Research and Professional Briefs

Brief Psychosocial Fruit and Vegetable Tool Is Sensitive for the US Department of Agriculture's Nutrition Education Programs

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ABSTRACT

The usefulness of an evaluation instrument is dependent on its reliability, validity, and ability to capture change. The latter psychometric characteristic is particularly important, yet is often neglected. The purpose of this study was to assess the sensitivity of a psychosocial fruit and vegetable evaluation tool for use by two US Department of Agriculture community-based programs. As part of a prospective randomized controlled trial, a sample of limited-resource women (n=93), recruited from eight counties, provided dietary recalls, behavioral assessments, and psychosocial assessments. A randomly selected subsample was used for venipuncture (n=55). Sensitivity of the tool was estimated using serum carotenoids, selected micronutrients, fruit/vegetable servings, and fruit/vegetable behaviors. Controlling for energy intake at baseline and change in energy intake, the change scores for the tool were correlated with reported changes in fruit and vegetable behaviors (r=0.28, P=0.01), vitamin C (r=0.25, P=0.02), and the biomarker serum carotenoids (r=0.31, P=0.02). This systematic process yielded a moderately sensitive evaluation tool useful with a limited-resource audience participating in two US Department of Agriculture programs. This is the first study to estimate sensitivity of a psychosocial tool for a fruit and vegetable intervention.

J Am Diet Assoc. 2007;107:2120-2124.

The usefulness of an evaluation tool is dependent on its reliability, validity, and ability to capture change (1,2). The latter psychometric characteristic, referred to as sensitivity to change or responsiveness, is particularly important, yet almost always neglected (3,4). A number of researchers have noted that sensitivity to change should join reliability and validity as necessary requirements for instruments designed to evaluate interventions (2-6).

This psychometric characteristic is particularly important when applied to evaluation instruments designed for the US Department of Agriculture's community-based programs for food-stamp recipients and other qualified limited-resource households. Two of these programs, Food Stamp Nutrition Education and Expanded Food and Nutrition Education Program, are low-intensity, primary prevention interventions resulting in modest change for large numbers of low-income families (4). The ability of a tool to capture change is more difficult for low-intensity interventions than for more-intense interventions, but is critical for program accountability (4,7). Because evaluation tools are routinely used with all Expanded Food and Nutrition Education Program and Food Stamp Nutrition Education participants, brevity is vital to maintain a low respondent burden (4-7).

In a literature search, eight citations were found for instruments to measure psychosocial aspects of fruit and vegetable consumptions in US adults (8-15). These instruments were designed for population surveillance or monitoring in a clinic setting, or were intended for use as an evaluation tool, but important psychometric characteristics were not assessed. Sensitivity to change was not reported for any tool.

This article builds on previous research establishing reliability (ie, stability and internal consistency) and validity (ie, face, content, convergent) of a psychosocial evaluation instrument for a fruit and vegetable education intervention in low-income communities (16). The instrument originally consisted of nine constructs with 19 items. Six constructs with 13 items remain for the next phase of instrument development. Using data collected longitudinally, the purpose of this article is to determine the sensitivity of this valid, reliable evaluation tool with a sample of limited-resource Californians from eight counties.

METHODS

Framework Underlying Study Design

The conceptual framework recognized the hierarchical structure of psychosocial factors related to change in fruit and vegetable behaviors and their importance in understanding the individual's health (Figure) (17). This framework includes psychosocial, behavioral, dietary, and biological variables and was adapted from a framework used previously (16). The targeted psychosocial variables are considered to be mediators of behavior

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0002-8223/07/10712-0009$32.00/0

doi: 10.1016/j.jada.2007.09.015

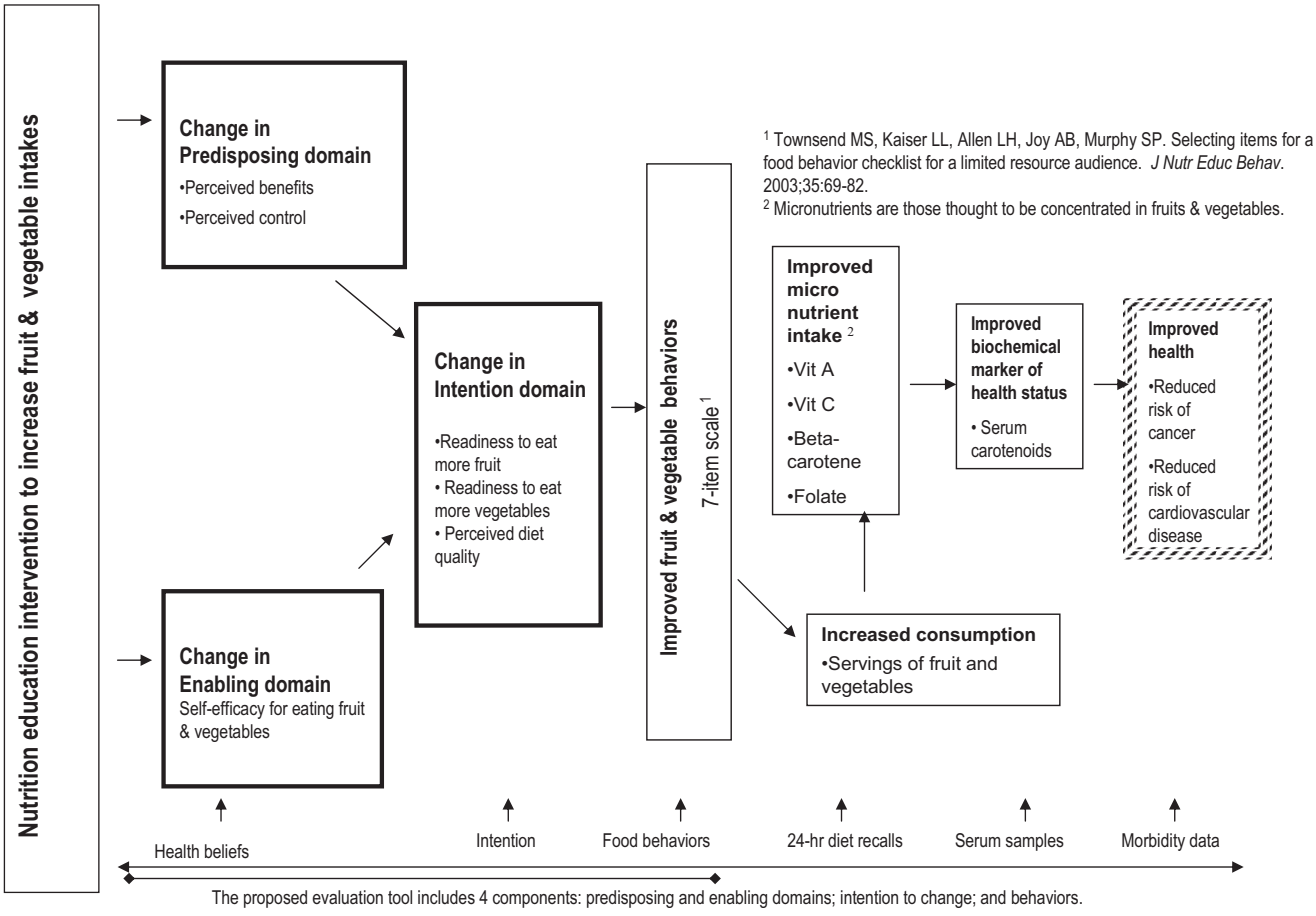

Figure. Biopsychosocial framework for estimation of sensitivity of evaluation tool for US Department of Agriculture education programs for increasing fruit and vegetable consumption.

change. The psychosocial constructs selected for sensitivity testing reflect the results of a validation study (16) and were chosen from behavioral change theories and clustered into two domains: predisposing and enabling factors/domains using the work of Glanz and colleagues (8) and Anderson (18). Reflecting the work of other researchers (19), "change in intention" was added to the framework resulting from change in the two preceding domains (Figure). The hypothesis is that change in the psychosocial factors impacts change in the behavioral domain, albeit to a lesser degree. Secondly, change in the behavioral domain impacts change in micronutrient and food group intakes, which, in turn and to a lesser degree, influence change in biomarker status (Figure).

Sample, Design, and Protocol

Participants were English-speaking women from eight California counties who were eligible to receive food stamps, had at least one child younger than 19 years of age living at home, and were not pregnant or lactating (n=93). As part of a prospective randomized controlled trial, participants were assigned to six weekly nutrition education classes (1 to 2 hours in length) or a "delayed intervention" control group. At baseline and 8 weeks later (postintervention), participants provided three 24-hour dietary recalls, a behavioral assessment, a psychosocial assessment, and demographic information. A randomly selected subsample of participants was used for venipuncture (n=55).

The content of the intervention was typical of Expanded Food and Nutrition Education Program and Food Stamp Nutrition Education nutrition education, with an emphasis on fruits and vegetables, food shopping, menu planning, and food-preparation skills using the Expanded Food and Nutrition Education Program's "Eating Right is Basic" curriculum. Details about staff training, protocol for instrument administration, and other instructions to participants are reported elsewhere (16). The study protocol and instruments were reviewed and approved by the Office of Human Research Protection of the University of California, Davis.

Data Collected

24-Hour Dietary Recalls. A modified three-pass method was used to obtain a detailed description of all foods and beverages the subjects consumed during the previous 24 hours (20). Details are reported elsewhere (16).

Serum Carotenoids. Serum carotenoids were selected as the biomarker for fruit and vegetable intake because of their presence in fruit and vegetables and role in the prevention of chronic disease (21,22). Polsinelli and colleagues (22) found fruit and vegetable intake highly correlated with carotenoid concentration (r=0.48, P<0.05) in women. For this study, blood samples were collected in clinics, immediately centrifuged, aliquoted, frozen, and shipped on dry ice to the University of California, Davis. Details are reported elsewhere (16).

Fruit and Vegetable Behaviors. A 7-item fruit and vegetable behavioral tool was used as a comparison measure (4,23). This scale has been previously shown to be reliable, valid, and sensitive to change when used as an evaluation tool with food-stamp clients (4). Other psychometric properties were shown to be acceptable, including a Cronbach's coefficient α of .80 and a validity coefficient of .44 (P<0.001) with serum carotenoids (4), comparing favorably to Polsinelli and colleagues' results (22).

Psychosocial Fruit and Vegetable Tool. Methods for item development for the evaluation instrument, selection of constructs, and scaling for the original instrument are reported elsewhere (16). The six psychosocial constructs in the revised instrument are identified here.

- Perceived benefits of eating fruits and vegetables (2 items). These beliefs were outcome expectations within the Social Cognitive Theory and were defined as what a person believes will happen as a result of performing a behavior (24). Outcome expectations provide motivation for eating fruit and vegetables.
- Perceived control (2 items). The items asked who is in charge of the food shopping and food preparation and refer to the perception of having control over the behaviors (25).
- Self-efficacy (6 items). Six items assessed the confidence a participant feels in performing specific fruit and vegetable behaviors in a variety of circumstances/settings. Within the Social Cognitive Theory and the Health Belief Model, self-efficacy provides the confidence that barriers can be overcome and has been shown to be an important mediator of behavior change (24).
- Readiness to eat more fruit and readiness to eat more vegetables (2 constructs). Readiness was examined for two behavioral outcomes: eating more fruit and eating more vegetables (9). Eating more fruit and vegetables referred to increasing the current intakes of fruit and vegetables compared to the amount eaten in the past. Readiness for change, measured by the stage of change algorithm, is the temporal dimension of Prochaska's Transtheoretical Model of Behavior Change (26). Using the method reported by Feldman and colleagues (9) and Campbell and colleagues (11), participants were grouped into one of five categories: I am not thinking about eating more fruit; I am thinking about eating more fruit. I am planning to start within 6 months; I am definitely planning to eat more fruit in the next month; I am trying to eat more fruit now; and I am already eating two or more servings of fruit a day.
- Perceived diet quality (1 item). Considered a mediator of behavior, perceived diet quality was assessed (10).

Analyses

Data were examined longitudinally to estimate the sensitivity or responsiveness of this new tool to capture change due to intervention. With the exception of perceived control for food shopping and preparation, the responses were expected to change along with changes in the diet-quality indicators. The change in biomarker, an external measure, was used as the "gold standard," recognizing that a weak response by the biomarker was expected, at best, as the psychosocial constructs changed. Changes in selected micronutrients found in high concentrations in fruit and vegetables, changes in food-group servings, and changes in fruit and vegetable behaviors were used in the analyses, recognizing that they were imperfect standards because of the self-reported format of the data collection. Using partial correlations, one-tail, change in the total score from baseline to follow-up for the fruit and vegetable psychosocial items was compared to change in indicators of diet quality during the same time period. Adjustments were made for total energy intake at baseline and change in total energy intake from baseline to follow-up. With a 5% level of significance and 80% power for a sample of 100 women, correlations of 0.26 and above could be detected. Statistical significance was set at P<0.05, with marginal significance at P<0.10. SPSS/PC (version 10.0, 1999, SPSS Inc, Chicago, IL) was used for the analyses.

RESULTS AND DISCUSSION

The average participant was 32.6±8.5 (mean±standard deviation) years of age, with 12.0±1.6 years of education, living in a household size with 4.0±1.4 members. The sample self-identified as 45% African American, 23% white, 21% Hispanic, 3% American Indian, and 5% other. Fruit and vegetable intakes for the randomly selected subsample (n=55) from whom biochemical measures were obtained at baseline were not substantially different from the full sample.

Changes in the enabling (r=0.30, P=0.004) and intention domains (r=0.42, P<0.0001) were positively associated with change in the fruit/vegetable behaviors (Table). The change in the predisposing domain was marginally associated with vitamin A (r=0.15, P<0.10). Overall scores of participants' perceptions of psychosocial predictors of fruit and vegetable behaviors were moderately consistent longitudinally with their reported changes in fruit and vegetables behaviors (r=0.28, P=0.01), vitamin C (r=0.25, P=0.02), and marginally vitamin A (r=0.15, P<0.10), and folate (r=0.17, P=0.08). Most importantly, the change in overall score (r=0.31, P=0.02) and the intention domain (r=0.33, P<0.01) were positively associated with the change in serum carotenoids (Table). Correlations based on a single change score, such as those stated here, rarely exceed r=0.3 to 0.4, according to Nunnally, as people are far too complex to permit a highly accurate estimate of psychosocial constructs (27). At the same time, random error associated with participant responses to the tool inflates the variance of the mean difference between pre- and postscores (28). The result is a decrease in sensitivity.

Results suggest that this new brief tool, although imperfect, will be useful for program evaluation in low-

Table. For assessment of sensitivity, comparison of change scores for evaluation tool with change in four diet quality indicators: Fruit and vegetable behaviors, selected nutrients from 24-hour dietary recalls, fruit and vegetable servings, and biomarker serum carotenoids[abc]

			Change in Diet-Quality Indicator		
			Fruit and Vegetable Behavioral Scale (7 items)[d]	24-Hour Dietary Recalls (Servings or Nutrients)	Biomarker: Serum Carotenoids
Domains and constructs of new instrument	Items (n)	Points[e] (range)	n=93 *r* (*P* value)	n=93 *r* (*P* value)	n=55 *r* (*P* value)
Predisposing (change)			NS	Vitamin A, 0.15 (0.10)	NS
Perceived benefit	2	0-1			
Perceived control	2	0-1			
Enabling (change)				NS	NS
Self-efficacy	6	0-1	0.30 (0.004)		
				Servings of fruit and vegetables, 0.22 (0.02)	
Intention (change)			0.42 (<0.0001)	Vitamin C, 0.17 (0.05)	0.33 (<0.01)
Readiness to eat more fruit	1	0-1			
Readiness to eat more vegetables	1	0-1			
Perceived diet quality	1	0-1			
All domains (change)	13	0-6	0.28 (0.01)	Vitamin A, 0.15 (0.10) Vitamin C, 0.25 (0.02) Folate, 0.17 (0.08)	0.31 (0.02)

[a]The change indicators are serum carotenoids as the biomarker; hypothesized nutrients and servings from the 24-hour dietary recalls: vitamins A and C, beta carotene, folate, servings of fruit and vegetables; and a 7-item fruit and vegetable behavioral scale.
[b]Partial correlation coefficients were adjusted for total dietary energy intake at baseline and change in total energy intake from baseline to follow-up.
[c]NS=not statistically significant.
[d]Adapted with permission for new scoring method. From Townsend M, Kaiser L, Allen L, Joy AB, Murphy S. Selecting items for a food behavior checklist for a limited-resource audience. *J Nutr Educ Behav.* 2003;35:69-82.
[e]For scoring, each construct has a maximum value of 1 point for a range of 0 to 6 points for the tool.

income communities in California (29). To provide consistency in administration of the tool and reduce random error, an instruction guide was developed and reviewed by eight professional and paraprofessional staff (30). A valid assessment of fruit and vegetable behaviors, similar to the fruit and vegetable scale previously reported with this food-stamp audience (4,31,32) or another valid assessment of fruit and vegetable behaviors is recommended as an accompaniment.

This research is unique for two reasons. This study is the first to report sensitivity to change for a psychosocial fruit and vegetable tool and to use a biomarker as a gold standard to assess change. This systematic process yielded a moderately sensitive evaluation tool useful with a limited-resource audience.

The small number of items for assessing each construct is a limitation, but a necessary one, given the goal of developing a brief tool with a low respondent burden for Food Stamp Nutrition Education and Expanded Food and Nutrition Education Program (5,7). Participant education levels were higher than that of our usual Expanded Food and Nutrition Education Program and Food Stamp Nutrition Education clients. Consequently, selection bias must be considered as a potential threat to the external validity of the study (28), and caution is needed in generalizing these results to other program participants in California. At the same time, the need for additional research to improve the psychometric characteristics of the tool is recognized.

CONCLUSIONS

This systematic process yielded a moderately sensitive evaluation tool useful with a limited-resource audience. Nutrition researchers in other states might find this systematic research process and results useful when designing brief instruments for interventions with similar content and target audience, such as those in 5 A Day for Better Health Program, Expanded Food and Nutrition Education Program, Food Stamp Nutrition Education, and Special Supplemental Nutrition Program for Women, Infants, and Children.

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