


[Top](#)
[Abstract](#)
[Background](#)
[Methods](#)
[Results](#)
[Discussion](#)
[Competing  
interests](#)
[Authors'  
contributions](#)
[Acknowledgements](#)
[References](#)

Research


Open Access

 Nutrition Journal  
Volume 4

# Evaluating changeability to improve fruit and vegetable intake among school aged children

 Marilyn S Nanney<sup>1</sup> , Debra Haire-Joshu<sup>2</sup> , Michael Elliott<sup>2</sup> , Kimberly Hessler<sup>2</sup>  and Ross C Brownson<sup>2</sup> 
<sup>1</sup> Department of Health Promotion & Education, University of Utah, Salt Lake City, UT

<sup>2</sup> Department of Community Health, School of Public Health, Saint Louis University, St. Louis, MO

 author email  corresponding author email

*Nutrition Journal* 2005, 4:34 doi:10.1186/1475-2891-4-34

 The electronic version of this article is the complete one and can be found online at: <http://www.nutritionj.com/content/4/1/34>

Received: 7 September 2005

Accepted: 21 November 2005

Published: 21 November 2005

© 2005 Nanney et al; licensee BioMed Central Ltd.

 This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/2.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## Abstract

### Background

The purposes of this paper are two fold. First, to describe an approach used to identify fruits and vegetables to target for a child focused dietary change intervention. Second, to evaluate the concept of fruit and vegetable changeability and feasibility of applying it in a community setting.

### Methods

Steps for identifying changeable fruits and vegetables include (1) identifying a dietary database (2) defining geographic and (3) personal demographics that characterize the food environment and (4) determining which fruits and vegetables are likely to improve during an intervention. The validity of these methods are evaluated for credibility using data collected from quasi-experimental, controlled design among 7–9 year old children (n = 304) participating in a tutoring or mentoring program in St. Louis, MO. Using a 28-item food frequency questionnaire, parents were asked to recall for their child how often foods were eaten the past 7 days. This questionnaire was repeated eight months later (response rate 84%). T-test analyses are used to determine mean serving differences from baseline to post test.

Viewing options:

- [Abstract](#)
- [Full text](#)
- [PDF \(242KB\)](#)

Associated material:

- [Readers' comments](#)
- [Pre-publication history](#)
- [PubMed record](#)



Related literature:

- [Articles citing this article on Google Scholar on PubMed Central](#)
- [Other articles by authors](#)
  - ⊖ [on Google Scholar](#)
  - Nanney MS
  - Haire-Joshu D
  - Elliott M
  - Hessler K
  - Brownson RC
  - ⊖ [on PubMed](#)
  - Nanney MS
  - Haire-Joshu D
  - Elliott M
  - Hessler K
  - Brownson RC
- [Related articles/pages on Google on Google Scholar on PubMed](#)

Tools:

- [Download references](#)
- [Download XML](#)
- [Email to a friend](#)
- [Order reprints](#)
- [Post a comment](#)
- [Sign up for article alerts](#)

Post to:

-  [Citeulike](#)
-  [Connotea](#)
-  [Del.icio.us](#)
-  [Digg](#)
-  [Facebook](#)

## Results

The mean serving differences from baseline to post test were significant for moderately eaten fruits ( $p < .001$ ), however, not for vegetables ( $p = .312$ ). Among the intervention group, significantly more children ate grapes ( $p < .001$ ), peaches ( $p = .022$ ), cantaloupe ( $p < .001$ ), and spinach ( $p = .044$ ) at post testing – all identified as changeable with information tailored to participants.

## Conclusion

Data driven, food focused interventions directed at a priority population are feasible and practical. An empirical evaluation of the assumptions associated with these methods supports this novel approach. However, results may indicate that these methods may be more relevant to fruits than vegetables. This process can be applied to diverse populations for many dietary outcomes. Intervention strategies that target only those changeable fruits and vegetables are innovative and warrant further study.

## Background

---

Children in the United States follow eating patterns that do not meet national recommendations for fruits and vegetables. [1,2] To date, dietary interventions have been only modestly successful in increasing fruit and vegetable (FV) intake among children [3] with effect sizes ranging from .2 servings (Gimme 5) [4] to .99 servings (High 5 Project). [5] One means of improving the impact of dietary interventions is to assure the intervention is relevant to a child by targeting foods that are available and accessible in their environment. [6]

Program planning models suggest that directing program resources toward those factors that are most *changeable* helps to ensure program efficiency and effectiveness. [7,8] For dietary interventions, the concept of changeability can be defined as identifying those FV that have the greatest likelihood for increased consumption and targeting them for an intervention. Changeability is moderated by variations in food consumption patterns across racial and ethnic, [9-12] gender, [9,10,12-15] age, [11,13,15] marital status, [11] and regional [11,13,16] differences. Changeability is also influenced by the discrepancies in the availability of food in the community and home environments, particularly in priority populations. [17-19]

From an individual perspective, the food experiences to which young children are exposed are critical to the early development of food acceptance patterns and choices. This exposure to FV influences familiarity, preferences, and intake. For purposes of an intervention, FV that are preferred and eaten by a child are less changeable because consumption goals are met. Instead, moderate intake of FV suggests foods that are familiar, accessible, and changeable. Systematic approaches derived from program planning constructs, are needed to determine program relevance and changeability in order to successfully impact health behaviors. [8]

The purpose of this paper is to describe a systematic approach used for identifying *changeable* FV that were targeted for intervention in Partners of all Ages Reading About Diet and Exercise (PARADE), a school based mentoring program designed to improve FV intake of children ages 7 to 9 years. Children enrolled in the mentoring program received one to one tutoring on a weekly basis during regular school hours. PARADE was incorporated within the routine curriculum of the mentoring program. PARADE was based on social cognitive theory and included (1) eight lesson plans with computer-generated storybooks tailored to the dietary patterns of each 7–9 year old child and (2) eight mailed parent newsletters introducing each book and offering tips on how to role model healthy eating at home. PARADE was evaluated using a quasi-experimental study design. Participants in the evaluation include children and their parents. Approval for this study was obtained from the Saint Louis University Institutional Review Board.

## Methods

---

Steps for identifying *changeable* FV

Limited time and resources increased the importance of identifying appropriate foods for change in this priority population. The following steps were used to identify and tailor information on FV as part of PARADE lesson plans and storybooks.

### Step 1: Identify a comprehensive nutrition database

Dietary measurement is complex. Accuracy can be maximized with methods that help individuals correctly recall the foods and amounts eaten on any given day that represents usual intake. Furthermore, a comprehensive list of foods and nutrient values is essential to calculating the dietary outcomes of interest. [20] The Continuing Survey of Food Intakes by Individuals (CSFII) database represents data from the priority population and is methodologically and psychometrically sound. Also popularly known as the "What We Eat in America Survey," the CSFII is a national food consumption survey conducted by the Agricultural Research Service of the United States Department of Agriculture. [21] The 10<sup>th</sup> edition of the CSFII (1994–1996) provides nationally representative data by over sampling for low-income individuals and young children. Individuals are asked to provide food intakes on two nonconsecutive days using a multiple pass 24-hour dietary recall administered in the home by trained interviewers. Sample sizes include 12,700 adults of all ages and 11,800 children birth-19 years. Response rates include 1-day 80% and 2-day 76%. Food consumption data are available on CD-ROM from the USDA. More information, including ordering the CD's, can be found at <http://www.ars.usda.gov/Services/docs.htm?docid=7787> [webcite](#).

### Step 2: Define the sociodemographic characteristics of the priority population

Variations in dietary patterns are influenced by individual characteristics such as race, [9-12] gender, [9,10,12-15] and age. [11,13,15] Thus, it is critical to assess these factors with regard to determining changeability of fruits and vegetables. For the CSFII database, food consumption differences can be viewed by five race categories; white, black, Pacific Asian, Native American, and Other. Furthermore, the data can be segmented by gender and age. The CSFII database reports age in months for children less than one year of age, and in years for those over 1 year of age. For Project PARADE, the CSFII data was analyzed for children 7–9 years of age (9% of CSFII sample), male (49%) and female (51%), and African American (18%). 892 children matched these criteria.

### Step 3: Define the geographic characteristics of the priority population

Dietary intake varies by geographic region and urban versus rural influences. The CSFII divides the United States into five geographic regions that are further defined by urbanization type. Urbanization types include city, outside the city, and rural areas. PARADE participants lived in ten urban and suburban counties in a large Midwest city. Therefore, the CSFII data was analyzed for those living in a metropolitan city and outside the city in the Midwest. Results identified nearly three-quarters of the sample living in a metropolitan area (central city, 21% and suburban, 53%). These geographic criteria resulted in a final sample of dietary intake data for 164 children, mean age 7.93 (SD = .82). Steps 1–3 identified 2423 food entries by the CSFII. This included 670 unique foods including 49 fruits and 79 vegetables consumed by the sample.

### Step 4: Identify changeable FV for the priority population

Individual characteristics and environmental exposures influence food familiarity and determine frequency of consumption. We next selected those foods meeting criteria for 'moderate consumption'. CSFII food consumption data is organized by numerical food codes and food amounts. Data can be viewed in a number of ways; specific food, food form (canned, frozen, raw), how often a food was eaten, and the amount eaten (gram weight). Individual food items were rank ordered by the percentage of respondents who reported consuming them over the observation period. Foods whose rank fell into the 25<sup>th</sup> to 75<sup>th</sup> percentile were defined as "moderately consumed". Five fruits and eight vegetables were identified as moderately consumed and targeted for an intervention among these school-aged children. Foods in the top quartile (>75%) or most frequently consumed (i.e., oranges, carrots) and FV at the lower range (<25%) of

consumption (i.e., grapefruit, sweet potatoes) were not included in the intervention. Table 1 summarizes the steps that define the key characteristics to consider when determining relevant foods for a dietary intervention.

[Table 1.](#) Steps to identify relevant foods to target in a dietary intervention

## Results

---

### Using national frequency data to estimate local FV consumption

An important assumption being made is that accurate conclusions can be drawn from food consumption frequencies collected from a national sample because they mirror local consumption patterns. Table 2 compares FV consumption frequency identified from the CSFII with baseline PARADE data (intervention and delayed intervention groups) and indicates agreement between CSFII rank % and PARADE rank % consumptions. For example, according to the national data, those FV eaten most frequently (oranges, juice, apples, potatoes, lettuce) correspond with the PARADE baseline data as indicated by the 76–100 rank percents. Similar agreement occurs for those fruits and vegetables eaten moderately (25–75 rank percent) and least often (<25 rank percent). However, a few discrepancies are noted. Although not identified as a moderately eaten fruit from the national data set, kiwi falls within the moderately eaten range at PARADE baseline (13% versus 31%) and therefore should have been targeted as changeable in the intervention. Vegetable consumption was less congruent than fruit consumption. Two vegetables (corn, carrots) were eaten more often in the national sample than reported by PARADE children at baseline. Conversely, PARADE children ate green beans and cabbage slaw more often. Overall, the authors conclude that using national dietary data to identify percent rank cut points defining consumption frequency can be useful when developing community interventions. These methods may be more accurate in predicting fruit consumption than vegetable consumption.

[Table 2.](#) Fruits and vegetables identified as changeable and targeted for intervention

After identifying FV for intervention, we incorporated this information into 8 tailored storybooks. Professionally trained interviewers then administered a telephone survey to parents of children enrolled in participating tutoring programs. Using a 28-item FV food frequency questionnaire, parents were asked to recall for their child how often select foods were eaten within the past 7 days. This questionnaire was repeated eight months later. Response choices included "none, 1 time, 2 times, 3–4 times, 5–6 times, 7 or more times in the past week". The questionnaire demonstrated acceptable internal consistency (Chronbach's alpha = .744). Table 3 presents the PARADE changeability results. Six PARADE fruits (PF) and eight vegetables (PV) identified as moderately consumed are hypothesized to be the most likely to improve from baseline to post intervention. Differences in the percent of children who consumed the "same (unchanged) or more" of each PF and PV from baseline to posttest indicate that those targeted as changeable in the intervention were more likely to be eaten.

[Table 3.](#) Fruits and vegetables targeted for Project PARADE improved at post intervention

Among the intervention group, significantly more children ate grapes ( $p < .001$ ), peaches ( $p = .022$ ), cantaloupe ( $p < .001$ ), and spinach ( $p = .044$ ) at post testing – all identified as changeable with information tailored to PARADE participants. As hypothesized, consumption of fruits and vegetables frequently and rarely eaten remained unchanged or were eaten more in two instances (potatoes, corn). Worth noting is that the majority of the vegetables remained unchanged at the end of the intervention. These results may indicate that these methods may be more relevant to fruits than vegetables.

Table 4 summarizes the results by grouping all frequently, moderately, and rarely consumed FV. Average (or mean) baseline servings among PARADE intervention participants (N = 304) are consistent with the assumptions presented where those described as frequently (Mean = 1.75 servings), moderately (Mean = 0.75 servings), and rarely (Mean = 0.26 servings) consumed follow that pattern. T-test analyses indicate that mean serving differences from baseline to post test were significant for moderately eaten fruits ( $p < .001$ ), however, not for vegetables ( $p = .312$ ). In general, the authors conclude that applying the concept of changeability to a FV intervention among school-aged children is feasible and supported by this data.

[Table 4.](#) Moderately eaten fruits improved at post intervention

## Discussion

---

Recent findings suggest that innovative research is necessary to broaden the traditional approach beyond increasing FV awareness and education. [22] Overall, this study reinforces these methods as a way to systematically identify FV to target for an intervention. Identifying and concentrating on the most changeable behavioral targets for interventions direct resources to where they will be most beneficial. Furthermore, greater specificity in program development simplifies the evaluation process (i.e., brief food frequency questionnaire). [23,24]

Assessments of changeability across fruit and vegetable patterns can be made by defining person and place variables of the priority population, examining the frequency with which fruits and vegetables have been consumed, and identifying those that can be reasonably expected to change for targets of an intervention. Moreover, this approach takes into account important environmental influences upon dietary patterns. Haire-Joshu and Nanney describe individual food preference, cultural and familial influences, and home, school and community environments as having significant influences upon the food environment of children. [6] This process addresses eating behavior as a function of the varied food environments for a specific population, albeit, in a broader community based context.

We developed, applied, and tested a systematic, data based approach to assess changeability and specify fruits and vegetables for an intervention among underserved school aged children. This approach will allow for further clarity of intervention effects by targeting only those changeable fruits and vegetables for intervention. Furthermore, this process can be applied to diverse populations for a variety of dietary outcomes. Additionally, larger mass media interventions like the 5 A Day campaign may benefit from this approach. More research is needed to evaluate the effectiveness and generalizability of community-based efforts that promote changeable foods for an intervention.

## Competing interests

---

The author(s) declare that they have no competing interests.

## Authors' contributions

---

MSN conceived of the concept of changeability and applied the methods to the intervention, developed the data collection instrument and drafted the manuscripts. DHJ conceived of the study, and participated in its design and coordination and helped to draft the manuscript. ME managed the data, performed statistical analysis, and helped to draft the manuscript. KH contributed to the conception of the study, application of the methods, and helped draft the manuscript. RB participated in the design of the study, oversaw the statistical analysis, and helped to draft the manuscript.

## Acknowledgements

---

This work is based upon funding from the American Cancer Society (TURPG-00-286-01 PBP) and National Institutes of Nursing Research (USPHS-5-R01-NR05079). The authors would like to



## References

---

1. Krebs-Smith SM, Cook A, Subar AF, Cleveland L, Friday J, Kahle LL: Fruit and Vegetable Intakes of Children and Adolescents in the United States. *Arch Pediatr Adolesc Med* 1996, 150:81-86. [PubMed Abstract](#) | [Publisher Full Text](#)
2. Munoz KA, Krebs-Smith SM, Ballard-Barbash RB, Cleveland LE: Food Intakes of US Children and Adolescents Compared With Recommendations. *Pediatrics* 1997, 100(9):323-329. [PubMed Abstract](#) | [Publisher Full Text](#)
3. Ammerman A, Lindquist C, Lohr KN, Hersey J: The Efficacy of Behavioral Interventions to Modify Dietary Fat and Fruit and Vegetable Intake: A Review of the Evidence. *Preventive Medicine* 2002, 35:25-41. [PubMed Abstract](#) | [Publisher Full Text](#)
4. Baranowski T, Davis M, Resnicow K, Baranowski J, Doyle C, Lin LS, Smith M, Wang DT: Gimme 5 fruit, juice, and vegetables for fun and health: outcome evaluation [published erratum appears in Health Educ Behav 2000 Jun;27(3):390]. *Health Educ Behav* 2000, 27(1):96-111. [PubMed Abstract](#) | [Publisher Full Text](#)
5. Reynolds KD, Franklin FA, Binkley D, Raczynski JM, Harrington KF, Kirk KA, Person S: Increasing the fruit and vegetable consumption of fourth-graders: results from the high 5 project. *Prev Med* 2000, 30(4):309-319. [PubMed Abstract](#) | [Publisher Full Text](#)
6. Haire-Joshu D, Nanney MS: Prevention of overweight and obesity in children: Influences on the Food Environment. *The Diabetes Educator* 2002, 28(3):415-422. [PubMed Abstract](#) | [Publisher Full Text](#)
7. Glanz K, Lewis FM, Rimer BK: *Health behavior and health education: theory, research, and practice*. 2nd edition. San Francisco , Jossey-Bass; 1997.
8. Green LW, Kreuter MW: Behavioral and environmental assessment. In *Health Promotion and Planning*. 3rd. edition. California , Mayfield Publishing Company; 1999:145.
9. Akan GE, Grilo CM: Sociocultural influences on eating attitudes and behaviors, body image, and psychological functioning: a comparison of African American, Asian American, and Caucasian college women. *International Journal of Eating Disorders* 1995, 18(2):181-187. [PubMed Abstract](#) | [Publisher Full Text](#)
10. Bronner Y: Nutritional status outcomes for children: Ethnic, cultural, and environmental contexts. *Journal of the American Dietetic Association* 1996, 96(9):891-903. [PubMed Abstract](#) | [Publisher Full Text](#)
11. Thompson B, Demark-Wahnefried WD, Taylor G: Baseline fruit and vegetable intake among adults in seven 5 a day study centers located in diverse geographic areas. *J Am Diet Assoc* 1999, 99:1241-1248. [PubMed Abstract](#) | [Publisher Full Text](#)
12. Xie B, Gilliland FD, Li YF, Rockett HR: Effects of Ethnicity, Family Income, and Education on Dietary Intake among Adolescents. *Preventive Medicine* 2003, 36:30-40. [PubMed Abstract](#) | [Publisher Full Text](#)
13. DiSogra L, Glanz K: The 5 A Day Virtual Classroom: an on-line strategy to promote healthful eating.

14. Kumanyika S, Tell GS, Shemanski L, Polak J, Savage PJ: Eating patterns of community-dwelling older adults: the Cardiovascular Health Study. *Ann Epidemiol* 1994, 4:261-271.
15. Shi L: Sociodemographic characteristics and individual health behaviors. *Southern Medical Journal* 1998, 91(10):933-941. [PubMed Abstract](#) | [Publisher Full Text](#)
16. Kirby S, Baranowski J, Reynolds K, Taylor G, Binkley D: Children's fruit and vegetable intake: Sociodemographic, adult child, regional, and urban-rural influences. *Journal of Nutrition Education* 1995, 27:261-271.
17. Hearn MD, Baranowski J, Doyle C, Smith M, Lin LS, Resnicow K: Environmental influences on dietary behavior among children: availability and accessibility of fruits and vegetables enable consumption. *J Health Educ* 1998, 29:26-32.
18. Kratt P, Reynolds K, Shewchuk R: The Role of Availability as a moderator of Family Fruit and Vegetable Consumption. *Health Education and Behavior* 2000, 27(4):471-482.
19. Morland K, Wing S, Roux AD: The Contextual Effect of the Local Food Environment of Residents' Diets: The Atherosclerosis Risk in Communities Study. *American Journal of Public Health* 2002, 92(11):1761-1767. [PubMed Abstract](#) | [Publisher Full Text](#)
20. Buzzard M: 24-hour dietary recall and food record methods. In *Nutritional Epidemiology*. 2nd edition. Edited by: Willett W. New York , Oxford University Press; 1998.
21. Continuing Survey of Food Intakes by Individuals (CSFII) and the Diet and Health Knowledge Survey (DHKS), 1994-96 1998.
22. Serdula MK, Gillespie C, Kettel-Khan L, Farris R, Seymour J, Denny C: Trends in fruit and vegetable consumption among adults in the United States: Behavioral Risk Factor Surveillance System, 1994-2000. *American Journal of Public Health* 2004, 94:1014-1018. [PubMed Abstract](#) | [Publisher Full Text](#)
23. Nanney MS, Hessler K, Kelly C, Haire-Joshu D: *Identifying usual portion sizes for commonly eaten foods among 7-9 year olds using parent-child consensus*. Saint Louis University School of Public Health; 2003.
24. Nielsen SJ, Popkin BM: Patterns and trends in food portion sizes, 1977-1998. *American Medical Association* 2003, 289(4):450-453. [Publisher Full Text](#)

[Have something to say? Post a comment on this article!](#)

