

“Validation of a 10-Item Questionnaire Measuring Fruit and Vegetable Consumption in 9-11 year old Children Living in Low Income Households”

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Purpose

The purpose of this study is to test the test-re-test-reliability, construct validity, and criterion-related validity of a 10-item fruit and vegetable questionnaire (10-item FVQ) in preadolescent children ages 9 to 11 years. For this pilot study, however, we are only examining criterion-related validity. The 24-hr dietary recall (24-HDR) was selected as the ‘gold standard’ reference tool. The 10-item FVQ has been validated for face and content validity by way of focus groups and expert panel review, respectively (Manganello, 2012). Validity in the context of nutritional assessment refers to “the ability of a dietary assessment tool to measure food consumption data that represents the true dietary intake of the individual”.^{1,2} A method is considered valid if reported dietary intake does not vary significantly from the actual dietary intake consumed.¹ To further validate the 10-item FVQ, construct and criterion-related validity, sensitivity, and test-re-test reliability must be confirmed.^{2,3,4,5} Validity will be expressed if 1) the construct measured (fruit and vegetable consumption) by the 10-item FVQ is significantly correlated with fruit and vegetable consumption reported on the 24-HDR gold standard of reference 2) if individual scores on the new test correspond to scores on the established 24-HDR 3) if the 10-item FVQ is able to detect change in behaviors related to the construct and 4) if the 10-item FVQ yields similar scores upon repeated administration. We hypothesize that upon assessment of construct and criterion-related validity, sensitivity, and test-re-test reliability, the 10-item FVQ will be a validated, easily administered substitute for measuring fruit and vegetable consumption in 9-11 year old children living in low-income households.

Background and Rationale

Many children do not meet the recommended daily requirements for fruit and vegetable (F&V) intake despite the established benefits⁶⁻¹¹; this is particularly true among low-income

populations.⁸ A study using the 1999-2002 National Health and Nutrition Examination Survey (NHANES) data reported only 16.2% of school-aged children (6-11 years old) met the USDA vegetable recommendations.⁸ Current data reports only 8% of children eat the recommended 1 ½ cups of fruit per day and a mere 6% are achieving the recommended 2 ½ cups of vegetables each day.⁹ Fruit and vegetable consumption is linked to a lowered risk of chronic diseases, including heart disease, hypertension, and several cancers, as well as a decreased risk of obesity,^{8, 10} with vegetable intake in particular being correlated with a child's health and weight status^{6,8}.

Childhood overweight (BMI 85th-<95th percentile of BMI-for-age growth charts) and obesity (BMI ≥95th percentile) affects more than 1 in 3 children ages 2 to 19 years of age and 27% of children 6-11 are considered obese.¹² With the rising rates of childhood obesity, there is also mounting evidence pointing to the long-term impact of childhood dietary habits on overall health. Healthy, whole-food dietary habits including fresh fruits and vegetables are indicated in the prevention of obesity and chronic disease.¹³ A key behavioral outcome of both the Dietary Guidelines 2010 and the Supplemental Nutrition Assistance Program Education (SNAP-Ed) is increasing fruit and vegetable intake.^{14,15} Fruits and vegetables are a good source of under-consumed nutrients such as folate, magnesium, potassium, dietary fiber, and Vitamins A, C, and K.¹⁵ Including more F&V in the diet can help people achieve and/or maintain a healthy weight, and the Dietary Guidelines 2010 advises eating a variety of vegetables, specifically dark green, red, and orange varieties.¹⁵ Concern over the long-term health impact of low F&V intake among children has generated a need for programs that encourage consumption and positive health behaviors. Targeting positive nutrition-related behaviors, such as increasing consumption of F&V, may promote healthy eating practices and mediate unhealthy gains in weight among children. Interventions focused on elementary school-age children impact behaviors before they are permanently established, which may lead to more lasting effects.^{16,17} Evidence of the long-

term impact of childhood dietary habits on adult health outcomes and chronic disease risk further enforces the need for programs promoting healthy dietary patterns in children.^{18,19} Research also supports the school environment as a promising target for interventions focused on improving children's dietary intake.²⁰ For this reason, SNAP-Ed programs are specifically targeting primary school-aged children by incorporating evidence-based, validated nutrition lessons into low-income schools. In order to improve upon the effectiveness of these programs, validated evaluation tools are needed.^{2,21}

Evaluation of school-based interventions for primary school-aged children is hindered by the scarcity of valid, reliable, and acceptable methods for gathering self-reports of dietary intake in a school setting.²² According to a review by McPherson *et al.* which looked at dietary assessment methods in school-aged children, there is a shortage of acceptable methods for assessing fruit and vegetable consumption.²³ Traditional validated methods of dietary collection include the 24-HDR, Food Records, and Food Frequency Questionnaire (FFQ); however, these methods are costly, time consuming, and have a high respondent burden, making them an impractical choice for ongoing monitoring of public programs with limited resources such as SNAP-Ed.^{2,21} For this reason, high-quality evaluation measures that are valid and reliable for the population, have a low-respondent burden, are simply worded, and are feasible for program use are needed to measure behavioral outcomes in program contexts and inform program decisions.^{2,21,24} In order for an instrument to be considered valid, it must show reliability, sensitivity, and internal consistency in addition to meeting the standards listed above for the sake of practical application in the field.² A lack of validated food-selection questionnaires for low-income children presents the opportunity for the development of new instruments that will accurately reflect the dietary patterns in the specified age-group.

Accurate methods of dietary assessment, particularly for F&V intake, are important to determine the nutritional adequacy of an individual child's diet.¹ Diet records, diet history interviews or recall, estimated or weighted food records, food frequency questionnaires, and direct observation are used to evaluate dietary intake in children, with validation studies of self-reported measures in children including comparisons with diet records or diaries.^{1,25} For this validation study in 9-11 year old children, the 24-HDR, which gives a snapshot of an individual's food intake, has been selected as the "gold standard of reference" for which the 10-item FVQ will be compared. A systematic review by Burrows *et al.* looking at the validity of dietary assessment methods in children as compared with the gold standard reference method of doubly labeled water found that while all methods of self-reported dietary intake are subject to misreporting, the 24-hour multiple pass recall produced more modest over-reports of dietary intake than other methods.¹ Other studies have shown that the 24-HDR is a valid method to assess dietary intake in 8-11 year old children, and the literature suggests a transition period between ages 8 and 12 years during which a child becomes a more accurate reporter of his or her own dietary intake, making the 24-HDR an appropriate choice for validating the 10-item FVQ in our study population.^{1,26} Food frequency questionnaires (FFQ) could also serve as a gold-standard of reference; however, FFQ's place a significant response burden on children, are time consuming, and children in this age group are thought too young to be able to complete an FFQ on their own.^{25,27}

Townsend illustrates the process by which evaluation tools should be developed for food stamp nutrition education programs (SNAP-Ed).² The first step in the development phase of the validation process requires evaluation for content and face validity. For the 10-item FVQ, *Manganello, 2012* completed the necessary developmental validation methods. The next phase of validation encompasses "testing of items" in the population for construct and criterion

validity, test-re-test reliability, and sensitivity to change.² Listed below are explanations for each type of validity being explored in the context of validating the 10-item FVQ.

1) *Construct Validity*: Construct validity shows an instrument correlates highly with other variables which it should theoretically correlate, and is assessed by comparing the new instrument with some current criteria measuring the same construct.⁵ Furthermore, it is the degree to which a test measures what it is intended to measure, and insurance that the scores truly reflect the construct they are intended to measure.^{3,29} Evidence of construct validity will ultimately demonstrate the meaning of the test scores generated from the 10-item FVQ. Assessment of construct validity will determine the degree to which the new test (FVQ) is measuring the behavioral construct (fruit and vegetable consumption) as it is intended, and to what degree the scores on the FVQ represent actual consumption of fruits and vegetables in 9-11 year old children. Examination of construct validity asks the following question: “Do the items reflect actual behavior as we are claiming?”² The level of correspondence between fruit and vegetable consumption as measured by the 24-HDR and the 10-item FVQ will provide evidence of construct validity.

2) *Criterion-Related (Concurrent) Validity*: Criterion-related evidence requires comparing an instrument with current (concurrent) gold-standard criteria.⁵ Criterion-related validity is the degree to which individuals’ scores on a new test correspond to their scores on an established test of the same construct that is administered shortly before or after the new test.²⁹ The established test is the criterion against which the new test is to be validated.²⁹ If a measure demonstrates criterion validity, then the scores will correlate with scores on a test that is known to be valid. Examining whether the scores on the 10-item FVQ are comparable to the gold standard of dietary assessment, the 24-HDR, in measuring fruit and vegetable

consumption will identify criterion-related validity. Establishing criterion-related validity will ask the following question: “Does the new diet quality measure correlate with established measures of diet quality?”²

3) *Sensitivity or Responsiveness*: A sensitive test is one with the ability to detect changes in behavior over time.²⁹ The extent to which a measure is sensitive or responsive to changes in a desired behavior will determine its ability to be used in repeated measures of change with a given construct.² Sensitivity is assessed in a pre- and post-intervention design.² Outcome measures intended to evaluate the effectiveness of educational interventions, particularly in SNAP-Ed, require demonstration of responsiveness to changes resulting from the intervention.²⁹

4) *Test-re-test reliability*: In order for a test to be considered valid, it must be reliable.^{29,30} A reliable test is one that yields a similar scores upon repeated administration; whatever the test measures, it measures consistently.^{29,30} Reliability represents the consistency of a subject’s responses on the evaluation tool and can be evaluated by examining the consistency of test scores from the same respondent at two different points in time.^{2,6} If an instrument is reliable, then respondents will reply to the item with the same answer at each administration point with no intrusive educational intervention. Test-retest reliability measures consistency of the same individual from one administration point to the next without an intervention, determining the correlation or strength of association between the two sets of scores.^{29,30} The time between test administrations should be long enough that subjects are not victim to recall bias (e.g. a subject’s memory of responses to the first administration of the test), but not so distant that a learning or event could alter the way subjects respond during the second administration.²⁹

The purpose of this pilot study was to test the criterion (concurrent) validity of a 10-item FVQ in preadolescent children (ages 9 to 11 years), previously validated for face and content validity.

We also examined the feasibility of implementation and completion of the 10-item FVQ, and the 10-item FVQ and 24-HDR on the same day with each participant in order to determine whether these testing methods were appropriate for further intervention.³²

Methods:

Participant Recruitment:

The University District Freedom School (UDFS) is a summer literacy program that enrolls low-income children grades pre-kindergarten-12th. Children enrolled in the 3rd and 4th grade classrooms (9-11 years) at the UDFS were invited to participate in the study. Recruitment took place during the first week of the UDFS summer program at child pick-up and drop-off when parents could be accessed to take and sign consent forms. All children enrolled at the UDFS took part in a 6-week nutrition and physical activity program called “Camp Nutrition and Fitness” (CNF); however, consent was needed for assessment of primary and secondary outcomes of the program. For the purpose of this paper, we will only focus on the criterion validity and feasibility of testing-implementation portion of the study. Participants were identified as those who 1) were enrolled in the UDFS 3rd or 4th grade classroom (9-11 years), 2) signed the child assent and had parental consent, 3) completed a matched 10-item FVQ and 24-HDR.

Testing

The study sought to examine criterion-related validity by comparing results of a new test (10-item FVQ) to scores on a current [gold-standard] criterion (24-HDR). In examining criterion-

related (concurrent) validity, the new test and established test must be administered at the same time. Prior to the start of CNF or following the completion of CNF, child participants aged 9-11 years (n=17) completed the 10-item FVQ followed by a one-day 24-HDR on the same day.

Trained nutritionists and nutrition assistants administered the 10-item FVQ followed by the 24-hour dietary recall to study participants.

Each child sat individually with a trained nutritionist or nutrition assistant to complete the 24-HDR using the USDA multiple pass approach. Several cognitive techniques have been set in place to assist children in the dietary recall process. For example, *recognition* involves providing children with a list of foods and asking him or her to report or recognize whether he or she ate the food. Recognition does not require construction of the previous day's meals or activities in order to recall particular foods.³¹ In this study, we provided children with a list of lunch items served in the school cafeteria the previous day to aid in the recall. *Retrieval* occurs when a person is asked to remember the previous day and construct what was eaten during the day.³¹ Children must use the information about events that happened the previous day in order to cue what he/she ate.³¹ In our study, retrieval techniques were used to prompt children to remember events of the day preceding in order to recall foods eaten. *Attention* to foods eaten is required for accurate recall; if a child does not notice some aspect of his or her meal, it cannot be recalled.³¹ To overcome this barrier to accurate recall, the trained research assistants used probing techniques for F&V, where components of a meal, dish, or food that may have been forgotten are anticipated by the facilitator and presented to the child; this provided him or her with the opportunity to recall forgotten components of the meal. Facilitators also used the National Dairy Counsel [fruit and vegetable] Food models which provide visual cues of the fruit or vegetable itself, along with the appropriate serving size. These models along with plates, cups, and

measuring spoons assisted children in relaying more accurate information regarding the types and amounts of fruit and/or vegetable they ate.

The 10-Item FVQ is designed to serve as a quick measure F&V intake among 9-11 year old low-income children; therefore, the test was administered as it would be in a SNAP-Ed group setting to test feasibility of implementing the tool in a classroom setting. The 10-item FVQ survey items are read aloud to eliminate bias towards variability in reading-ability among students and between classrooms.² Children were allowed to read and work ahead; however, each question was read completely by the facilitator and ability to complete the questionnaire was assessed.

Prior to the questionnaire's completion, the facilitator followed this standardized script:

“This survey will ask you about the fruits and vegetables that you typically eat. Each question will be asking about a fruit OR a vegetable, and how often or not-often you eat fruits and vegetables. There is no right or wrong answer and you will not be graded on the answers you choose, this is a survey about what you do and what you like to do.

We will go through each question together and I will read each question out loud. You will have time to think about each response before answering. If you have a question, please raise your hand and I will assist you. Remember, it is very important that you answer based on the fruits and vegetables that you actually eat, not based on what you would like to eat or what you think you should put for an answer.

This activity is for you to complete on your own, keep your answers to yourself, there is no need to discuss with your neighbor. If you have a question about whether a specific food is considered a fruit or vegetable, raise your hand and I will assist you. Remember, there is no right or wrong answer, circle the response that is true for you.

The following foods are not considered a fruit or vegetable for this survey:

White Potatoes, French fries, fried sweet potatoes, ketchup, fruit juice, fruit snacks, olives, fruit flavored yogurts or ice cream, or products made with a vegetable such as chips, corn chips or tortillas. Tomatoes are considered a vegetable for the purpose of this survey.

What questions do you have before we begin?

The main outcome measure was the level of agreement between responses on the 10-item FVQ and reference values obtained through 24-HDR. The level of agreement between the tests was

measured using Spearman correlation. Feasibility was assessed by the facilitator in the child participant's ability to 1) fully complete the 10-item FVQ in a group setting and 2) completion of the 24-HDR in the same day.

Results

All child participants ages 9-11 (n=17) were able to fully complete the 10-item FVQ on their own, demonstrating feasibility of using the 10-item FVQ in classroom setting among children living in low-income households. Additionally, all child participants ages 9-11 were able to complete the 24-HDR assessment following the 10-item FVQ.

Table 1.
Frequency of F&V
intake

Assessment Tool	10-item FVQ	24-HDR
Mean	33.06	5.06
S.D.	6.92	2.49
Correlation	$r=0.77$	$p<0.001$

Frequency of F&V intake was calculated for the 24-HDR (mean=5.06, SD=2.49) and a frequency score for the 10-item questionnaire (mean=33.06, SD=6.92), (Table 1). Spearman correlation was used to measure the level of agreement between questionnaires. Low-income child participants (n=17), ages 9 to 11 years, completed a matched 10-item FVQ and 24-HDR.

The means of F&V intake frequency from the 10-item FVQ was significantly correlated with the 24-hour dietary recall ($r=0.77$, $p<0.001$).

Conclusions and Implications of Findings:

The validity of a food questionnaire is the degree to which the instrument measures the dietary intake of the subjects it was designed to study.²¹ Results from this pilot test demonstrate the potential criterion-related validity of this easily administered and cost-effective 10-item FVQ when compared to the gold-standard, a 24-HDR. These results support that the 10-item FVQ may be an appropriate substitute for assessing F&V intake among this population. Feasibility was demonstrated in the 10-item FVQ's quick and easy administration in a classroom setting, and the capability of the questionnaire to be completed by the child participants. In addition, children demonstrated the ability to complete both the 10-item FVQ and 24-HDR within the same testing period, making this an appropriate design for future validation studies.

A future study encompassing test-re-test reliability, sensitivity, construct validity, and further validation of criterion validity should be conducted to establish full validity of this screening tool. Future work will also include a larger sample size ($n=85-100$) in order to establish stronger evidence of validity. Analysis of the 24-HDR will also be based on the USDA's cups of F&V versus frequency of consumption to establish a correlation between amounts eaten as reported by the 24-HDR and the 10-item FVQ. Validation of this quick and easily administered tool will allow its use among 9-11 year old children living in low-income households, strengthening the assessments conducted among SNAP-Ed program participants.

References:

1. Burrows TL, Martin RJ, Collins CE. A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. *Journal of the American Dietetic Association*. 2010; 110:1501-1510.
2. Townsend MS. Evaluating food stamp nutrition education: process for development and validation of evaluation measures. *Journal of Nutrition Education and Behavior*. 2006; 38:18-24.
3. Angelelli, Claudia, and Holly E. Jacobson. *Testing and Assessment in Translation and Interpreting Studies: A Call for Dialogue between Research and Practice*. Amsterdam: John Benjamins Pub., 2009.
4. Carmines EG, Zeller RA. Reliability and Validity Assessment. Sage Publications: London, 1979.
5. Instrument Validity - Educational Research - Del Siegle [Internet]. [cited 2013 Jan 14]; Available from:
<http://www.gifted.uconn.edu/siegle/research/Instrument%20Reliability%20and%20Validity/Validity.htm>
6. Wall DE, Least C, Gromis J, Lohse B. Nutrition education intervention improves vegetable-related attitude, self-efficacy, preference, and knowledge of fourth-grade students. *Journal of School Health*. 2012; 82:37-43.
7. Serdula MK, Byers T, Mokdad AH, Simoes E, Mendlein JM, Coates RJ. The association between fruit and vegetable intake and chronic disease risk factors. *Epidemiology*. 1996;7:161-165.
8. Lorson BA, Melgar-Quinonez HR, Taylor CA. Correlates of fruit and vegetable intakes in US children. *Journal of the American Dietetic Association*. 2009;109:474-478.
9. Balance My Day reference
10. Guenther PM, Dodd KW, Reedy J, Krebs-Smith SM. Most Americans eat much less than recommended amounts of fruit and vegetables. *Journal of the American Dietetic Association*. 2006;106:1371-1379.
11. Lohse B, Cunningham-sabo L, Walters LM, Stacey JE. Valid and reliable measures of cognitive behaviors toward fruits and vegetables for children aged 9 to 11 years. *Journal of Nutrition Education and Behavior*. 2011;43(1):42-9
12. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA*. 2014;311(8):806-14.
13. Liu RH. Health-promoting components of fruits and vegetables in the diet. *Advanced Nutrition*. 2013;4(3):384S-92S.
14. United States Department of Agriculture. About SNAP---Ed : National SNAP---Ed : SNAP---Ed Connection [Internet]. Available from:
http://snap.nal.usda.gov/nal_display/index.php?info_center=15&tax_level=2&tax_subject=250&topic_id=1203

15. Dietary Guidelines for Americans, 2010 [Internet]. Available from: <http://www.cnpp.usda.gov/DGAs2010---PolicyDocument.htm>
16. Shariff ZM, Bukhri SS, Othman N, Hashim N, Ismail M, Jamil Z, Kasim SM, Paim L, Samah BA, Hussein ZAM. Nutrition education intervention improves nutrition knowledge, attitude, and practices of primary school children: a pilot study. *International Electronic Journal of Health Education*. 2008; 11:119-132.
17. Sandeno C, Wolf G, Drake T, Reicks M. Behavioral strategies to increase fruit and vegetable intake by fourth-through-sixth grade students. *Journal of the American Dietetic Association*. 2000;100(7):828-830.
18. Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics*. 1998;101:518-525.
19. Steinberger J, Moran A, Hong CP, Jacobs DR Jr, Sinaiko AR. Adiposity in childhood predicts obesity and insulin resistance in young adulthood. *Journal of Pediatrics*. 2001;138:469-473.
20. Briefel RR, Crepinsek MK, Cabili C, Wilson A, Gleason PM. School food environments and practices affect dietary behaviors of US public school children. *Journal of the American Dietetic Association*. 2009;109(suppl):S91-S107.
21. Thiagarajah K, Fly AD, Hoelscher DM, et al. Validating the food behavior questions from the elementary school SPAN questionnaire. *Journal of Nutrition Education and Behavior*. 2008;40(5):305-10.
22. Rockett HRH, Colditz GA. Assessing diets of children and adolescents. *Journal of Clinical Nutrition*. 1997;65(suppl):S1116-S1122.
23. McPherson RS, Hoelscher DM, Alexander M, Scanlon KS, Serdula MK. Dietary assessment methods among school-aged children: validity and reliability. *Preventive Medicine*. 2000;31(suppl 2):S11-S33.
24. Dickin KL, Lent M, Lu AH, Sequeira J, Dollahite JS. Developing a measure of behavior change in a program to help low-income parents prevent unhealthy weight gain in children. *Journal of Nutrition Education and Behavior*. 2012;44(1):12-21.
25. Edmunds LD, Ziebland S. Development and validation of the Day in the Life Questionnaire (DILQ) as a measure of fruit and vegetable questionnaire for 7-9 year olds. *Health Education Research*. 2002;17(2):211-20.
26. Lytle LA, Nichaman MZ, Obarzanek E, Glovsky E, Montgomery D, Nicklas T, Zive M, Feldman H. Validation of 24-hour recalls assisted by food records in third-grade children. *Journal of the American Dietetic Association*. 1993;1431-1436.
27. Paxton A, Baxter SD, Fleming P, Ammerman A. Validation of the school lunch recall questionnaire to capture school lunch intake of third-to fifth-grade students. *Journal of the American Dietetic Association*. 2011; 111:419-424.
28. Paxton A, Baxter SD, Fleming P, Ammerman A. Validation of the school lunch recall questionnaire to capture school lunch intake of third-to fifth-grade students. *Journal of the American Dietetic Association*. 2011; 111:419-424.

29. Kimberlin CL, Winterstein AG. Validity and reliability of measurement instruments used in research. *Am J Health Syst Pharm*. 2008;65(23):2276-84.
30. Instrument Validity - Educational Research - Del Siegle [Internet]. [cited 2013 Jan 14]; Available from:
<http://www.gifted.uconn.edu/siegle/research/Instrument%20Reliability%20and%20Validity/Reliability.htm>
31. Baranowski T, Domel SB. A cognitive model of children's reporting of food intake. *American Journal of Clinical Nutrition*. 1994;59(suppl):S212-S217.
32. Bowen DJ, Kreuter M, Spring B, et al. How we design feasibility studies. *American Journal of Preventive Medicine*. 2009;36(5):452-7.