the FHC-Q cannot be converted to exact amounts of food or minutes of physical activity. The use of 12 classes in one geographical location consisting mostly of African-American and Hispanic students could limit its application to other

ethnicities and geographic areas. However, the validity of an instrument used in this population fills a needed gap. Most of the other instruments^{20,28,31} did not focus on these large minority populations, with one exception that measured only fruit and vegetable intake and physical activity.²⁹ The foods captured in the FHC-Q were commonly and widely eaten by youth in the US, and do not differ materially by race/ethnicity or poverty level.^{48,49} Thus the instrument is useful more generally. Lastly, in the validation process, the length of testing session was different between the FHC-Q and the reference questions (two vs. one 45-minute sessions). It has to be noted that this may have influenced students' responses.

The current study has also many strengths. Even though there are few previously validated questionnaires measuring several EBRBs and psychosocial determinants at the same time,^{20,28} the FHC-Q assessed a wider range of behaviors important to energy balance and at the same time attempted to be efficient in the number of questions asked. The current study incorporated multiple methods to ensure validity and reliability of a questionnaire intended to evaluate behavioral and psychosocial determinants changes in a school-based childhood obesity prevention trial and that can be administered using technology or paper-and-pencil formats.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The FHC-Q is a promising tool for measurement of EBRBs and associated theory-based psychosocial determinants in upper elementary school children. The FHC-Q generated more reliable data when outcomes were used as scales instead of individual questions. It is crucial to have a simple, but valid and reliable data collection method when evaluating a large-size randomized controlled trial. Administration via ARS has been shown to be as reliable a method of data collection as a paper-and-pencil format. This study warrants the possible use of ARS or

387 similar technology for application to other dietary and physical activity questionnaires in
 388 research studies.

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FIGURES

FIGURE1. Data collection of the validation and reliability tests for the Food, Health & Choices Questionnaire (FHC-Q)

- ARS stands for audience response system.
- PP stands for paper-and-pencil.
- Reference questions are from the Beverage and Snack Questionnaire,¹⁵ Physical Activity Questionnaire-C,⁴⁶ and the School Physical Activity and Nutrition Questionnaire.¹⁷

My Food and Activity Assessment

Please think about what you ate and drank **during the past week** as you complete this survey. Some questions ask you about how often or how much you ate certain foods. Other questions ask how often or how long you did some physical activities. There are also some questions that ask for your opinions about foods and activities.

Example:

In the past week, I ate...	0 times	About 1-2 times	About 3-4 times	Almost every day	2 or more times every day
Pizza	☐	☐	☒	☐	☐

For each question, mark **how many times** you had this kind of food in the past week.

In the past week, I ate...	0 times	About 1-2 times	About 3-4 times	Almost every day	2 or more times every day
1. Apples	☐	☐	☐	☐	☐
2. Grapes	☐	☐	☐	☐	☐
3. Oranges	☐	☐	☐	☐	☐
4. Bananas	☐	☐	☐	☐	☐

The response options will be at the bottom of the screen. For each question, choose the best response for you.

For this response, press:

1A

For this response, press:

2B

For this response, press:

3C

For this response, press:

4D

For this response, press:

5E

In the past week I ate...

1. apples

0 times

About 1-2 times

About 3-4 times

Almost everyday

2 or more times every day

1A

2B

3C

4D

5E

In the past week I drank...

1. fruit drinks & sweetened iced teas

0 times

About 1-2 times

About 3-4 times

Almost everyday

2 or more times every day

1A

2B

3C

4D

5E

When I think about myself...

37. eating **fast food** is part of my daily routine

Not at all true for me

Not true for me

Neither true or not true

Somewhat true for me

Very true for me

1A

2B

3C

4D

5E

I am sure I can...

48. eat fruits and vegetables for **snacks**

Not at all sure

A little sure

Neither sure or not sure

Sure

Very sure

1A

2B

3C

4D

5E

How much did you usually eat at one time?

42. baked goods (such as cookies, brownies, pies, or cakes)

I didn't eat this

Less than small

small

medium

large

more than large

1A

2B

3C

4D

5E

6F

According to experts...

64. how many cups of fruit and vegetables should someone your age eat each day? (one cup is about the size of your fist)

About 1 cup

About 2 cups

About 3 cups

About 4 cups

About 5 cups

1A

2B

3C

4D

5E

I would like to...

19. do more physical activity

Not at all true for me

Not true for me

Neither true or not true

Somewhat true for me

Very true for me

1A

2B

3C

4D

5E

In the past week, what size did you usually drink or eat?

30. Fruit drinks, sweetened iced teas, or sodas (such as Capri Sun, Snapple, Coke or Sprite)

I didn't drink this

Less than 8 oz

8oz

12 oz

20 oz

More than 20 oz

31. Sports drinks or flavored waters (such as Gatorade, PowerAde, or Vitaminwater)

I didn't drink this

Less than small

Small 8 oz

Medium 12 oz

Large 20 oz

More than large

32. Chips and other salty snacks (such as Ruffles, Lay's, Cheese nips, Chex mix, or pretzels)

I didn't eat this

Less than small

Small 12 chips

Medium 25 chips

Large 40 chips

More than large

Figure 2. Example questions of the Food, Health & Choices questionnaire for urban upper elementary school children. Two images on the left side are examples from the paper-and-pencil version, and 8 images on the right side are from the audience response system (ARS) version.

TABLES

Table 1. Demographic characteristics of students who participated in Food, Health & Choices questionnaire validity and reliability testing.

Variables		Counts (%)			
School-level demographics (n=2)		Total	School 1		School 2
% Student eligible for free and reduced price lunch		97.65%	100%		95.3%
Race / Ethnicity	% Black	26.80%	25.4%		28.2%
	% Hispanic	69.10%	68.7%		69.5
Mean English Language Arts proficiency score ^a		2.48	2.51		2.44
Mean math test proficiency score ^a		2.61	2.57		2.65
Student-level demographics (n=221)		Total	Subset 1 n=66	Subset 2 n=82	Subset 3 n=73
Age	9 years or younger	88 (39.8%)	23 (34.8%)	53 (64.6%)	12 (16.7%)
	10 years	107 (48.4%)	36 (54.5%)	26 (31.7%)	45 (62.5%)
	11 years	16 (7.2%)	5 (7.6%)	3 (3.7%)	8 (11.1%)
	12 years or older	9 (4.1%)	2 (3.0%)	-	7 (9.7%)
Gender	% boys	112 (50.7%)	33 (50%)	40 (48.8%)	39 (54.9%)

a. proficiency score ranges from 1 to 4.5: the first digit corresponds to the student’s performance level (1 being well below proficient – 4 being above proficient) and the following digits indicate how close the student is to another proficiency level.

Table 2. Relative validity results of behavioral outcomes between Food, Health & Choices Questionnaire (FHC-Q) and reference instruments.

Behavior	FHC-Q questions	# Q	Range	Mean (SD)	Examples of reference questions	# Q	Range	Mean (SD)	r	p-value
Fruits and vegetables	In the past week, I ate... apples (grapes, oranges, bananas, broccoli, carrots, dark green leafy vegetables, or tomatoes)	8	1-5 ^a	2.21(0.88)	How often did you eat a serving of fruit such as a banana, apple or grapes? (do not count juices)/ a serving of vegetables such as green salad, peas, green beans or corn? (do not count fried potatoes or French fries) ^f	2	1-7 ^c	3.12 (1.48)	0.38	0.002**
Sugar-sweetened beverages	In the past week I drank...	4	1-5^a	2.77 (1.07)	How often did you drink these beverages in the past week? ^f	4	1-7^c	2.19 (1.10)	0.55	<0.001***
	Fruit drinks and sweetened iced teas (Snapple, Hawaiian punch, Capri Sun, SunnyD, Brisk, Arizona iced teas)	1	1-5 ^a	3.49 (1.43)	Fruit drinks (such as Snapple, flavored teas, Capri Sun and Kool-Aid)	1	1-7 ^c	2.68 (1.52)	0.31	0.014*
	Sodas (Coke, Pepsi, Mt.Dew, Dr.Pepper, Sunkist, Sprite)	1	1-5 ^a	2.58 (1.55)	Regular soda or pop (including all kinds such as Coke, Pepsi, 7-Up, Sprite, root beer)	1	1-7 ^c	2.09 (1.50)	0.56	0.001**
	Sports drinks (Gatorade and PowerAde)	1	1-5 ^a	2.88 (1.65)	Sport drinks (such as Gatorade or PowerAde); these drinks usually do not have caffeine	1	1-7 ^c	2.21 (1.60)	0.72	0.001**
	Flavored water (vitamin water)	1	1-5 ^a	2.11 (1.51)	Flavored waters such as Propel or vitamin waters; these drinks usually do not have caffeine	1	1-7 ^c	1.81 (1.38)	0.26	0.04*
Processed packaged snacks	In the past week I ate...	6	1-5^a	2.78 (1.26)	How often did you eat these snacks in the past week? ^f	8	1-7^c	2.38 (1.16)	0.61	<0.001***
	Potato chips, tortilla chips, corn chips and puffs	1	1-5 ^a	3.07 (1.60)	Low-fat or non-fat potato chips, tortilla chips and corn chips Regular potato chips, tortilla chips, corn chips, and puffs	2	1-7 ^c	2.78 (1.83)	0.53	<0.001***
	Other salty snacks (such as Cheese Nips, Chex Mix, or pretzels)	1	1-5 ^a	2.11 (1.39)	Other salty snacks (like Cheese Nibs, Chex Mix, gold fish crackers, or Ritz Bitz)	1	1-7 ^c	1.91(1.46)	0.22	0.091
	Candy (Reese's, Hershey's, Snickers, Twix, lollipops...etc.)	1	1-5 ^a	3.09 (1.64)	Candy, including chocolate, candy bars, jelly bellies, gummies and Lifesavers (do not include cookies)	1	1-7 ^c	2.70 (1.70)	0.56	<0.001***
	Donuts and pastries	1	1-5 ^a	2.51 (1.59)	Donuts, pop tarts or other breakfast pastries	1	1-7 ^c	2.18 (1.50)	0.30	0.018*
	Cookies, brownies, pies, or cakes	1	1-5 ^a	2.53 (1.51)	Cookies, brownies, pies and cakes	1	1-7 ^c	2.37 (1.58)	0.50	<0.001***
	Ice cream, milkshakes, or popsicles	1	1-5 ^a	3.28 (1.54)	Low or nonfat frozen desserts such as low fat ice cream, frozen yogurt, popsicles and sherbet Regular ice cream and milkshakes (include all flavors)	2	1-7 ^c	2.30 (1.26)	0.40	0.001**
Physical activity	In the past week, I did things that...	2	1-5^a	3.54 (1.19)	Have you done any of the following activities in the past 7 days (last week)? ^g	10	1-5^d	2.63 (0.87)	0.52	<0.001***
	Medium activity: made my heart beat a little faster (dancing, tag, baseball, fencing)	1	1-5 ^a	3.67 (1.31)	Dance, tag, bicycling, jogging or running, aerobics, baseball/softball, football, badminton, soccer, basketball	4	1-5 ^d	2.28 (0.94)	0.42	0.001**
	Heavy activity: got my heart	1	1-5 ^a	3.42 (1.37)	dance, tag, bicycling, jogging or running,	6	1-5 ^d	2.76 (0.91)	0.46	<0.001***

	beating really fast (soccer, basketball, running, and playing tennis)	aerobics, baseball/softball, football, badminton, soccer, basketball	
Recreation al screen time	In the past week, 4 1-5^a 2.92 (1.62)	Yesterday, how many hours did you...^h 3 0-6^e 2.29 (1.50)	0.60 <0.001***
	I sat and watched TV 1 1-5 ^a 3.91 (1.17)		0.32 0.009**
	How long each time did I sit and watch TV 1 1-5 ^b 3.35 (1.63)	Watch TV or video movies away from school? 1 0-6 ^e 2.51 (1.93)	0.47 0.001**
	I sat and played video or computer games (do not count Wii Fit or other fitness games) 1 1-5 ^a 3.00 (1.58)		0.35 0.006**
	How long each time did I sit and play video or computer games (do not count Wii Fit or other fitness games) 1 1-5 ^b 2.96 (1.72)	Usually spend on the computer away from school? or playing video games? 2 0-6 ^e 2.18 (1.67)	0.57 0.001**

a. 0 times; about 1-2 times; about 3-4 times; almost every day; 2 or more times every day

b. Less than half an hour-more than 3 hours

c. Never or less than 1 per week to 4+ per day

d. No; 1-2; 3-4; 5-6; 7 times or more

e. I didn't do it; 1 hour; 2 hours; 3 hours; 4 hours; 5 hours; 6 hours

f. The Beverage and Snack Questionnaire (BSQ)¹⁵

g. Physical Activity Questionnaire-C (PAQ-C)⁴⁶

h. The School Physical Activity and Nutrition (SPAN)¹⁷

SD represents standard deviation

*p < 0.05, **p < 0.01, ***p < 0.001

Table 3. Energy balance related behavior questions in the final Food, Health & Choices questionnaire

Scale	Questions		# of Qs	Total #
Fruit and vegetables	Fruit frequency	In the past week, I ate apples	6	14
		In the past week, I ate grapes		
		In the past week, I ate oranges		
		In the past week, I ate bananas		
		In the past week, I ate fruits at breakfast		
		In the past week, I ate fruits at lunch		
	Vegetables frequency	In the past week, I ate broccoli	6	
		In the past week, I ate carrots		
		In the past week, I ate dark green leafy vegetables		
		In the past week, I ate tomatoes		
In the past week, I ate vegetables at lunch (DO NOT count fried potatoes or French fries)				
In the past week, I ate vegetables at dinner (DO NOT count fried potatoes or French fries)				
Fruit portion size	How much did you usually eat at one time fruits (such as apples, grapes, oranges, or bananas)?	2		
Vegetables portion size	How much did you usually eat at one time vegetables (such as green salad, broccoli, carrots, and tomatoes DO NOT count fried potatoes or French fries)			
Sugar-sweetened beverages	Frequency	In the past week, I drank fruit drinks & sweetened iced teas	4	6
		In the past week, I drank sodas		
		In the past week, I drank sports drinks		
		In the past week, I drank flavored water		
	Portion size	How much did you usually drink at one time sodas, fruit drinks or iced teas?	2	
How much did you usually drink at one time sports drinks or flavored waters?				
Processed packaged snacks	Frequency	In the past week, I ate potato chips, tortilla chips, corn chips and puffs	6	10
		In the past week, I ate other salty snacks (such as Cheese Nips, Chex Mix, or pretzels)		
		In the past week, I ate candy		
		In the past week, I ate donuts and pastries		
		In the past week, I ate cookies, brownies, pies, or cakes		
		In the past week, I ate ice cream, milkshakes, or popsicles		
	Portion size	How much did you usually eat at one time chips and other salty snacks (such as Ruffles, Cheese Nips, Chex Mix, or pretzels)?	4	
		How much did you usually eat at one time candy (such as lollipops, gummies, or chocolate bars)?		
		How much did you usually eat at one time baked goods (such as cookies, brownies, pies, or cakes)?		
		How much did you usually eat at one time ice cream (such as ice cream sandwiches, popsicles, or sundaes)?		
Fast food	Frequency	In the past week, I ate fast food	2	5
		At fast food restaurants I had combo meals (such as a burger with fries and drink)		
	Size	What size did you usually have fast food burgers or sandwiches?	3	
		What size did you usually have French fries?		
		What size did you usually have fountain soda?		
Physical activity	Frequency	In the past week, I did things that got me up and moving	3	6
		In the past week, I did things that made my heart beat a little faster		
		In the past week, I did things that got my heart beating really fast		
	Duration	How long each time did I do things that got me up and moving	3	
		How long each time did I do things that made my heart beat a little faster		
		How long each time did I do things that got my heart beating really fast		
Recreational screen time	Frequency	In the past week, I sat and watched TV	2	4
		In the past week, I sat and played video or computer games (DO NOT count Wii Fit or other fitness games)		
	Duration	How long each time did I sit and watch TV	2	
		How long each time did I sit and play video or computer games (DO NOT count Wii Fit or other fitness games)		
Total				45

Table 4. Psychosocial determinants questions in the final Food, Health & Choices questionnaire

Scale	Construct	Questions	# of Qs	Total
Self-determination	Goral setting skills	I believe that I can set a goal for healthy eating	3	9
		I believe that when I have a goal I can follow through with it pretty well		
		I believe that I know how to keep track of my food intake		
	Competence	When I think about myself I feel confident in my ability to eat healthy regularly	3	
		When I think about myself I am capable of eating healthy regularly		
		When I think about myself I can keep eating healthy over the long-term		
Autonomous motivation	The reason I would eat healthy foods is because it fits in with what I want to do with my life	3		
	The reason I would eat healthy foods is because I personally believe it is the best thing for my health			
	The reason I would eat healthy foods is because it is an important choice I really want to make			
Outcome expectations	Fruit and vegetables	Eating fruits and vegetables helps me do well at school	3	15
		Eating fruits and vegetables helps my body do what I want it to do		
		Eating fruits and vegetables makes me feel good about myself		
	Sugar-sweetened beverages	Drinking lots of sweetened beverages helps me do well at school	3	
		Drinking lots of sweetened beverages helps me stay in energy balance		
		Drinking lots of sweetened beverages makes me feel good about myself		
	Processed packaged snacks	Eating lots of packaged snacks helps me do well at school	3	
		Eating lots of packaged snacks helps me stay in energy balance		
		Eating lots of packaged snacks makes me feel good about myself		
	Physical activity	Being physically active helps me do well at school	3	
		Being physically active helps me stay in energy balance		
		Being physically active makes me feel good about myself		
	Recreational screen time	Sitting and watching TV or playing video games helps me do well at school	3	
		Sitting and watching TV or playing video games helps me stay in energy balance		
		Sitting and watching TV or playing video games makes me feel good about myself		
Self-efficacy	Fruit and vegetables	I am sure I can eat fruits at breakfast	5	20
		I am sure I can eat fruits at school lunch		
		I am sure I can eat vegetables at school lunch		
		I am sure I can eat vegetables at dinner		
		I am sure I can eat fruits and vegetables for snacks		
	Sugar-sweetened beverages	I am sure I can drink fewer sweetened beverages after school	3	
		I am sure I can bring fewer sweetened beverages to school		
	Processed packaged snacks	I am sure I can drink smaller sizes of sweetened beverages	3	
		I am sure I can eat fewer packaged snacks at home		
		I am sure I can bring fewer packaged snacks to school		
	Fast food	I am sure I can eat fewer packaged snacks when I'm with my friends	3	
		At fast food restaurants, I am sure I can eat only a small size of hamburger or French fries		
		At fast food restaurants, I am sure I can eat healthier options		
	Physical activity	At fast food restaurants, I am sure I can eat combo meals less often	3	
		I am sure I can participate in sports or other exercise at school		
		I am sure I can walk to get exercise		
	Recreational screen time	I am sure I can walk or bike to school instead of taking a car, bus, or subway	3	
		I am sure I can watch TV no more than 1 hour per day		
I am sure I can play video games no more than 1 hour a day				
Habit strength	Fruit and vegetables	Eating fruits and vegetables is part of my daily routine	1	6
	Sugar-sweetened beverages	When I think about myself drinking sweetened beverages is part of my daily routine	1	
	Processed packaged snacks	When I think about myself eating packaged snacks is part of my daily routine	1	
	Fast food	When I think about myself eating fast food is part of my daily routine	1	
	Physical activity	When I think about myself exercise is part of my daily routine	1	
	Recreational screen time	When I think about myself watching TV or playing video games is part of my daily routine	1	
Goal intention	Fruit and vegetables	I would like to eat more fruits and vegetables	1	6
	Sugar-sweetened beverages	I would like to drink fewer sweetened beverages	1	
	Processed packaged snacks	I would like to eat fewer packaged snacks	1	
	Fast food	I would like to eat fewer fast foods	1	
	Physical activity	I would like to do more physical activity	1	
	Recreational screen time	I would like to spend less time on computer games or watching TV	1	
Knowledge	Fruit and vegetables	According to experts how many cups of fruit and vegetables should someone your age eat each day?	1	6
	Sugar-sweetened beverages	According to experts how many ounces of sweetened beverages is the daily limit for someone your age?	1	
	Processed packaged snacks	According to experts what size of packaged snacks is the daily limit for someone your age?	1	
	Fast food	According to experts which size French fries should someone your age order?	1	
	Physical activity	According to experts how long should someone your age do physical activity each day?	1	
	Recreational screen time	According to experts what is the daily limit for watching TV or playing video games for someone your age?	1	
Social desirability		I always wash my hands before every meal. [Yes=1, No=0]	1	9
		I always brush my teeth after each meal. [Yes=1, No=0]	1	
		I am always polite, even to people who are not very nice. [Yes=1, No=0]	1	
		I sometimes do things I have been told not to do. [Yes=0, No=1]	1	
		I always listen to my parents. [Yes=1, No=0]	1	
		I sometimes wish I could just play around instead of having to go to school. [Yes=0, No=1]	1	
		I always do the right things. [Yes=1, No=0]	1	
		I sometimes feel angry when I don't get my way. [Yes=0, No=1]	1	
		I sometimes feel like making fun of other people. [Yes=0, No=1]	1	
Total				71

Table 5. Test-retest and internal consistency reliability test results of the Food, Health & Choices questionnaire

Scale / subscale		# of Qs	Cronbach's alpha	ARS vs PP		ARS vs ARS	
				ICC	p-value	ICC	p-value
Behaviors	Fruit and vegetables	14	0.85	0.81	<0.001***	0.71	<0.001***
	Sugar-sweetened beverages	6	0.77	0.86	<0.001***	0.77	<0.001***
	Processed packaged snacks	10	0.92	0.87	<0.001***	0.79	<0.001***
	Fast food	5	0.84	0.75	<0.001***	0.81	<0.001***
	Physical activity	6	0.84	0.73	<0.001***	0.66	<0.001***
	Recreational screen time	4	0.78	0.84	<0.001***	0.59	<0.001***
Psychosocial Mediators	Self-determination	9	0.87	0.56	<0.001***	0.60	<0.001***
	Goal setting skills	3	0.60	0.44	0.005**	0.55	0.001**
	Competence	3	0.83	0.49	0.001**	0.63	<0.001***
	Autonomous motivation	3	0.73	0.39	0.013*	0.56	<0.001***
	Outcome expectations	15	0.82	0.85	<0.001***	0.68	<0.001***
	Fruit and vegetables	3	0.68	0.71	<0.001***	0.55	0.001**
	Sugar-sweetened beverages	3	0.74	0.69	<0.001***	0.62	<0.001***
	Processed packaged snacks	3	0.69	0.65	<0.001***	0.81	<0.001***
	Physical activity	3	0.66	0.70	<0.001***	0.77	<0.001***
	Recreational screen time	3	0.82	0.71	<0.001***	0.61	<0.001***
	Self-efficacy	20	0.90	0.59	<0.001***	0.67	<0.001***
	Fruit and vegetables	5	0.71	0.57	<0.001***	0.57	<0.001***
	Sugar-sweetened beverages	3	0.71	0.44	0.01*	0.56	0.001*
	Processed packaged snacks	3	0.81	0.58	<0.001***	0.45	0.01*
	Fast food	3	0.81	0.67	<0.001***	0.56	0.001**
	Physical activity	3	0.44	0.56	<0.001***	0.41	0.016*
	Recreational screen time	3	0.72	0.74	<0.001***	0.66	<0.001***
	Habit strength	6	0.79	0.36	<0.001***	0.65	<0.001***
	Fruit and vegetables	1 ^s	NA	0.45	<0.001***	0.24	0.064
	Sugar-sweetened beverages	1 ^s	NA	0.31	0.007**	0.66	<0.001***
	Processed packaged snacks	1 ^s	NA	0.41	<0.001***	0.56	<0.001***
	Fast food	1 ^s	NA	0.35	0.002**	0.54	<0.001***
	Physical activity	1 ^s	NA	0.27	0.018*	0.28	0.025*
	Recreational screen time	1 ^s	NA	0.47	<0.001***	0.32	0.011*
	Goal intention	6	0.74	0.55	<0.001***	0.51	<0.001***
	Fruit and vegetables	1 ^s	NA	0.49	<0.001***	0.32	0.015*
	Sugar-sweetened beverages	1 ^s	NA	0.27	0.019*	0.50	<0.001***
	Processed packaged snacks	1 ^s	NA	0.35	0.002**	0.25	0.064
	Fast food	1 ^s	NA	0.37	0.001**	0.53	<0.001***
	Physical activity	1 ^s	NA	0.43	<0.001***	0.34	0.007**
	Recreational screen time	1 ^s	NA	0.40	<0.001***	0.35	0.004**
	Knowledge			% agreement		% agreement	
	Fruit and vegetables	1	NA	75.3		84.8	
	Sugar-sweetened beverages	1	NA	78.1		73.2	
	Processed packaged snacks	1	NA	77.6		69.8	
	Fast food	1	NA	75.0		81.4	
	Physical activity	1	NA	78.6		75.0	
	Recreational screen time	1	NA	74.3		74.5	
Social desirability		9	0.68	0.61	<0.001***	0.64	<0.001***

S = Spearman's r coefficients; ARS = audio response system; PP = paper and pencil questionnaire; ICC = intraclass correlation coefficients; *p < 0.05, **p < 0.01, ***p < 0.001