

2001

Low-Saturated-Fat Soybean Oil Reduces Saturated Fat In School Menus

J. M. Mahnken
University of Missouri


S. F. Lutz
University of Missouri

C. J. Anders

W. R. Fehr
Iowa State University, wfehr@iastate.edu

Copyright © Copyright 2001 by the Iowa Academy of Science, Inc.

Follow this and additional works at: <http://scholarworks.uni.edu/jias>

 Part of the [Anthropology Commons](#), [Life Sciences Commons](#), [Physical Sciences and Mathematics Commons](#), and the [Science and Mathematics Education Commons](#)

Recommended Citation

Mahnken, J. M.; Lutz, S. F.; Anders, C. J.; and Fehr, W. R. (2001) "Low-Saturated-Fat Soybean Oil Reduces Saturated Fat In School Menus," *The Journal of the Iowa Academy of Science: JIAS*: Vol. 108: No. 1 , Article 3.
Available at: <http://scholarworks.uni.edu/jias/vol108/iss1/3>

This Research is brought to you for free and open access by UNI ScholarWorks. It has been accepted for inclusion in The Journal of the Iowa Academy of Science: JIAS by an authorized editor of UNI ScholarWorks. For more information, please contact scholarworks@uni.edu.

Low-Saturated-Fat Soybean Oil Reduces Saturated Fat In School Menus

J. M. MAHNKEN¹, S. F. LUTZ¹, C. J. ANDERS² and W. R. FEHR³

¹Department of Food Science and Human Nutrition, University of Missouri, Columbia, MO 65211

²Nutrition Education, Iowa Department of Education, Grimes State Office Building, Des Moines, IA 50319-0146

³Department of Agronomy, Iowa State University, Ames, IA 50011-1010

³Corresponding author [email wfehr@iastate.edu]

This study evaluated the impact of using low-saturated-fat soybean [*Glycine max* (L.) Merr.] oil on the saturated fat content of school menus. Seventy-six weekly menus were obtained from the Iowa Department of Education during School Meals Initiative reviews for the 1996–1997 school year. Three modifications were performed on school menus using the Nutrikids computer program: Low-saturated-fat (LSF) soybean oil replaced traditional vegetable oil in menu items; LSF soybean oil was substituted for traditional vegetable oil, solid fats, and egg yolks in recipes; and a menu simulation was conducted where oils and solid fats used in menu items were postulated to contain no saturated fat. Saturated fat content (grams and percentage of energy) was assessed at baseline and after each modification. Total fat (grams and percentage of energy) was assessed at baseline and after the second modification. Saturated fat and total fat decreased significantly from baseline following the second modification. After the second modification, 47% of menus met the dietary guideline for saturated fat compared with 32% of menus at baseline. Results suggested that LSF soybean oil improved the nutritional quality of school menus when substituted for traditional vegetable oil and solid fats in recipes.

INDEX DESCRIPTORS: saturated fat, soybean oil, school meals, child nutrition.

The National School Lunch Program (NSLP) and School Breakfast Program (SBP) have important roles in the health and well-being of our Nation's children. Each day, the NSLP serves approximately 25 million children (USDA/FCS/SBP 1997). These meals provide significant daily needs of protein, calcium, and vitamins A and C, but they are often high in fat and saturated fat (USDA/FCS/NSLP 1997, USDA/FCS/SBP 1997). Results from the School Nutrition Dietary Assessment Study (SNDAS) indicated that NSLP provided an average of 38% of calories from fat and 15% of calories from saturated fat (Burghardt et al. 1995). Other studies reported school meals to be high in fat and saturated fat (Chapman et al. 1995, Dwyer et al. 1996, Ellison et al. 1989, Harris et al. 1997, Luepker et al. 1996, Osganian et al. 1996, Simons-Morton et al. 1991, Snyder et al. 1992, Whatley et al. 1996, Whitaker et al. 1993).

To encourage the production of healthier school meals, the USDA began the School Meals Initiative for Healthy Children (Federal Register 1995, Healthy Meals for Healthy Americans Act 1994). The initiative requires that by the 1998–1999 school year all schools produce meals that meet the recommendations of the USDA Dietary Guidelines for Americans, including less than 10% of calories from saturated fat and no more than 30% of calories from total fat (Federal Register 1995, USDA & U.S. Department of Health and Human Services 1995).

Although studies have reported significant reductions in the saturated fat and total fat content of school menus when using multiple recipe modifications and lower-fat vendor products, research has not examined the impact of one specific menu modification on the saturated and total fat content of school meals (Dwyer et al. 1996, Ellison et al. 1989, Ellison et al. 1990, Harris et al. 1997, Luepker et al. 1996, Osganian et al. 1996, Simons-Morton et al. 1991, Snyder et al. 1992, Whatley et al. 1996, Whitaker et al. 1993). The Child and Adolescent Trial for Cardiovascular Health (CATCH), for example, reported significant reductions in the saturated and total fat

of school menus following the implementation of numerous menu modifications, which included reducing or eliminating fat in recipes; draining and rinsing ground beef; reducing or eliminating butter on the school lunch and school breakfast line; and reducing the amount of mayonnaise, sour cream, and oil in salad dressings (Dwyer et al. 1996, Luepker et al. 1996, Osganian et al. 1996).

School food service personnel need simple alternatives for lowering saturated fat and total fat in school meals. A survey of 628 school food service personnel in Minnesota found that a commonly cited barrier to implementing the dietary guidelines in school meals was the lack of time to incorporate lower-fat meal preparation methods (Stang et al. 1997).

A menu modification that could be easily implemented by school food service personnel is substituting a lower-saturated-fat vegetable oil for the traditional vegetable oil and solid fats found in school menu items. Our research examined the impact of using a low-saturated-fat (LSF) soybean oil in menu items on the nutritional quality of school meals. The LSF soybean oil, sold commercially as LoSat-Soy[™], was included in the 1998–1999 USDA food commodity list. It contains 50% less saturated fat than traditional soybean oil, comparable to the saturated fat content of canola oil (Iowa State University 1997). The objectives of this study were to examine the impact of LSF soybean oil on (a) the saturated and total fat content of weekly school menus and (b) the percentage of school menus meeting the dietary guidelines for saturated and total fat.

METHODS

School Menus

Seventy-six weekly menus from 62 elementary schools in Iowa were obtained from the Iowa Department of Education. Elementary school menus were used for this study because there generally were fewer menu choices for elementary students than secondary students.

All study schools were participating in the School Meals Initiative (SMI). Trained consultants from the Iowa Department of Education collected the menus used in this study during their SMI reviews for the 1996–1997 school year. The 76 menus included 60 lunch menus and 16 breakfast menus. The weekly menus collected during the SMI reviews included a 5-day period for 67 of the 76 (88%) menus, a 4-day period for six (8%) of the menus, a 3-day period for 2 (3%) of the menus, and a 2-day period for one (1%) of the menus.

Menu Modifications

Three modifications were performed on the school menus using the Nutrikids computer program (LunchByte Systems, Inc. 1997). The first modification replaced regular vegetable oil with the LSF soybean oil. Regular vegetable oil has two g of saturated fat per tablespoon and LSF soybean oil has one g of saturated fat per tablespoon. All recipes using vegetable oil were identified. These recipes were modified by substituting the same amount of the LSF soybean oil for the traditional vegetable oil. The primary menu items that changed during the first modification included baked products and entrees made with vegetable oil, such as pancakes, rolls, and casseroles. Manufactured items made with vegetable oil, including salad dressing (pourable and spoonable), mayonnaise, and tartar sauce, also were altered to reflect the reduction of saturated fat achieved when LSF soybean oil was substituted in these items.

The second modification substituted LSF soybean oil for traditional vegetable oil, solid fats (butter/margarine/shortening), and egg yolks found in recipes. The LSF soybean oil replaced the solid fat in recipes using the substitutions of (a) two-thirds cup oil for one cup of solid fat and (b) one egg white plus one teaspoon oil for one egg (Hachfeld and Eykyn 1992). Two-thirds cup of LSF soybean oil contains 11 g of saturated fat. The saturated fat content per cup of solid fat is 115 g for butter, 38 g for margarine, and 51 g for shortening based on averages from the USDA Nutrient Database. One egg white plus one teaspoon LSF oil contains 0.33 g of saturated fat, while one egg contains approximately two g of saturated fat. The oil substitutions were more often done in baked goods, such as cakes and quick breads. When a substitution was not appropriate, because of adverse aesthetic qualities, a margarine with a lower saturated fat content (1.8 g/Tbsp) was substituted for the solid fat (2.5–7.0 g saturated fat/Tbsp). Items for which the oil substitution was not appropriate included macaroni and cheese, other casserole entrees, sandwiches made with butter or margarine, and vegetables prepared with butter or margarine.

For the third modification, the saturated fat content of vegetable oil and oil-based products found in school menu items following the second modification was set to zero in the Nutrikids database. The oil-based products included margarine, shortening, and salad dressings. This menu simulation was conducted to determine the total contribution of saturated fat from oils and solid fats in school meals. The resulting menus contained only the saturated fat contributed by meat, dairy, and processed foods.

Analysis of Menus

Saturated fat and total fat content of the school menus were analyzed using Nutrikids. The Nutrikids program is approved by the USDA for use in Nutrient Standard Menu Planning and contains the USDA Child and Nutrition Program Database and a branded product database. The branded product database includes nutrition information provided by the manufacturers and is updated as new versions of Nutrikids are released. For this study, menu items initially missing saturated fat information were supplemented with nutrition information obtained from manufacturers on the exact or a similar product.

The 76 menus were analyzed in Nutrikids using weekly averages. Weekly averages were used because schools must comply with the dietary guidelines on a weekly average basis. The nutritional quality of school meals was assessed by measuring the average percentage of calories from saturated fat and total fat in a weekly menu. Menus were considered to have high nutritional quality if they contained less than 10% of calories from saturated fat and no more than 30% of calories from total fat, as recommended in the dietary guidelines. Weekly averages for grams of saturated fat and percentage of energy from saturated fat were noted at baseline and after each modification. Weekly averages of grams of total fat and percentage of energy from total fat were only noted at baseline and after the second modification, which was the only modification that could elicit a change in total fat.

Statistical Analysis

Descriptive statistics were used to assess baseline characteristics of the study schools. Analysis of variance and the Tukey test were used to assess differences in saturated fat content among baseline and modified menus. Paired t-tests were used to analyze differences in total fat content between the baseline and menu following the second modification. This was the only modification using recipe substitutions that affected total fat content. All data analyses were performed using Statistical Analysis System for Windows software (SAS Institute, Inc. 1996).

RESULTS

Description of Schools and Baseline Menus

Sixty-six percent of the 62 elementary schools included were public schools. More study schools were classified as rural (89%) than urban (11%). Rural schools were defined as those not located in or adjacent to Des Moines, Cedar Rapids, Waterloo, Davenport, Sioux City, Council Bluffs, or Dubuque, Iowa. All schools in the study participate in the NSLP.

Only 32% (24 of 76) of the baseline menus met the dietary guideline of less than 10% of calories from saturated fat, and 39% (30 of 76) of the baseline menus met the dietary guideline for total fat (Table 1). Twenty-six percent (20 of 76) of the menus met the guidelines for both saturated fat and total fat (Table 1). Of the 52 menus not meeting the dietary guideline for saturated fat, 50% (26 of 52) had 12% or more calories from saturated fat (Table 2). Thirty-five percent (16 of 46) of the menus not meeting the total fat dietary guideline had more than 35% of calories from fat (Table 2).

A larger proportion of breakfast menus met the dietary guidelines than did lunch menus. Sixty-nine percent (11 of 16) of the breakfast menus had less than 10% of calories from saturated fat, while only 22% (13 of 60) of the lunch menus met this dietary guideline. Seventy-five percent (12 of 16) of the breakfast menus had less than 30% of calories from total fat, but only 30% (18 of 60) of the lunch menus originally met the total fat dietary guideline. Sixty-nine percent (11 of 16) of the breakfast menus met both guidelines at baseline, while just 13% (8 of 60) of the lunch menus met both guidelines (Table 1).

Changes in Saturated Fat

The direct substitution of the LSF soybean oil for the traditional vegetable oil in menu items decreased the average percentage of calories from saturated fat, as shown by the first modification (Table 3). Twenty-seven weekly menus met the dietary guideline for saturated fat after the first modification compared with 24 menus at baseline (Table 1). Of the 49 menus not meeting the guideline, 24 (49%) contained 12% or more of calories from saturated fat (Table 2).

Table 1. Percentage of breakfast and lunch menus meeting the dietary guidelines for saturated fat and total fat at baseline and following three menu modifications.

Dietary Guidelines	Baseline Menus		Modification of Menus ^a					
			First		Second		Third	
	n	%	n	%	n	%	n	%
Total (n = 76)								
Saturated fat	24	32	27	36	37	49	47	62
Total fat ^b	30	39	—	—	31	41	—	—
Both	20	26	22	29	26	34	27	36
Breakfast (n = 16)								
Saturated fat	11	69	12	75	13	81	16	100
Total fat ^b	12	75	—	—	12	75	—	—
Both	11	69	12	75	12	75	12	75
Lunch (n = 60)								
Saturated fat	13	22	15	25	23	38	31	52
Total fat ^b	18	30	—	—	19	32	—	—
Both	8	13	10	17	14	23	15	25

^aFirst = Low-saturated fat (LSF) soybean oil substituted for traditional vegetable oil; Second = LSF soybean oil substituted for traditional vegetable oil, solid fats, and egg yolks; Third = oils, solid fats, and egg yolks assumed to contain no saturated fat.

^bTotal fat content was not altered for the first and third modification.

Table 2. Distribution of all menus not meeting the dietary guidelines for saturated fat and total fat at baseline and following each modification.

Percentage of Calories	Baseline Menus		Modification of Menus ^a					
			First		Second		Third	
	n	%	n	%	n	%	n	%
Saturated fat								
10.1–10.9	13	25	11	22	11	28	9	31
11.0–11.9	13	25	14	29	15	38	14	48
12.0–12.9	10	19	10	20	7	18	2	7
13.0–13.9	10	19	10	20	2	5	1	3
14.0–14.9	2	4	1	2	3	8	2	7
greater than 15	4	8	3	6	1	3	1	3
Totals ^b	52	100	49	100	39	100	29	100
Total Fat ^c								
30.1–30.9	6	13	—	—	6	13	—	—
31.0–31.9	5	11	—	—	7	16	—	—
32.0–32.9	6	13	—	—	5	11	—	—
33.0–33.9	6	13	—	—	6	13	—	—
34.0–34.9	7	15	—	—	6	13	—	—
greater than 35	16	35	—	—	15	33	—	—
Totals ^b	46	100	—	—	45	100	—	—

^aFirst = Low-saturated fat (LSF) soybean oil substituted for traditional vegetable oil; Second = LSF soybean oil substituted for traditional vegetable oil, solid fats, and egg yolks; Third = oils, solid fats, and egg yolks assumed to contain no saturated fat.

^bDue to rounding, cumulative percentages may not equal 100% when totaled.

^cTotal fat content was not altered for the first and third modification.

After substituting LSF soybean oil for traditional vegetable oils, solid fats, and egg yolks as part of the second modification, the percentage of calories from saturated fat and the grams of saturated fat were significantly lower than at baseline and after the first modification ($p < 0.05$) (Table 3). Nearly half of the 76 weekly menus met the dietary guideline for saturated fat after the second modification compared with 24 menus at baseline (Table 1). Of the re-

maining 39 menus not meeting the guideline, only 13 (33%) had 12% or more of calories from saturated fat (Table 2).

The third modification was the menu simulation where vegetable oil and solid fats used in menu items were postulated to contain no saturated fat. The saturated fat content of the weekly menus after the third modification was significantly lower than menus at baseline and after the first and second modifications ($p < 0.05$) (Table 3).

Table 3. Means, standard deviations (SD), and ranges of saturated fat and total fat content of school menus at baseline and following each modification (n = 76).

Fat Content	Baseline Menus			Modification of Menus ^a								
				First			Second			Third		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Saturated Fat												
% calories	11.1	2.3	4.2–16.3	10.9	2.3	4.2–16.2	10.0*	2.3	4.1–15.8	9.2*	2.5	2.4–15.4
grams	8.4	2.8	2.6–18.5	8.3	2.7	2.4–18.4	7.5*	2.6	1.9–16.9	7.0*	2.7	1.1–16.2
Total Fat ^b												
% calories	31.2	5.4	14.1–47.1	—	—	—	30.8**	5.4	14.1–47.1	—	—	—
grams	23.5	7.4	9.4–49.0	—	—	—	23.1**	7.2	9.4–49.0	—	—	—

^aFirst = Low-saturated fat (LSF) soybean oil substituted for traditional vegetable oil; Second = LSF soybean oil substituted for traditional vegetable oil, solid fats, and egg yolks; Third = oils, solid fats, and egg yolks assumed to contain no saturated fat.

^bNo change in total fat content expected with first and third modifications due to their design.

*,**Mean of second modification significantly different from the baseline and first modification, or mean of third modification significantly different from the baseline, first and second modification at the 0.05 and 0.01 probability levels, respectively.

However, 38% (29 of 76) of the menus still had more than 10% of calories from saturated fat even after this modification (Table 2).

Changes in Fat

Substituting LSF soybean oil for the oil, solid fats, and egg yolks in menu items led to a significant decrease in the average weekly fat content and percentage of calories from fat compared with baseline menus ($p < 0.01$) (Table 3). One additional menu met the total fat dietary guideline after the second modification (Table 1). Of the menus not meeting the dietary guideline, 33% (15 of 45) had more than 35% of calories from fat (Table 2).

DISCUSSION

This study examined the impact of using a LSF soybean oil on the saturated fat and total fat content of school meals from a group of Iowa schools participating in the NSLP. Although this study contained only 16 breakfast menus, the results for breakfast and lunch menus were comparable to findings from other national studies (Burghardt et al. 1995, Dwyer et al. 1996). At baseline, a larger proportion of the breakfast menus (11 of 16) met fat and saturated fat recommendations than did lunch menus (8 of 60). Both the SNDAS and the CATCH also found breakfast menus to be initially lower in fat and saturated fat than lunch menus (Burghardt et al. 1995, Dwyer et al. 1996). Breakfast menus in our study tended to have more grain and fruit products than meat products when compared with lunch menus, which would lead to inherently lower saturated fat and total fat content. This was comparable to the results from the SNDAS and the CATCH indicating breakfast menus often include complex carbohydrates rather than meat (Burghardt et al. 1995, Dwyer et al. 1996).

Minor recipe modifications using the LSF soybean oil were useful for improving the saturated fat and total fat content of school menus. The first menu modification of directly substituting LSF soybean oil for traditional vegetable oil in menu items, led to three additional menus meeting the dietary guideline for saturated fat. Substituting LSF soybean oil for traditional vegetable oil, solid fats, and egg yolks in menu items as part of the second menu modification elicited significant decreases in the average grams of saturated fat (8.4 to 7.5 g) and percentage of energy from saturated fat (11.1 to 10.0%). Slight decreases in the average total grams of fat (23.5 to 23.1 g) and percentage of energy from fat (31.2 to 30.8%) after the second

modification also were statistically significant ($p < 0.01$). Although the changes in saturated fat content were relatively small, weekly averages for percentage of calories from saturated fat met the dietary guidelines in 49% of the schools following the second modification compared with 32% of schools at baseline (Table 1).

A limitation of our study was that the LSF soybean oil was not actually used in food production; changes in taste and acceptability, therefore, could not be assessed. Several institutions, including Iowa State University Residence Halls, have successfully used LSF soybean oil in place of traditional vegetable oil in recipes. Their positive experiences support the use of LSF soybean oil in quantity food production. Our study was the first step in determining the usefulness of the LSF soybean oil in improving the nutritional quality of meals for such quantity food production facilities.

Our research was unique because it examined the effect of one specific technique in improving the nutritional quality of school menus. Other studies focused on reducing fat and saturated fat content in school meals have more commonly used numerous recipe modifications (Dwyer et al. 1996, Ellison et al. 1989, Ellison et al. 1990, Harris et al. 1997, Luepker et al. 1996, Osganian et al. 1996, Simons-Morton et al. 1991, Snyder et al. 1992, Whatley et al. 1996, Whitaker et al. 1993). These modifications often require additional food service staff training to successfully implement changes. Use of a LSF soybean oil instead of other vegetable oils or solid fats in recipes provides food service staff with a simple way to reduce the saturated fat content of school meals.

While this study did show significant decreases in the saturated fat and total fat content of school menus, 38% (29 of 76) of the menus still contained more than 10% of calories from saturated fat after the third modification. This suggested that significant proportions of fat and saturated fat come from meat entrees and other animal products, which was supported by other research (Chapman et al. 1995). Other simple strategies for use in school food service operations need to be identified to further reduce the saturated fat and total fat content of school meals to meet the recommendations of the dietary guidelines.

ACKNOWLEDGMENTS

The authors thank Jane Heikenen, MS, RD; Patti Harding, MS; Janet Wendland, PhD; Barb Pothast, MS, RD; Connie LaBarr, PhD; Dean Flaws, MS; and Darlene Busch, MS, for obtaining the menus

for this project. Journal Paper No. J-18477 of the Iowa Agriculture and Home Economics Experiment Station, Ames, IA, Project No. 3107, and supported by the Hatch Act, State of Iowa, and Iowa State University Research Foundation.

LITERATURE CITED

- BURGHARDT, J. A., B. L. DEVANEY, and A. R. GORDON. 1995. The school nutrition dietary assessment study: Summary and discussion. *American Journal of Clinical Nutrition* 61:252S-257S.
- CHAPMAN, N., A. R. GORDON, and J. A. BURGHARDT. 1995. Factors affecting the fat content of National School Lunch Program lunches. *American Journal of Clinical Nutrition* 61:199S-204S.
- DWYER, J. T., L. V. HEWES, P. D. MITCHELL, T. A. NICKLAS, D. H. MONTGOMERY, L. A. LYTLE, M. P. SNYDER, M. M. ZIVE, K. J. BACHMAN, R. RICE, and G. S. PARCEL. 1996. Improving school breakfasts: Effects of the CATCH Eat Smart program on the nutrient content of school breakfasts. *Preventive Medicine* 25:413-422.
- ELLISON, R. C., A. L. CAPPER, R. J. GOLDBERG, J. C. WITSCHI, and F. J. STARE. 1989. The environmental component: Changing school food service to promote cardiovascular health. *Health Education Quarterly* 16(2):285-297.
- ELLISON, R. C., R. J. GOLDBERG, J. C. WITSCHI, A. L. CAPPER, E. M. PULEO, and F. J. STARE. 1990. Use of fat-modified food products to change dietary fat intake of young people. *American Journal of Public Health* 80:1374-1376.
- FEDERAL REGISTER. 1995. Department of Agriculture; Food, and Nutrition Services 7 CFR Parts 210 and 220. National School Lunch Program and School Breakfast Program: School meal initiatives for healthy children. *Federal Register* 60:31188-31222.
- HACHFELD, L., and B. EYKYN. 1992. *Cooking a'la heart*. Appletree Press, Inc., Mankato, Minnesota.
- HARRIS, K. J., A. PAINE-ANDREWS, K. P. RICHTER, R. K. LEWIS, J. A. JOHNSTON, V. JAMES, L. HENKE, and S. B. FAWCETT. 1997. Reducing elementary school children's risks for chronic diseases through school lunch modifications, nutrition education, and physical activity interventions. *Journal of Nutrition Education* 29(4):196-202.
- HEALTHY MEALS FOR HEALTHY AMERICANS ACT, November 2, 1994 (P.L. No 103-448) United States Statutes at Large. Stat 4699.
- IOWA STATE UNIVERSITY. 1997. LoSatSoy[®]: A superior vegetable oil for nutrition and flavor. Department of Agronomy, Ames, Iowa.
- LUEPKER, R. V., C. L. PERRY, S. M. MCKINLAY, P. R. NADER, G. S. PARCEL, E. J. STONE, L. S. WEBBER, J. P. ELDER, H. A. FELDMAN, C. C. JOHNSON, S. H. KELDER, and M. WU. 1996. Outcomes of a field trial to improve children's dietary patterns and physical activity: The child and adolescent trial for cardiovascular health (CATCH). *Journal of the American Medical Association* 275(10):768-776.
- LUNCHBYTE SYSTEMS, INC. 1997. *Nutrikids*. Version 6.1. LunchByte Systems, Inc., Rochester, New York.
- OSGANIAN, S. K., M. K. EBZERY, D. H. MONTGOMERY, T. A. NICKLAS, M. A. EVANS, P. D. MITCHELL, L. A. LYTLE, M. P. SNYDER, E. J. STONE, M. M. ZIVE, K. J. BACHMAN, R. RICE, and G. S. PARCEL. 1996. Changes in the nutrient content of school lunches: Results from the CATCH Eat Smart food service intervention. *Preventive Medicine* 25:400-412.
- SAS INSTITUTE, INC. 1996. *SAS/STAT User's Guide*. Version 6.11. SAS Institute, Cary, North Carolina.
- SIMONS-MORTON, B. G., G. S. PARCEL, T. BARANOWSKI, R. FORTHOFFER, and N. M. O'HARA. 1991. Promoting physical activity and a healthful diet among children: Results of a school-based intervention study. *American Journal of Public Health* 81(8):986-991.
- SNYDER, M. P., M. STORY, and L. L. TRENKNER. 1992. Reducing fat and sodium in school lunch programs: The LUNCHPOWER! intervention study. *Journal of the American Dietetic Association* 92(9):1087-1091.
- STANG, J. S., M. STORY, B. KALINA, and M. P. SNYDER. 1997. Meeting the U.S. Dietary Guidelines in school meals: Current practices, perceived barriers, and future training needs. *Journal of Nutrition Education* 29:152-158.
- UNITED STATES DEPARTMENT OF AGRICULTURE/FOOD AND CONSUMER SERVICE/NATIONAL SCHOOL LUNCH PROGRAM. Retrieved 5 August 1997. Available at <http://www.fns.usda.gov/cnd/Lunch/Default.htm>.
- UNITED STATES DEPARTMENT OF AGRICULTURE/FOOD AND CONSUMER SERVICE/SCHOOL BREAKFAST PROGRAM. Retrieved 5 August 1997. Available at <http://www.fns.usda.gov/cnd/Breakfast/Default.htm>.
- UNITED STATES DEPARTMENT OF AGRICULTURE & UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES. 1995. *Nutrition and your health: Dietary guidelines for Americans*, 4th ed. Home and Garden Bulletin No. 232. U.S. Government Printing Office, Washington, D.C.
- WHATLEY, J. E., J. E. DONNELLY, D. J. JACOBSEN, J. O. HILL, and M. K. CARLSON. 1996. Energy and macronutrient consumption of elementary school children served modified lower fat and sodium lunches or standard higher fat and sodium lunches. *Journal of the American College of Nutrition* 15(6):602-607.
- WHITAKER, R. C., J. A. WRIGHT, A. J. FINCH, and B. M. PSATY. 1993. An environmental intervention to reduce dietary fat in school lunches. *Pediatrics* 91:1107-1111.