

Reliability of a Kid's Activity and Nutrition Questionnaire for School-Based SNAP-Ed Interventions as Part of a Tiered Development Process

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ABSTRACT

Objective: To assess the reliability of the Kids' Activity and Nutrition Questionnaire (KAN-Q) as part of a tiered process for developing *Supplemental Nutrition Assistance Program–Education* tools.

Methods: The KAN-Q was administered at 2 time points to assess internal consistency using standardized values of Cronbach α and test-retest reliability using the intraclass correlation coefficient for continuous variables, Cohen's kappa (κ) statistic for categorical variables, and the weighted κ statistic for ordinal data.

Results: Data were collected from 119 fourth graders. Cronbach α was adequate for behavior (.71) and knowledge (.72) scales and nutrition behavior (.78) and nutrition knowledge (.75) subscales. Test-retest reliability was generally acceptable, with intraclass correlation coefficients from 0.40 to 0.75 and κ coefficients showing fair to substantial agreement (0.30 to 0.72).

Conclusions and Implications: The KAN-Q is a practical and reliable questionnaire for school-based administration that aligns directly with *Supplemental Nutrition Assistance Program–Education* evaluation priorities.

Key Words: reliability, questionnaire design, *Supplemental Nutrition Assistance Program*, childhood obesity, schools (*J Nutr Educ Behav.* 2017;49:125-129.)

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INTRODUCTION

Effective program evaluation combines 2 unlikely partners: rigor and feasibility. This pairing is particularly salient in the evaluation of *Supplemental Nutrition Assistance Program–Education* (SNAP-Ed), which operates through the US Department of Agriculture. As the education component of the largest federal nutrition assistance program, SNAP-Ed serves SNAP participants and eligible people by providing evidence-based, behaviorally-focused obesity prevention interventions that include direct education; policy, systems and environmental supports; and social marketing.¹ Specif-

ically, interventions targeting youth are a SNAP-Ed priority. Among the 6 million recipients of SNAP-Ed direct education in 2012, more than two thirds were school-aged youth.² Thus schools have become a focal point for delivering SNAP-Ed.^{2,3}

Consequently, school-based assessments of children's nutrition and physical activity behaviors are central to understanding SNAP-Ed effectiveness. However, it can be daunting for states and implementing agencies to collect these data. On the one hand, schools can provide optimal settings for the evaluation of obesity prevention programs: The audience is captive, class

turnover is relatively low, and assessment can be incorporated into curricula.^{2,3} Conversely, competing demands on the educational system and the lack of top-down support may be powerful barriers to SNAP-Ed programming and evaluation, especially in under-resourced schools.^{2,4} A 2013 Institute of Medicine workshop offered educator perspectives on nutrition education that highlighted election politics, inadequate funding, lack of teacher training, and severely limited instruction time as persistent obstacles to obesity prevention in schools.² In terms of evaluation, measures perceived as intrusive, costly, or overly burdensome are more likely to be challenged by school administrators and teachers.⁵ Alternatively, questionnaires that are minimally invasive and easy to administer are more readily accommodated.⁵⁻⁷

This problem typifies a broader dilemma in SNAP-Ed evaluation: Programs should be systematically assessed with what Guthrie et al⁵ referred to as a "common core of measures that would give us a basis for comparison," and yet to be successful, the evaluation

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must be appropriate and feasible at the community or site level.⁵⁻⁹ In other words, the quintessential SNAP-Ed measure should be easily applied across diverse contexts and still capture high-quality, consistent data for aggregation on state and national levels.

Over the past decade, impressive strides have been made to guide SNAP-Ed evaluation in this direction.⁵⁻⁹ In 2006, Townsend⁸ published a 6-stage process for developing accurate, practical measures to assess community-based nutrition education programs targeting low-income audiences. Table 1 outlines the tiered stages. More generally, the recent national SNAP-Ed Evaluation Framework and associated Interpretive Guide⁹ provide direction for evaluating SNAP-Ed, including recommended tools to measure nutrition and physical activity behaviors. These measures are valuable in that they can be applied across diverse contexts to assess indicators linked to SNAP-Ed objectives. Moreover, select tools in the Interpretive Guide were validated using the Townsend process or a similar one. However, well-validated youth measures requiring >30 minutes and/or the collection of biometric data^{10,11} can be difficult to administer in classrooms, whereas the Guide's shorter, validated measures are limited in scope (eg, the Beverage and Snack Questionnaire¹²). Therefore, SNAP-Ed would benefit from an accurate, practical tool that measures both MyPlate and physical activity behaviors for use with comprehensive, school-based obesity prevention programs.

Following Townsend's⁸ tiered process for tool development, the current authors present the reliability testing phase (stage 4) for a Kids' Activity and Nutrition Questionnaire (KAN-Q) that is feasible to administer in classrooms and aligns directly with the national SNAP-Ed

Evaluation Framework indicators for healthy eating and physical activity.

METHODS

Early Questionnaire Development

Initial questionnaire development spanned stages 1–3 of the Townsend process⁸ (Table 1). A team of experts in nutrition, SNAP-Ed, and evaluation selected content domains (stage 1) by examining nutrition education instruments for school-aged children in the peer-reviewed literature alongside SNAP-Ed objectives. Specific behaviors and knowledge associated with the Dietary Guidelines for Americans¹³ were chosen as fundamental indicators: consumption of fruits, vegetables, low-fat dairy, and whole grains; water and sugar-sweetened beverage intake; time spent doing physical activity and being sedentary; MyPlate knowledge; and knowledge of the Physical Activity Guidelines for Americans. Questionnaire items were generated (stage 2) from the validated Day in the Life Questionnaire¹⁴ and School Physical Activity and Nutrition questionnaire.¹¹ The resultant visually enhanced measure was piloted iteratively over 3 years for face validity (stage 3) with fourth to eighth graders in Arizona's SNAP-Ed-eligible schools. The revised questionnaire included a child-friendly font and a readability grade of 2.6 to accommodate fourth graders below reading level.

Study Design

This study tested the revised measure for internal consistency and test-retest reliability (stage 4). The project was approved by the Arizona Department of Health Services Human Subjects Review

Board as being of minimal risk to participants and administered in compliance with school district regulations for parental and student consent. A written disclaimer reinforced that participation was optional, and student assent was obtained verbally before questionnaire administration.

The researchers recruited a convenience sample of 119 fourth graders aged 9–11 years from 5 SNAP-Ed-eligible classrooms in Pima County, AZ. A trained proctor administered the questionnaire in classrooms at 2 time points with no nutrition education in between. Four classes received the test and retest 1 week apart; 1 class was retested at 6 weeks to accommodate the teacher's schedule. A standardized proctor protocol was used with item explanations and prescribed responses to potential questions: The proctor led classes through each item, allowing students to ask clarifying questions but not otherwise talk or share answers. Administration times ranged from 10 to 20 minutes, depending on students' questions and completion pace.

Data Analysis

Items were categorized into primary scales and secondary subscales: behavior–nutrition and physical Activity, and knowledge–nutrition and physical activity. Internal consistency was examined using standardized values of Cronbach α at both time points using reverse coding of answers for 3 items (refined grain consumption, sweetened beverage consumption, and sedentary time). Alpha values for scales and subscales were generated separately. Although interpretation of α is not rigorously defined, .7 is generally regarded as acceptable and was used here.^{8,15}

Test-retest reliability was assessed for continuous variables using the intraclass correlation coefficient (ICC) in a 2-factor mixed-effects model testing for consistency. Cohen's kappa (κ) statistic, a reliability measure that takes into account agreement occurring by chance, was used for categorical variables. The weighted κ statistic was used for ordinal data. Interpretations of the ICC and κ were based on the values suggested by Cicchetti¹⁶ and Landis and Koch,¹⁷ respectively. Stata/IC13.1 (StataCorp, College Station, TX, 2013) was used for all analyses.

Table 1. Best Practice Development of Nutrition Education Measures and Progress to Date for the KAN-Q

Stage of Development	KAN-Q Progress
1. Domain selection using literature review	Completed
2. Item generation from evidence base and expert contribution	Completed
3. Item pretesting with target audience	Completed
4. Item testing/analysis for consistency and reliability	Reported here
5. Convergent and criterion validity testing	Planning phase
6. Sensitivity assessment of ability to detect change	Planning phase

KAN-Q indicates the Kids' Activity and Nutrition Questionnaire.

RESULTS

Internal Consistency

Table 2 provides reliability results for internal consistency. Cronbach α was adequate¹⁶ for the behavior and knowledge scales (.71 and .72, respectively) and the nutrition behavior and nutrition knowledge subscales (.78 and .75, respectively). At .46, internal consistency for the physical activity behavior subscale was below the minimally acceptable level.

Test-Retest Reliability

Test-retest reliability (Table 3) was generally acceptable. The ICCs for continuous data fell within the fair (0.40) to excellent (0.75) range suggested by Cicchetti,¹⁶ excluding the physical education (PE) question. Kappa coefficients for categorical and ordinal data had fair (0.30) to substantial (0.72) agreement, per Landis and Koch.¹⁷

DISCUSSION

The current study describes progress toward a feasible, appropriate, and valid SNAP-Ed questionnaire for school-aged youth using established best practices for developing such measures.^{5,8} The KAN-Q was purposefully designed to assess school-based nutrition and physical activity interventions targeting grades 4–8. Its brief administration and absence of biometric data collection help to overcome the potential barriers of limited classroom time, sociopolitical obstacles in schools, and restrictions on the time and resources of SNAP-Ed implementing agencies. The KAN-Q was also developed to align with SNAP-Ed objectives. Recently, this alignment was scrutinized against the SNAP-Ed

Evaluation Framework⁹ and was found to measure 2 of its 4 core indicators: healthy eating behaviors and physical activity and reduced sedentary behaviors.

Beyond practicality and suitability, the KAN-Q was shown to be reliable in terms of internal consistency and reproducibility among the youngest intended audience. For internal consistency, Cronbach α exceeded .7 for the 2 primary scales, behavior ($\alpha = .71$) and knowledge ($\alpha = .72$), and for all subscales except physical activity behavior. Hall et al¹⁸ reported similar findings for a nutrition-only youth survey, which included a behavior subscale ($\alpha = .71$) and a knowledge subscale ($\alpha = .56$). Although debate exists regarding minimally acceptable α values,^{15,16} Townsend⁸ has recommended a .6–.7 cutoff for nutrition education measures, and researchers commonly report these values as adequate.^{7,19,20} Tavakol and Dennick¹⁵ have averred that α values are positively influenced by the number of scale items and negatively influenced by scale heterogeneity. Here, α values may have been lower-bound estimates of reliability because the number of scale items was relatively low and multiple factors likely underlay both scales.

Test-retest reliability was acceptable for all but the PE question. Results were comparable to estimates for similar instruments.^{11,19,21} In a child nutrition questionnaire, Wilson et al¹⁹ reported ICCs of 0.57, 0.66, and 0.66 for water, fruit, and vegetable intake, respectively, compared with KAN-Q values of 0.61, 0.75, and 0.55. Conversely, the KAN-Q had higher ICCs than the child nutrition questionnaire for fruit knowledge (0.46 vs 0.16) and vegetable knowledge (0.51 vs 0.36) and a lower ICC for sweetened beverage intake (0.45 vs 0.59). In a child food frequency questionnaire,

Saeedi et al²¹ also described ICCs for fruit (0.63) and vegetable (0.60) consumption that were similar to KAN-Q findings.

With an ICC of -0.50 , the PE question was likely problematic because PE classes were scheduled to recur weekly, not daily. Reframing the question from asking about yesterday to weekly PE may strengthen agreement. The relatively low ICC for after-school activities (0.40) may require similar revision, because sports and activity clubs are often scheduled weekly. In addition, 4 of the 5 nutrition knowledge subscale items had acceptable but lower-range test-retest agreement: recommended cups of fruit per day, recommended cups of vegetables per day, how much of kids' plates should be covered by fruits and vegetables, and how much of all grains consumed should be whole grains. For these questions, reliability may be improved by having proctors remind students to avoid guessing and selecting the option of "I don't know" when they are uncertain.

One class received pre-post tests at a substantially longer time interval than the other 4 classes (6 weeks vs 1 week) to accommodate the teacher's schedule, which appeared to have influenced results. Agreement generally improved when the class surveyed 6 weeks apart was excluded from the analysis (Table 3). This suggested that 6 weeks may be too long an interval to test for KAN-Q agreement among this age group and that the slightly higher agreements reported in parentheses in Table 3 may be a more accurate representation of test-retest reliability.

This study had several limitations. There is an inherent challenge to developing a practical SNAP-Ed questionnaire for school-based administration: limiting length also limits scope and scale accuracy.¹⁵ Here, internal consistency was influenced by the number of questions in each scale/subscale; dimensions with few items may have demonstrated lower-bound reliability. Moreover, the self-report questionnaire may have been less burdensome than direct observation or food records, but it was subject to recall bias.^{10,11} The low reliability of the physical activity behavior subscale prompted investigator doubt regarding recall accuracy. Although the KAN-Q posed behavioral questions about yesterday to enhance recall, those items cannot be assumed to reflect usual intake without multiple administrations

Table 2. Internal Consistency Reliability for 2 Administrations of the Kids' Activity and Nutrition Questionnaire

Scale/Subscale	Questions, n	Cronbach α (Test 1)	Cronbach α (Test 2)
Behavior	13	.72	.71
Nutrition	7	.79	.78
Physical activity	6	.36	.46
Knowledge	5	.52	.72
Nutrition	4	.58	.75
Physical activity	1	NA	NA
Overall	18	.73	.73

NA indicates not available.

Table 3. Test-Retest Reliability for the Kids' Activity and Nutrition Questionnaire

Scale/ Subscale	Item	Intraclass Correlation Coefficient ^a	
Behavior	Nutrition	Yesterday, did you drink any milk? ^b	0.68 (0.70)
		Yesterday, did you eat any corn tortillas or bread, tortillas, buns, bagels, or rolls that were brown? ^b	0.43 (0.50)
	Physical activity	Yesterday, did you eat any corn tortillas or bread, tortillas, buns, bagels, or rolls that were white? ^b	0.57 (0.59)
		Did you eat any vegetables yesterday? ^b	0.55 (0.54)
		Yesterday, did you eat any fruit? ^b	0.75 (0.76)
		Yesterday, did you drink any regular (not diet) soda, Kool-Aid, sports drink, or other fruit-flavored drinks? ^b	0.45 (0.45)
		Yesterday, did you drink any water? ^b	0.61 (0.61)
		Did you do any activities after school yesterday that made your heart beat fast or made you breathe hard? ^c	0.40 (0.45)
		Did you go to physical education or gym class yesterday? ^c	-0.50 (-0.61)
		When you were not in school yesterday, how many hours did you spend sitting or lying around? ^c	0.48 (0.53)
Knowledge	Nutrition	How many total cups of fruit should most kids eat each day?	0.46 (0.57)
		How many total cups of vegetables should most kids eat each day?	0.51 (0.54)
	Physical activity	How many minutes of physical activity/exercise should most kids have on all or most days of the week?	0.53 (0.62)
		Kappa	
Behavior	Nutrition	What type of milk do you drink most of the time?	0.72 (0.74) ^d
		Physical activity	How did you travel to school yesterday?
	How did you travel home from school yesterday?		0.53 (0.57) ^d
	What did you do most of the time at lunchtime recess yesterday?		0.38 (0.38) ^e
		If you had a morning break yesterday, what did you do most of the time at morning break?	0.55 (0.60) ^e
Knowledge	Nutrition	What type of milk should most kids drink most of the time?	0.48 (0.59) ^d
		How much of most kids' plates at meals should be fruits and vegetables?	0.39 (0.46) ^e
		How much of the bread and cereal that most kids eat should be made with whole grains (brown, whole wheat, etc)?	0.30 (0.42) ^e

^aValues that excluded the class surveyed at a 6-week (vs 1-week) interval are in parentheses; ^bResponse choices were continuous as number of times consumed; ^cResponse choices were continuous as number of minutes/hours; ^dCohen's kappa statistic; ^eWeighted kappa statistic.

to the same cohort to better reflect habitual consumption.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Given its success as a reliable measure, the KAN-Q shows promise as a standard SNAP-Ed questionnaire for grades 4–8. With a 15- to 20-minute administration protocol, it addresses feasibility concerns for school-based administration and aligns directly with national SNAP-Ed evaluation priorities. Items

that were identified here as problematic (eg, physical activity behavior questions) are currently under revision. A potential next step is to assess convergent validity using 24-hour recall (Table 1, stage 5).⁸

Today's SNAP-Ed initiatives demand multilevel programming using a combination of direct education with policy, systems and environmental interventions, and social marketing.¹ Population indicators are sought across all levels for fruits and vegetables, whole grains, dairy, and beverages; physical activity; and reduced sedentary behaviors.⁹ Because the KAN-Q includes

each of these population-level indicators, it has potential for broad use in measuring SNAP-Ed outcomes related to multiple levels of intervention, given the proper evaluation design.

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REFERENCES

1. US Department of Agriculture, Food and Nutrition Service. SNAP-Ed plan guidance FY 2017: Nutrition Education and Obesity Prevention Grant Program. <https://snaped.fns.usda.gov/sites/default/files/uploads/Final%20FY%202017%20SNAP-Ed%20Plan%20Guidance%2004-04-2016.pdf>. Accessed July 30, 2016.
2. Institute of Medicine. *Nutrition Education in the K-12 Curriculum: The Role of National Standards: Workshop Summary*. Washington, DC: National Academies Press; 2013.
3. Institute of Medicine. *Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation*. Washington, DC: National Academies Press; 2012.
4. Budd GM, Volpe SL. School-based obesity prevention, research, challenges, and recommendations. *J Sch Health*. 2006;76:485-495.
5. Guthrie JF, Stommes E, Voichick J. Evaluating food stamp nutrition education: issues and opportunities. *J Nutr Educ Behav*. 2006;38:6-11.
6. Taylor-Powell E. Evaluating food stamp nutrition education: a view from the field of program evaluation. *J Nutr Educ Behav*. 2006;38:12-17.
7. Branscum P, Sharma M, Kaye G, Succop P. An evaluation of the validity and reliability of a food behavior checklist modified for children. *J Nutr Educ Behav*. 2010;42:349-352.
8. Townsend MS. Evaluating food stamp nutrition education: process for development and validation of evaluation measures. *J Nutr Educ Behav*. 2006;38:18-24.
9. US Department of Agriculture, Food and Nutrition Service. The SNAP-Ed Evaluation Framework: nutrition, physical activity, and obesity prevention indicators: interpretive guide to the SNAP-Ed Evaluation Framework. <https://snaped.fns.usda.gov/>. Accessed July 30, 2016.
10. Thiagarajah K, Fly A, Hoelscher D, et al. Validating the food behavior questions from the elementary school SPAN Questionnaire. *J Nutr Educ Behav*. 2008;40:305-310.
11. Penkilo M, George GC, Hoelscher DM. Reproducibility of the School-based Nutrition Monitoring Questionnaire among fourth-grade students in Texas. *J Nutr Educ Behav*. 2008;40:20-27.
12. Neuhouser ML, Lilley S, Lund A, Johnson DB. Development and validation of a beverage and snack questionnaire for use in evaluation of school nutrition policies. *J Am Diet Assoc*. 2009;109:1587-1592.
13. US Department of Health and Human Services and US Department of Agriculture. *2015-2020 Dietary Guidelines for Americans*. 8th ed. <http://health.gov/dietaryguidelines/2015/guidelines/>. Accessed July 30, 2016.
14. Edmunds L, 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 Educ Res*. 2002;17:420-430.
15. Tavakol M, Dennick R. Making sense of Cronbach's alpha. *Int J Med Educ*. 2011;2:53-55.
16. Cicchetti DV. Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychol Assess*. 1994;6:284-290.
17. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33:159-174.
18. Hall E, Chai W, Koszewski W, Albrecht J. Development and validation of a social cognitive theory-based survey for elementary nutrition education program. *Int J Behav Nutr Phys Act*. 2015;12:47.
19. Wilson AM, Magarey AM, Mastersson N. Reliability and relative validity of a child nutrition questionnaire to simultaneously assess dietary patterns associated with positive energy balance and food behaviours, attitudes, knowledge and environments associated with healthy eating. *Int J Behav Nutr Phys Act*. 2008;5:5.
20. Gray HL, Koch PA, Contento IR, Bandelli LN, Ang I, Di Noia J. Validity and reliability of behavior and theory-based psychosocial determinants measures, using audience response system technology in urban upper-elementary schoolchildren. *J Nutr Educ Behav*. 2016;48:437-452.
21. Saeedi P, Skeaff SA, Wong JE, Skidmore PML. Reproducibility and relative validity of a short food frequency questionnaire in 9-10 year-old children. *Nutrients*. 2016;8:271.

CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.