Selecting Items for a Food Behavior Checklist for a Limited-Resource Audience

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ABSTRACT

Objective: To report 6 psychometric properties of food behavior checklist (FBC) items and then to use these properties to systematically reduce the number of items on this evaluation tool.

Design: Random assignment to the intervention and control groups.

Setting: Low-income communities.

Participants: Women (N = 132) from limited-resource families.

Main Outcome Measures: Reliability, internal consistency, baseline differences by ethnicity, sensitivity to change, and criterion and convergent validity of subscales.

Results: The fruit and vegetable subscale showed a significant correlation with serum carotenoid values ($r = .44$, $P < .001$), indicating acceptable criterion validity. Milk, fat/cholesterol, diet quality, food security, and fruit/vegetable subscales showed significant correlations with dietary variables. Nineteen items have acceptable reliability. Twenty items showed no baseline differences by ethnic group. Eleven of the 15 items expected to show change following the intervention demonstrated sensitivity to change.

Conclusions and Implications: This brief food behavior checklist (16 items) is easy to administer to a client group, has an elementary reading level (fourth grade), and has a low respondent burden in addition to meeting requirements for validity, reliability, and sensitivity to change. This study establishes a process that can be used by other researchers to develop and further refine instruments for use in community health promotion interventions.

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INTRODUCTION

Evaluation of community health promotion interventions poses a significant methodological challenge. Dietary instruments must be valid, reliable, internally consistent, and sensitive to small dietary changes, as well as easy to administer and inexpensive to score.[1] Traditional methods of dietary assessment such as 24-hour dietary recalls, multiple-day food records, or food frequency questionnaires are not practical to use in community settings.[2] Their length, respondent burden, scoring method, and/or validity, when administered in a group setting, can be problematic. Traditional methods can be insensitive to small changes targeted at specific eating behaviors or methods of food preparation.[3] Consequently, a pressing need exists for evaluation tools that are valid, reliable, and practical to use in field settings with all participants.[2]

Specifically, an evaluation instrument is needed for low-income, multiethnic audiences that is appropriate for two community-level federally funded education programs: (1) the Expanded Food and Nutrition Education Program (EFNEP) and (2) the Food Stamp Nutrition Education Program (FSNEP). A recent review of possible evaluation measures for low-income audiences recommended that, in addition to being valid in a group setting, reliable, and sensitive to change, a suitable instrument should also be appropriate for diverse audiences, useful as a teaching tool, quick to administer, and easy for limited-literacy participants to complete.[4] An appropriate evaluation measure for this audience should also reflect the program objectives, duration of the intervention, and characteristics of the clientele.[5] "Establishing validity and reliability requires additional research time and effort . . . but it is essential,"[5] and it is particularly essential for federally funded programs such as EFNEP and FSNEP. This type of research helps to establish the trustworthiness of the evaluation tool.

In our review of the literature, no evaluation instruments for community settings were found meeting these criteria and covering the range of dietary topics included in EFNEP and FSNEP interventions such as increasing fruit, vegetable, and calcium intakes;decreasing fat intake; and assessing food security status. Most existing instruments focused on one content domain: fat,[2,3,6-16] fruit and vegetables,[17-23] calcium,[24] or food security.[25] Occasionally, 2 or 3 content domains including fiber were assessed by one instrument.[26-28] Few were considered for use with interventions.[3,6,13-15,26-28] The majority were designed for population surveillance, for monitoring, or as screeners in a clinic setting.

In a recently published article, we described the steps involved in the development and evaluation of a 39-item group-administered food behavior checklist (FBC) for EFNEP and FSNEP settings.[29] These steps included item selection, item scaling, and criterion and convergent validation to generate a 22-item checklist for a limited-resource audience. Our purpose for this article was to report on an extension of that work: item reduction of the checklist. Specifically, our purpose was to (1) conduct additional analyses with the 22 valid items, (2) use those results for item reduction to produce a brief checklist meeting the additional requirements discussed by McClelland et al[4] and Contento et al,[5] and (3) report the characteristics of the resulting brief checklist. Our ultimate goal is to have a behaviorally focused checklist, satisfying the mentioned criteria, for evaluation of our EFNEP and FSNEP interventions.

METHOD

Sample

The study was conducted at the University of California, Davis, and the University of California Cooperative Extension in 9 counties (Alameda, Fresno, Los Angeles, Monterey, San Francisco, San Joaquin, San Mateo, Santa Barbara, and Santa Clara). Study participants were English-speaking women who were receiving Food Stamps and who had at least 1 child less than 19 years of age living at home. To examine cultural differences in instrument response, an effort was made to recruit a sample that was approximately 50% black and 50% white. Participants (N = 132) were recruited through community organizations and agencies such as the Special Supplemental Food Program for Women, Infants and Children (WIC) and Head Start. The participant received $50 if she agreed to receive 2 venipunctures in addition to providing the other data or $30 for her participation without the blood draws.

Design and Protocol

The study protocol and instruments were reviewed and approved by the Human Participants Review Committee of the University of California,Davis. After signing the consent forms,participants were randomly assigned to 2 groups.The first group (treatment) received 6 weekly nutrition education classes (1 to 2 hours in length).The second group served as a delayed intervention control. Data collected at 2 time points (before and after the 6-week period) included demographic information,FBC, 3 24-hour dietary recalls, and serum sample. Of the 132 recruited for the study, 32 participants did not complete all 3 days of dietary data collection prior to the intervention or did not supply all of the necessary demographic data. Consequently, convergent validity, sensitivity to change, and internal consistency were reported for the 100 participants with complete data. Reliability was examined among an additional 44 women who completed a second FBC about 3 weeks after the initial interview with no intervening nutrition education intervention. A subsample of 59 participants was randomly selected for blood draws. To simulate the method for administering the FBC during the first nutrition education class, each participant completed the FBC without assistance from staff, unless it was requested. FBC instructions to participants included,"As you read each question, think about how you *usually* do things now."

In each county, a second paraprofessional who did not collect data delivered the nutrition education intervention during the months of February through April 1997.The lesson objectives focused on "usual" FSNEP and EFNEP content: increasing fruit, vegetable, and dairy/calcium intakes; reducing fat intake; increasing diet quality; and enhancing food shopping and preparation skills.

Staff Training

Two staff persons were hired in each of the counties, one for data collection and one for program delivery. All staff and supervisors participated in a 2-day intensive training to ensure that procedures and protocols were followed explicitly.

To assist the reader, a summary of the development of the original 39 FBC items and an estimation of their validity are provided here in steps 1 and 2.This previously reported work focused on the validation process.[29] The current article focuses on other analyses, for example, reliability, internal consistency, and sensitivity to change, to further reduce the number of items to a brief checklist.

Step 1: Item pool selection and scaling. This step included development of the original 39 items, their response options, focus group interviews. and content validation.Items for this checklist and their specific wording came from previously published research[3,6,11,13,25]; recommendations from an EFNEP evaluation committee in California; recommendations from the staff at the Center for Nutrition Policy and Promotion, US Department of Agriculture (USDA); and findings from focus group interviews conducted in California. Items reflected the content of the EFNEP and FSNEP educational experiences. A longer version was initially tested by the authors in individual interviews with EFNEP clients to identify and modify items that were not well understood. A pilot study using the revised instrument was conducted in several counties. Based on feedback from county nutritionists,

the instrument was further revised and shortened to the 39-item checklist (Table 1). The items were organized into 5 sections or subscales that covered important content areas or domains in the education intervention (see Table 1).

Several items related to sugar intake were included in the diet quality subscale. Sugar items could not be validated against added sugar intake because food composition tables containing added sugar were not available. However, we hypothesized that high-sugar foods might replace calories from more nutrient-dense foods and thus would be related to diet quality, as measured by the Healthy Eating Index (HEI).[30] Two items were related to food security. The first was from the mandated national EFNEP FBC. The second, deemed to measure a similar level of food insecurity, was drawn from the USDA 18-item Food Security Scale to serve as a comparison item.[25] Although food safety is an important content area in EFNEP and FSNEP, validation of those items was beyond the scope of this study.

Items were worded so that the desirable food behavior was not always linked to the same type of response. Responses were re-coded during analyses so that an increase in score always reflected a change in the desired direction.

Step 2: Item validation. Validity is an important characteristic of an evaluation measure[4,5] and is an estimate of the accuracy of the new instrument. Specifically, it is defined as the extent to which a measuring instrument (item or scale) measures what it is intended to measure.[31] There are various types of validity, for example, face, content, criterion, and convergent, among others, and each type takes a somewhat different approach in assessing the extent to which an assessment tool measures what it is intended to measure.[5,31] Having examined the first 2 types of validity in step 1, we examined 2 additional types of validity in step 2. First, criterion validity of the FBC items was examined using a biological measure (serum carotenoids) as a gold

Table 1. Estimation of Criterion and Convergent Validity of 22 Food Behavior Checklist Items†

	Criterion Validity‡§: Serum Carotenoid Correlation (n = 59)	Convergent Validity‡§: Recall Nutrient and Food Group Correlation (n = 100)
	r, *P* Value	*r*, *P* Value
Fruit and Vegetable Items		
Expect positive correlations with serum carotenoids, vitamins A and C, beta-carotene, folate, dietary fiber, servings of fruit and vegetables, and Healthy Eating Index (HEI).		
1. Do you eat more than 1 kind of fruit daily?‖	.32*	.23* vitamin A .20* vitamin C .30** serving fruit
2. During the past week, did you have citrus fruit or citrus juice?¶	.35**	.24* vitamin C .27** serving fruit
3. Do you eat more than 1 kind of vegetable a day?‖	.28*	.24* fiber .28** vitamin A .24* vitamin C .29** folate .34** serving vegetables
4. How many servings of vegetables do you eat each day?#	.33*	.35** fiber .27** vitamin A .31** carotene .30** folate .32** serving vegetables .20* HEI
5. Do you eat 2 or more servings of vegetables at your main meal?‖	.35**	.27** fiber .25* vitamin A .28** serving vegetables .25* HEI
6. Do you eat fruit or vegetables as snacks?‖	.27*	None

Murphy S, Kaiser L, Townsend M, et al. Evaluation of validity of items for a food behaviour checklist. 2001;101:751-761.

Continued

Table 1. *Continued*

	Criterion Validity[‡§]: Serum Carotenoid Correlation (n = 59)	Convergent Validity[‡§]: Recall Nutrient and Food Group Correlation (n = 100)
	r, *P* Value	*r*, *P* Value
7. How many servings of fruit do you eat each day?[#]	.31*	.32** fiber .28** vitamin A .29** carotene .24* vitamin C .27** folate .39*** serving fruit .20* HEI
8. During the past week, did you have raw vegetables?[¶]	NS	.22* HEI
9. Do you eat low-fat instead of high-fat foods?[‖]	.48***	.27** vitamin A .31** carotene .22** serving vegetables
Milk Items		
Expect positive correlations with vitamin A, riboflavin, calcium, and servings of dairy.		
10. Do you drink milk daily?[‖]	NA	.30** calcium .26** vitamin A .32** riboflavin
11. During the past week, did you have milk as a beverage or on cereal?[¶]	NA	.21* calcium .21* riboflavin .26** vitamin A .23* serving dairy
Fat and Cholesterol Items		
For most items, expect positive correlation with energy, fat, saturated fat, and cholesterol; for fish consumption and taking the skin off chicken, the correlations should be negative.		
12. During the past week, did you have fish?[¶]	NA	–.20*, % energy as saturated fat
13. Do you take the skin off the chicken?[‖]	NA	–.20*, % energy as saturated fat
14. How many times a week do you usually eat food from a fast-food restaurant?[#]	NA	.22* energy .26* total fat .25* saturated fat
15. During the past week, did you have eggs?[¶]	NA	.23* fat .38** cholesterol
16. If you eat eggs, about how many eggs do you usually eat in a week?[#]	NA	.28** fat .25* saturated fat .50*** cholesterol
Diet Quality Items		
Expect positive correlations with serum carotenoids, vitamin and mineral intake, fiber, servings of fruit and vegetables, and the HEI.		
17. When shopping, do you use the Nutrition Facts on the food label to choose foods?[‖]	.28*	.20* fiber .41*** vitamin A .24* vitamin C .25* HEI
18. Do you drink regular soft drinks?[††]	NS	.30** HEI
19. Do you buy Kool-Aid, Gatorade, Sunny Delight, or another fruit drink/punch?[††]	NS	.26* HEI
20. Would you describe your diet as excellent, very good, good, fair, or poor?[‡‡]	.45***	.24* vitamin C .30** serving fruit

Continued

Table 1. *Continued*

	Criterion Validity[‡§]: Serum Carotenoid Correlation (n = 59)	Convergent Validity[‡§]: Recall Nutrient and Food Group Correlation (n = 100)
	r, *P* Value	*r*, *P* Value
Food Security Items		
Expect positive correlations with servings of vegetables and fruit or HEI and negative correlation with fat intake because questions have been recoded to reflect food security.		
21. Do you run out of food before the end of the month?[††]	NA	–.20* % energy fat .21* serving fruit
22. Do you worry whether your food will run out before you can buy more?[††]	NA	.20* serving fruit

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*$P < .05$; **$P < .01$; ***$P < .001$;

[†]Adapted from Murphy SP et al.[29]

[‡]Spearman correlation coefficients were calculated to evaluate associations of the potential food behavior checklist (FBC) items with dietary recall and biochemical variables.Four items (frequency of eating fast food, eggs, fruit, and vegetables) were log-transformed for the analyses. Correlations between FBC items and dietary recall nutrient intakes and food group servings were considered to be statistically significant if a relationship was hypothesized (eg, milk intake and calcium) and the *P* value was less than .05.Although all significant relationships by this definition are presented, the number of tests performed suggests that some of the associations could have occurred by chance. Thus, we focus on correlations with *P* values of .01 or less.For dichotomous items (yes/no responses), the correlations were actually *t* tests;therefore, the coefficients are not directly interpretable.

[§]The following items did *not* show hypothesized correlations with values from the nutrient/food group or serum carotenoid analyses:

- Fruit and vegetable items: *During the past week, did you have cooked vegetables? During the past week, did you have other fruit or fruit juice (noncitrus)? When you cook, do you add extra vegetables to the dish?*
- Fat/cholesterol items: *Do you put butter or margarine on bread, rolls, or muffins? Do you cook potatoes or other vegetables in oil, lard, butter, or margarine? Do you put butter or margarine on potatoes or other vegetables? Do you trim all visible fat from meat? Do you use low-fat (2%), very low-fat (1%), buttermilk, or nonfat (skim) milk? When you eat hamburger, chicken, fish, or other meat, is it fried? Do you put regular sour cream, cheese, or other cream sauces on vegetables, potatoes, or pasta dishes? When you eat cheese, do you eat special, low-fat cheeses?*
- Diet quality items: *Do you buy sweetened cereal (like Frosted Flakes, Fruit Loops, Lucky Charms, etc)? Do you drink diet soft drinks?*
- Salt item: *Do you add salt to your food?*
- Fiber item: *When you eat bread, do you eat whole-wheat bread?*
- Food expenditure items: *Do you buy store brands of canned, frozen, or other packaged foods? Do you make main dishes from scratch?*

[‖]Always = 4, often = 3, sometimes = 2, never = 1.

[¶]Yes = 2, no = 1.

[#]Open-ended question.

[††]Always = 1, often = 2, sometimes = 3, never = 4.

[‡‡]Excellent = 5, poor = 1.

NA indicates not applicable;NS, not significant.

standard. Second, convergent validity was examined using the mean of 3 24-hour dietary recalls at baseline. Although dietary recalls were not considered a gold standard for dietary intake, we expected nutrient intakes derived from 24-hour dietary recalls to correlate with related food behaviors.

Dietary recalls A detailed description of all foods and beverages participants consumed during the previous 24 hours was collected from participants by the data collection staff person using a modified three-pass method.[32] The 3 passes included: listing foods, adding detailed descriptions of each food, and reviewing list to capture missing food items.The individual interview for the first recall was conducted in person using standardized probes and a 2-dimensional portion guide, based on Posner et al.[33] The second and third recalls were collected by individual interview over the phone. The nutrient database contained 29 nutrients for approximately 1000 foods and was a subset of the USDA Nutrient Database for Individual Surveys, updated to release 8 (USDA/Food Survey Research Group, 1995 release).To estimate food group servings, the methodology used in calculating food group intakes for the Healthy Eating Index (HEI) was followed.[30] Groups were defined to correspond to the Food Guide Pyramid (FGP).[34] Items that were mixtures of ingredients from multiple food groups contributed to total servings from each group. The HEI score, a measure of diet quality, was calculated.[30].

Serum carotenoids Data collection staff arranged for blood samples to be collected from participants in clinics in eight counties. Participants were scheduled for early morning blood draws and followed instructions to enable fasting blood samples to be obtained. Samples were immediately centrifuged, aliquoted, frozen, and shipped for analysis on dry ice to the University of California at Davis, Department of Nutrition. Total serum carotenoids were measured by a spectrophotometric method after conjugation to trifluoroacetic acid.[35]

Step 3: Item reduction. Item reduction of the FBC is the focus of this article. Additional analyses were used to reduce the 22 valid items to a brief FBC. Specifically, our purpose in step 3 was to (1) conduct additional analyses with the 22 valid items and (2) then use those results for item reduction to produce a brief checklist meeting the requirements mentioned above.

In this step, additional psychometric properties were examined: reliability, internal consistency, baseline differences by ethnicity, and sensitivity to change. SAS/PC (Version 6.1, SAS Institute, Cary, NC) and SPSS/PC (Version 8.0, SPSS Inc, Chicago, Ill) were used for the analyses described below. Performance criteria were established to delete items that detracted from or did not contribute to the usefulness of the instrument using the method of Kirshner et al.[36]

Reliability. Participants completed the FBC on 2 occasions 3 weeks apart with no intervention. Reliability of individual items, also known as stability, was defined as the coefficient from the Spearman rank order correlation between the scores for that item at the 2 time points.[26,31]

Internal consistency. Another measure of reliability, internal consistency of subscales, reflected how well the items related to one another in a subscale and was determined by Cronbach coefficient α.[37] Items were deleted to build subscales with maximum α level, with consideration of theoretical justification for retaining or deleting items.[31] Coefficient α was calculated for subscales with 3 or more items.

Ethnic baseline differences Ideally, items should score similarly for each ethnic group, but we recognized that cultural differences in food patterns or interpretation of the items existed. Items that varied across ethnic groups were identified and "flagged" to permit adequate interpretation of results when those FBC items were used as evaluation measures. Analysis of variance (SAS, PROC GLM) was used to determine baseline response differences by ethnic group.

Sensitivity to change. Defined as the difference between baseline and post-intervention scores for each item, sensitivity to change was measured using analysis of variance, adjusting for baseline values for those content areas in which change occurred. With the exception of food insecurity, the intervention was expected to alter the eating behaviors represented by the FBC items. However, if the intervention did not change nutrient intakes or food group servings, as assessed by difference in the means from the pre and post dietary recalls, then the corresponding FBC behaviors were not examined for sensitivity to change.

Parsimonious checklist. An important characteristic for the final checklist was that it be as short as possible to reduce respondent burden.[36] Time spent on data collection comes at the expense of the educational experience,[2] and a lengthy or complicated evaluation tool can generate frustration among our low-literacy clients. Consequently, to produce a parsimonious checklist, items that reflected unique behaviors were given priority. If 2 items were highly correlated at baseline using Spearman rank order correlation coefficients but were otherwise suitable for the checklist, one was deleted as both were not deemed necessary.[36]

Other characteristics of a brief FBC. In addition to the analyses in step 3, other characteristics of the brief FBC are reported in this article.

Readability. Readability was defined as the ease of understanding or comprehension of the evaluation tool owing to vocabulary, sentence length, writing style, and other factors.[38] Using Grammatik software (Grammatik for Macintosh, Reference Software International, San Francisco, Calif, 1990), readability of the FBC was reported as the Flesch Kincaid and the Flesch Reading Ease scores. The Flesch Kincaid formula included average number of words per sentence and average number of syllables per word and produced a grade-level score. The Flesch Reading Ease formula was based on average sentence length and number of syllables per 100 words and was reported as a numeric score from 0 to 100, with a higher score denoting a lower reading level.[39]

Ease of administration. The 24-hour dietary recall was administered to the participant individually and in a group setting by the paraprofessional and compared with the FBC for ease of administration. The goal was an assessment tool that is quick to administer.[4]

Respondent burden. This was determined by comparing the time (minutes) for participants to complete the traditional 24-hour diet recall used in EFNEP with the time for participants to complete the new FBC. The goal was a reduced burden for the participant.[4]

Criterion validity for fruit/vegetable subscale. Item scores were summed for a subscale score. Criterion validity was defined as the Spearman rank order correlation coefficient of the subscale score with serum carotenoids.

Convergent validity for subscales. Convergent validity was defined as the Spearman rank order correlation coefficient of the subscale score with the hypothesized nutrients and food groups from the mean of 3 24-hour dietary recalls.

RESULTS

Sample Characteristics

Mean age of the participants was 33 ± 9 years with a mean of 12 ± 2 years of education. Average household size was 3.9 ± 1.9 members. The treatment group was significantly older than the control (34 versus 28 years, respectively) and also received more food stamps ($211/month versus $138/month). The sample self-identified as 46% black, 23% English-speaking Hispanic, 21% non-Hispanic white, and 10% other groups (Asian, Native American). Owing to the small number of Asian and Native American participants, the influence of ethnicity on responses was examined only among English-speaking black, Hispanic, or non-Hispanic white participants (n = 84). The randomly selected subsample from which biochemical measures were obtained (n = 59) was not significantly different from the full sample (data not shown).

Item Validation

The 22 FBC items showed significant, expected correlations with either serum carotenoid values or with dietary recall variables. The results from serum and dietary recall analyses have been reported in detail elsewhere[29] and are summarized in Table 1. A list of expected associations for each FBC domain is shown with the related items in Table 1. The 17 items that could not be validated with these methods are listed in the footnote to Table 1.

Other Properties

The results for the 22 valid items for reliability, ethnic baseline differences, and sensitivity to change from step 3 are shown in Table 2. The characteristics of the subscales in the brief FBC are shown in Table 3.

Reliability. Reliability coefficients showed that 20 of the 22 items met the criterion ($P < .05$) for reliability (see Table 2). The retained items have an acceptable level of stability ($P < .05$).

Internal consistency. The Cronbach α correlation coefficients for the fruit/vegetable and diet quality subscales had acceptable internal consistency values (coefficients = .80 and .61, respectively) using a cutpoint of .60.[5,40] Spearman correlation coefficients were calculated for the fat/cholesterol

Table 2. Additional Psychometric Properties of 22 Valid Food Behavior Checklist (FBC) Items†

	Reliability (n = 44)	Ethnic Baseline Differences (n = 84)	Sensitivity to Change for Items Expected to Change‡ (n = 78)	Rationale for Exclusion from Short FBC
	r, *P* Value	*P* Value	*P* Value	
Fruit and Vegetable Items				
1. Do you eat more than 1 kind of fruit daily?‡§	.35*	NS	< .05	
2. During the past week, did you have citrus fruit or citrus juice?‖	.58***	NS	NS	
3. Do you eat more than 1 kind of vegetable a day?§	.65****	NS	NA	
4. How many servings of vegetables do you eat each day?¶	.58***	NS	NA	
5. Do you eat 2 or more servings of vegetables at your main meal?§	.55***	NS	NA	
6. Do you eat fruit or vegetables as snacks?§	.53***	NS	< .05	
7. How many servings of fruit do you eat each day?¶	.42**	NS	< .01	
8. During the past week, did you have raw vegetables?‖	.78****	NS	NA	Not valid with serum carotenoids or servings of vegetables. Surrogate for diet quality.
Milk Items				
9. Do you drink milk daily?§	.77****	NS	NA	
10. During the past week, did you have milk as a beverage or on cereal?‖	.38*	NS	NA	
Fat and Cholesterol Items				
11. During the past week, did you have fish?‖	.68****	NS	NA	
12. Do you take the skin off the chicken?§	.68****	Whites, 2.8 Blacks, 1.9 *P* < .006	< .05	

Continued

Table 2. *Continued*

	Reliability (n = 44)	Ethnic Baseline Differences (n = 84)	Sensitivity to Change for Items Expected to Change† (n = 78)	Rationale for Exclusion from Short FBC
	r, *P* Value	*P* Value	*P* Value	
13. How many times a week do you usually eat food from a fast-food restaurant?¶	.58****	Whites, 1.0 Blacks, 1.9 Latinos, 2.1 White vs Black, *P* < .04; White vs Latino, *P* < .01	NS	Sensitivity to change not observed
14. During the past week, did you have eggs?‖	.27 NS	NS	< .05	May not be useful as teaching tool
15. If you eat eggs, about how many eggs do you usually eat in a week?¶	.75****	NS	< .05	May not be useful as teaching tool
16. Do you eat low-fat instead of high-fat foods?§	.23 NS	NS	< .05	Not valid for fat; ambiguous for clients and staff as a fruit/vegetable item
Diet Quality Items				
17. When shopping, do you use the Nutrition Facts on the food label to choose foods?§	.39**	NS	< .001	
18. Do you drink regular soft drinks?#	.83****	NS	< .0001	
19. Do you buy Kool-Aid, Gatorade, Sunny Delight, or other fruit drink/punch?#	.72****	NS	< .0001	
20. Would you describe your diet as excellent, very good, good,fair, or poor?††	.73****	NS	< .001	
Food Security Items				
21. Do you run out of food before the end of the month?#	.68****	NS	NA	
22. Do you worry whether your food will run out before you can buy more?#	.69****	NS	NA	With a correlation of .85 for the two food security items, both are not necessary

*$P < .05$, **$P < .01$, ***$P < .001$, ****$P < .0001$.

†The mean of 3 24-hour recalls after the intervention compared with the mean of 3 recalls before the intervention indicated positive dietary changes for fruit, fat, and diet quality.Vegetables and milk intakes did not change with the intervention. Food security status was not expected to change over this short interval.

‡Items in boldface are retained in the brief food behavior checklist.

§Always = 4, often = 3, sometimes = 2, never = 1.

‖Yes = 2, no = 1.

¶Open-ended question.

#Always = 1, often = 2, sometimes = 3, never = 4.

††Excellent = 5, poor = 1.

NA indicates not applicable;NS, not significant ($P > .05$).

and milk/calcium content areas because only 2 valid items are currently available for each domain. The nonsignificant correlation for the two fat/cholesterol items (see Table 3) indicated that they are not correlated with each other, although they were each correlated with a dietary fat variable (see Table 1).

Ethnic baseline differences. Responses to 2 of the 22 items were significantly different among the black, non-Hispanic white, and Hispanic participants: "Do you take the skin off the chicken?" ($P < .05$) and "How many times a week do you usually eat food from a fast-food restaurant?" ($P < .05$). White participants reported removing chicken skin more often than black participants did. Compared with the non-Hispanic white participants, the Hispanic and black participants reported greater frequency of eating at fast-food restaurants (see Table 2).

Sensitivity to change. Sensitivity to change was examined for those items expected to change as a result of the educational experience, that is, fruit, fat/cholesterol, and diet quality

items. This analysis could not be conducted for the milk/calcium, vegetable, and fish FBC items because no changes owing to the intervention were evident from the mean values of food group servings and nutrient intakes calculated from the mean of 3 24-hour recalls at baseline and the mean of 3 recalls post-intervention. Eleven of the 13 remaining FBC items expected to show change demonstrated sensitivity to change.

Further Reduction of Items

We used the above results to further eliminate items from the FBC. Two fat items were significantly correlated with dietary fat and cholesterol variables (see Table 1) but were removed from the FBC: "During the past week, did you have eggs?" and "If you eat eggs, about how many eggs do you usually eat in a week?" Although both items were positively related to fat and cholesterol intake, the goal of the EFNEP and FSNEP interventions was not necessarily to reduce consumption of eggs, an inexpensive source of protein for EFNEP/FSNEP clients, but rather to change the way in which eggs were prepared (ie, fried) or served (ie, with bacon or sausage). Neither of these issues was addressed in the wording of the items (our error). To avoid inadvertently recommending a reduction in eggs for low-income families, we eliminated the items until revision and further testing are possible. We recommend that the 2 items be tested as "When you serve eggs, are they fried?" and "When you serve eggs, do you serve them with sausage, bacon, or ham?"

The item from the fat/cholesterol subscale, "How many times a week do you usually eat food from a fast-food restaurant?" was correlated with total calories, total fat, and saturated fat but was not sensitive to change following our low-intensity intervention and was deleted (see Table 2). It is altogether possible, however, with longer, more intensive EFNEP/FSNEP interventions that this item could be significantly altered by the educational experience. Another item, "Do you eat low-fat instead of high-fat foods?" performed as a surrogate for fruit and vegetable consumption, rather than fat (see Table 1). We deleted the item from the fat subscale and did not place it among the final fruit and vegetable items in Table 3 to avoid confusion by the paraprofessional educators delivering the program.

The 2 food security items were considered for the checklist. We did not expect our relatively low-intensity intervention to improve food security for these families. However, including these items on the FBC would enable nutrition educators to assess the level of economic constraints and tailor the intervention accordingly. These items also provided a way to explain situations in which nutrition education appears to have little impact on food choices. The responses

Table 3. Current 16-Item Food Behavior Checklist for Use with Some Low-Income Clientele; Properties of 5 Content Areas: Criterion Validity for Fruit/Vegetable Subscale, Convergent Validity for 4 Subscales, Internal Consistency for Subscales.

	Criterion Validity for Subscale: Serum Carotenoid Correlation (n = 59)	Convergent Validity for Subscale: Recall Nutrient and Food Group Correlation (n = 100)	Internal Consistency for Subscale (α) or Spearman Correlation if Only 2 Items (*r*) (n = 100)
	r, *P* Value	*r*, *P* Value	α or *r*, *P* Value
Fruit and Vegetable			
1. Do you eat more than 1 kind of fruit daily?†			
2. During the past week, did you have citrus fruit or citrus juice?‡ Reword: During the past week, did you have citrus fruit (such as orange or grapefruit) or citrus juice?			
3. Do you eat more than 1 kind of vegetable a day?†			
4. How many servings of vegetables do you eat each day?§			
5. Do you eat 2 or more servings of vegetables at your main meal?†			
6. Do you eat fruit or vegetables as snacks?†			
7. How many servings of fruit do you eat each day?§			
7-Item fruit and vegetable scale Expect positive correlations with serum carotenoids, vitamins A and C, beta-carotene, folate, dietary fiber, servings of fruit and vegetables, and Healthy Eating Index (HEI)	0.44***	Servings fruit, .36**** vegetables, .33*** fiber, .31** vitamin C, .32*** vitamin A, .29** folate, .26* beta-carotene, .25*	α = .80

Continued

Table 3. *Continued*

	Criterion Validity for Subscale: Serum Carotenoid Correlation (n = 59)	Convergent Validity for Subscale: Recall Nutrient and Food Group Correlation (n = 100)	Internal Consistency for Subscale (α) or Spearman Correlation if Only 2 Items (*r*) (n = 100)
	***r*, *P* Value**	***r*, *P* Value**	**α or *r*, *P* Value**
Milk			
8. Do you drink milk daily?†			
9. During the past week, did you have milk as a beverage or on cereal?‡			
Subscale Expect positive correlations with vitamin A, riboflavin, calcium, and servings of dairy	NA	.27** vitamin A .27** riboflavin .30*** calcium .33**** serving dairy	*r* = .47**
Fat and Cholesterol			
10. During the past week, did you have fish?‡			
11. Do you take the skin off the chicken?†			
2-Item fat and cholesterol subscale For most items, expect positive correlation with energy, fat, saturated fat, and cholesterol;for fish consumption and taking the skin off chicken, the correlations should be negative	NA	–.25* % energy as saturated fat	*r* = NS
Diet Quality			
12. When shopping, do you use the Nutrition Facts on the food label to choose foods?†			
13. Do you drink regular soft drinks?‖			
14. Do you buy Kool-Aid, Gatorade, Sunny Delight, or other fruit drink/punch?‖			
15. Would you describe your diet as excellent, very good, good, fair, or poor?¶			
4-Item diet quality subscale Expect positive correlations with serum carotenoids, vitamin and mineral intake, fiber, servings of fruit and vegetables, and the HEI	.32*	.31**, HEI .34**, vitamin A .32**, vitamin C .23*, folate .28**, servings vegetables .35**, servings fruit –.25*, % energy from fat –.22*, % energy from saturated fat	α = .61
Food Security			
16. Do you run out of food before the end of the month?‖ Subscale Expect positive correlations with servings of vegetables and fruit or HEI and negative correlation with fat intake because questions have been recoded to reflect food security	NA	NA	NA

*$P < .05$, **$P < .01$, ***$P < .001$, ****$P < .0001$.
†Always = 4, often = 3, sometimes = 2, never = 1.
‡Yes = 2, no = 1.
§Open-ended question.
‖Always = 1, often = 2, sometimes = 3, never = 4.
¶Excellent = 5, poor = 1.
NA indicates not applicable; NS, not significant.

to the 2 food insecurity items were highly correlated ($r = .85$). Because our goal was a parsimonious checklist, we did not want to include 2 items measuring essentially the same behavior for the same individual in the same manner. To avoid redundancy, we chose to retain the item "Do you run out of food before the end of the month?" because of its correlations with both percent energy from fat and fruit intake (see Table 1). Others have also demonstrated that food insecurity is significantly correlated with lower household stores of fruit and vegetables[41] and with increased calories from fat.[42]

We retained "Would you describe your diet as excellent, very good, good, fair, or poor?" because of its excellent performance. It correlated with serum carotenoids, servings of fruit, and vitamin C; was stable and sensitive to change; and performed equally well with different ethnic groups (see Tables 1 and 2). However, recognizing that this item was a "belief," not a "behavior," we retained the item with the thought that it would eventually be placed on another evaluation measure (ie, a health beliefs questionnaire).

The citrus fruit item, "During the past week, did you have citrus fruit or citrus juice?" was valid and reliable but insensitive to change with these participants. Because no other item focused specifically on vitamin C–rich fruit among the FBC items, we recommend that the item be revised and tested as "During the past week, did you have citrus fruit (such as an orange or grapefruit) or citrus juice?" Knowledge of "citrus" may have been embedded in the wording of the item for participants in the study.

Because the correlation between the 2 milk items was relatively low, .47 ($P < .0001$), we retained both milk items. Further testing should include new items about cooking with milk and nonmilk/nondairy sources of calcium to complete this subscale as an indicator of calcium intake.

Other Characteristics of the Brief FBC

The brief FBC was examined for readability, ease of administration, and respondent burden. In addition, subscales were examined for convergent validity. The fruit and vegetable subscale was examined for criterion validity. The results in this section were not used for item reduction but to validate the quality of those reduction decisions.

Readability. The 16-item FBC demonstrated a reading level of less than fourth grade, as reported by 2 measures. A Flesch Kincaid score of 2.8 indicated a reading level of third grade. A Flesch Reading Ease score of 96 was equivalent to a "very easy reading"level or less than fourth grade. Because of limited literacy among EFNEP and FSNEP clients, particularly new immigrants, readability at grade 6 or lower was desirable.

Ease of administration. A group-administered instrument was the goal because most of the clients currently participate in group-delivered interventions. The primary EFNEP evaluation instrument, the 24-hour dietary recall, required a one-on-one environment with food models and probing questions for a valid result.[43] The 24-hour dietary recall required about 20 minutes of paraprofessional time to administer individually to a client.[4] For group administration, the recall required about 40 to 50 minutes to administer depending on the size of the group and with the assistance of a second paraprofessional. The FBC was tested by our paraprofessional staff in a variety of settings and found to be easier to administer to groups of participants than the recall and to require fewer total hours by paraprofessional staff.

Respondent burden. The simple format of the 16-item FBC enabled participants to complete it in 10 to 20 minutes, meeting the goal for an evaluation tool with a reduced respondent burden compared with the traditional dietary recall.

Subscale validity. The subscales showed significant correlations with hypothesized dietary recall variables (convergent validity of subscale). A list of these expected associations and results are shown with each subscale in Table 3. The fruit and vegetable subscale showed a significant correlation with serum carotenoid values ($r = .44$, $P < .001$), indicating acceptable criterion validity of this subscale.

DISCUSSION

Our purpose was to examine 22 valid FBC items for additional psychometric analyses and then to use those results to systematically reduce the number of items on this evaluation tool. Our ultimate goal was to produce a brief checklist that is easy to administer to a client group, has an elementary reading level, and has a low respondent burden in addition to meeting requirements for validity, reliability, and sensitivity to change.

The checklist items described here have performed reasonably well for assessing behaviors associated with overall diet quality, food security, fruit and vegetables, and milk intakes with our low-income participants. The sensitivity of the FBC to modest dietary changes from a low-intensity nutrition education intervention is an important finding for relevant items in this instrument. The milk/calcium and fat subscales require further testing and additional items. Internal consistency was acceptable for the fruit/vegetable and diet quality subscales. In particular, more research is needed to identify useful indicators of fat/cholesterol and calcium intakes in this population.

Because this brief FBC was readable by EFNEP clients with a fourth grade reading level, was easier to administer in a group setting by EFNEP and FSNEP paraprofessionals, and had a lower respondent burden for EFNEP clients compared with the traditional 24-hour recall, it was practical for evaluating behavior change with study participants. However, it is essential that these FBC items be studied with other EFNEP and FSNEP audiences, particularly audiences with other cultural backgrounds.

Two of the 22 items were different at baseline among English-speaking Latino, white, and black participants (see Table 2). Others have reported ethnic differences in the removal of skin from chicken and consumption of fried and high-fat foods.[44] Other, more subtle differences in food behaviors among the 3 ethnic groups may not have been detected owing to our small sample size for each subgroup. Consequently, our findings are not definitive. More research is needed comparing the psychometric properties of instru-

ments among ethnic subgroups of the population. This type of analysis is particularly important to researchers in our state, where our EFNEP clientele for FY 2000-2001 were 62% Latino, 17% black, 17% white, and 12% Asian, Native American, or Pacific Islander.

Sixteen items were retained in the final instrument (see Table 3), including one recommended for further testing. To enhance the appeal and comprehension of the written text, the final printed version of the FBC should include text with a large font size, artwork depicting real foods, use of bright colors, and a layout that includes white space to make the reading task appear less formidable.[45]

Strengths and Limitations

The development and evaluation of this brief FBC are useful to our low-income community education interventions for several reasons. First, nutrition paraprofessionals can use this FBC in California's EFNEP and FSNEP at baseline to customize the lessons to the strengths and weaknesses of client groups. Identification of specific behaviors to reinforce or to alter is valuable particularly when the length of the intervention is relatively short. Second, messages from the FBC such as "Eat fruit or vegetables as snacks" and "Remove the skin from chicken" are clearer client messages than more general messages such as "Eat 5 a Day," "Eat more fruit and vegetables," "Eat more fiber," and "Eat less fat." Third, program evaluation is essential for program refunding and, consequently, is valuable politically at the county, state, and federal levels. Nutrition professionals in EFNEP and FSNEP in other states may find these results useful when designing short instruments to evaluate the effectiveness of interventions with similar content domains. Fourth, the ease of administration and respondent burden for this FBC are markedly better compared with that of the 24-hour dietary recall. Last, interpretation of evaluation results for EFNEP and FSNEP can be accomplished only with use of an assessment tool shown to be accurate and reliable.

This research is unique in that this study is the only one in the literature on brief evaluation instruments to report 6 psychometric properties of FBC items and then to use these properties for item reduction to produce a parsimonious checklist tool. Another strength is use of a pretest-posttest control group design with random assignment to groups, allowing us to state with confidence that the study's internal validity is excellent.[46]

However, this study has a number of limitations that should be addressed. First, a participant's memory of her responses about food behaviors during the first interview for the reliability analysis may have influenced her responses at the second interview. The memory effect could lead to inflated reliability coefficients.[31] Second, variability in participant responses may be lower than that seen in the general EFNEP and FSNEP audience; the women who agreed to be in the study volunteered to participate. It is possible that FBC items are sensitive to change only for the participants who agreed to be in the study. These participants were sufficiently motivated by the monetary incentive or by an interest in the nutrition content. Consequently, selection–treatment interaction must be considered as a potential threat to the external validity of the research results.[46] Thus, caution is needed in generalizing these results to other low-income audiences in California. Third, the intervention itself was not sufficiently intense to stimulate behavior change in all of the desired domains. Therefore, sensitivity to change could not be tested for all FBC items. Fourth, nutrient intakes and food group servings calculated from the 3 dietary recalls were an imperfect measure of diet. For convergent validity, we compared the results from the new instrument (FBC items) with an imperfect representation of diet. The result was lower correlation coefficients than one might otherwise have with a perfect measure of diet.

Last, we could test this instrument only with a small sample of black, white, and English-speaking Hispanic subjects. We recognize that testing these FBC items with many ethnic and cultural groups is essential.

IMPLICATIONS FOR RESEARCH AND PRACTICE

With the increasing emphasis in community interventions on low-intensity education, practitioners must have access to evaluation methods that are valid, reliable, sensitive, and appropriate to the intervention and audience. The FBC is a straightforward and more targeted evaluation tool than the 24-hour recall because it focuses on specific objectives of the intervention. In our experience, the FBC is viewed favorably by EFNEP and FSNEP paraprofessionals throughout this state.[47]

This parsimonious checklist, now containing 16 items, is a work in progress. Recognizing that this FBC requires further refinement, this research represents a starting point for future study by other researchers. We have described a process used to develop an evaluation tool of dietary behavior for our FSNEP and EFNEP audience that is valid, reliable, and sensitive yet feasible for a community setting, with its concomitant time and cost constraints. Using the example of this brief FBC, we have shown that it is possible to create an evaluation instrument with these properties for low-income community programs. More importantly, we have established a process that can be used by other researchers to develop and further refine instruments for use in community education interventions.

We recommend that funds be sought to support a multistate effort to test these FBC items with EFNEP and FSNEP audiences in other states. A valid, reliable, culturally sensitive, multicontent instrument is needed to maintain program integrity and support continued funding in the 21st century.

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