Original Research

"Healthy-Start": Outcome of an Intervention to Promote a Heart Healthy Diet in Preschool Children

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Objective: We evaluated the effects of a preschool nutrition education and food service intervention "Healthy Start," on two-to-five-year-old children in nine Head Start Centers in upstate NY. The primary objective was to reduce the saturated fat (sat-fat) content of preschool meals to <10% daily energy (E) and to reduce consumption of sat-fat by preschoolers to <10% E.

Methods: Six centers were assigned to the food service intervention and three to control condition. Food service intervention included training workshops for cooks and monthly site visits to review progress towards goals. Child dietary intake at preschool was assessed by direct observation and plate waste measurement. Dietary intake at home was assessed by parental food record and telephone interviews. Dietary data were collected each Fall/Spring over two years, including five days of menus and recipes from each center. Dietary data were analyzed with the Minnesota NDS software.

Results: Consumption of saturated fat from school meals decreased significantly from 11.0%E to 10.4%E after one year of intervention and to 8.0%E after the second year, compared with an increase of 10.2% to 13.0% to 11.4%E, respectively, for control schools ($p < 0.001$). Total caloric intake was adequately maintained for both groups. Analysis of preschool menus and recipes over the two-year period of intervention showed a significant decrease in sat-fat content in intervention preschools (from 12.5 at baseline to 8.0%E compared with a change of 12.1%E to >11.6%E in control preschools ($p < 0.001$)). Total fat content of menus also decreased significantly in intervention schools (31.0% to >25.0%E) compared with controls (29.9% to >28.4%E).

Conclusions: The Healthy Start food service intervention was effective in reducing the fat and saturated fat content of preschool meals and reducing children's consumption of saturated fat at preschool without compromising energy intake or intake of essential nutrients. These goals are consistent with current U.S. Dietary Guidelines for children older than two years of age.

INTRODUCTION

Promoting a healthful diet among young children is a national public health objective since dietary factors contribute substantially to the burden of preventable illness and death, especially premature cardiovascular disease [1,2]. Promotion of healthful behaviors should begin early in life, since it has been established that atherosclerosis begins in childhood [3]. Studies have shown that anatomic changes in the aorta and coronary arteries of young adults are related to antecedent risk factors developed during childhood [4–7]. Moreover, evidence exists that cardiovascular risk factors, such as blood pressure, obesity and serum lipids and lipoproteins track from childhood to young adulthood [8–13]. Toward this goal, the National Institutes of Health, the United States Department of Agriculture (USDA), the American Academy of Pediatrics, the American

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Heart Association, the Centers for Disease Control and other national organizations have initiated and supported new research, programs and policies in the past decade aimed at promoting health-enhancing changes in school food services and nutrition education [1,14–21]. Several initiatives require schools to serve meals that comply with the Dietary Guidelines for Americans and offer technical support to schools that need assistance in making the desired changes [22]. USDA also urges that "nutrition education be a major educational component of all child nutrition programs and offered in all the schools, child care facilities, and summer sites" by the year 2000 [22]. The Healthy People 2010 national health objectives have also specifically recommended provision of "nutrition education from preschool through 12th grade" [1]. The synergism of nutrition education in the classroom combined with a school-food service offering healthy foods consistent with Dietary Guideline objectives provides the greatest likelihood that efforts will translate into sustained healthy eating habits among children and adolescents.

The majority of comprehensive health education programs, school-based nutrition education initiatives and school food service interventions have focused primarily on older children and adolescents, of elementary, middle and high school age. Very few studies and interventions have targeted younger children, even though virtually all of our national dietary guidelines include the two-to-five year-old preschool group. This includes recommendations from Healthy People 2000, the American Academy of Pediatrics, the National Cholesterol Education Program, the American Heart Association, and the United States Department of Agriculture [1,15–17,20]. The U.S. Dietary Guidelines apply to all Americans over two years of age.

With the growing consensus that children over two should consume a diet with 30% or fewer of calories from total fat and fewer than 10% from saturated fat, there is a need for population-based studies to implement the guidelines among children, including those of preschool age. This study was designed as a preschool cardiovascular risk reduction and comprehensive health education program designed to modify the preschool environment with respect to the fat content (particularly saturated fat) of preschool meals and snacks. We report the effects of the program on preschool menus and children's dietary intake during a two year period of time.

METHODS

Study Design

Healthy Start is a three-year intervention trial of preschool children enrolled in nine New York State Head Start Centers. The overall goal of the project was to evaluate the effects of a food service modification and nutrition education intervention on CVD risk reduction in preschool children. After baseline measurements, six centers that were able to participate in the food service component of the program were randomly assigned to one of two study conditions: food service modification plus classroom education (A group), or school food service modification plus classroom safety education (B group). The food service modifications were exactly the same in the A and B groups. Three other centers with food service operations not amenable to modification served as controls C group). The schools in group C all received their food from the school district and could not make any changes in their acquisitions. Schools in all groups had in common the fact that they had to meet specific federal nutritional guidelines. All three groups received one of two research versions of the *Healthy Start* Comprehensive Preschool Health Education Curriculum, developed for this project. Group A received the core curriculum plus nutrition-related units, while Groups B and C received the core curriculum plus safety-related units. All preschoolers, as required by federal Head Start guidelines, received the nutrition education program already in place at each center prior to initiation of this study. The primary goal of the supplemental Healthy Start Preschool Health Education Curriculum was to increase children's health awareness and knowledge and to provide children with ample opportunity to practice positive health behaviors through stories and poems, games, crafts and creative play, hands-on demonstrations, interactive discussions, and investigative observations. Nutrition interventions were designed to create an environment in which predisposing, enabling, and reinforcing factors could be targeted to facilitate a decrease in consumption of total and saturated fat to AAP-recommended levels of $\leq$30%E for total fat and $<$10% energy for saturated fat.

Study Population

Children participating in the Healthy Start study were enrolled in nine Head Start preschool programs in upstate New York with similar enrollments of low-income, predominately minority preschool children. Subjects included in this report consisted of 1,296 children who attended the Head Start school either in Year 1 (Fall 1995 to Spring 1996) or in Year 2 (Fall 1996 to Spring 1997) or in both years. At baseline, children were two to five years of age at their last birthday (mean 3.4 $\pm$ 0.6 years). Ninety-eight percent of the children were three or four years of age, and males and females were equally represented. Three-fourths of the children enrolled in the project were minority, primarily African American (41%) and Latino (33%). The majority of children lived in families with annual income below poverty level ($<$\$15,100 for a family of four).

Dietary Interventions

The primary dietary intervention was a preschool Food Service Modification plan designed to help preschools meet the requirements for a USDA-reimbursable meal pattern [23] while achieving a five-day meal/snack plan that provided no more than 30% of energy from total fat and no more than 10% of

energy from saturated fat. Special emphasis was given to maintaining adequate caloric intake.

By design, after the five-day baseline menu assessment, cooks in the intervention preschools participated in a one day training program which covered the major food service intervention areas: menu planning, recipe development, food purchasing and food preparation. A list of objectives was developed which when implemented would gradually result in increased offering and selection of fruit, vegetables, breads and grains in meals, decreased total and saturated fat content of foods purchased for the center and decreased total and saturated fat due to alterations in food preparation techniques. These objectives were developed together with the cooks, who then selected initial objectives to target for their center. As the initials objectives were met and incorporated into the daily regimen, the cook selected others. In this manner, the food modification program was a gradual process in which the cooks played an active role. Once all the guidelines were selected, the focus was on maintenance of change throughout the intervention. An in-depth description of Healthy Start food service intervention has been published [24].

Dietary Assessment

Since preschool children have not yet acquired the verbal or written language skills to report on their own dietary intake and since parents are not with their preschoolers while they are in day-care centers, an innovative combination methodology was employed to assess child dietary intake. The goal was to collect 24-hour dietary recalls on participating preschool children at baseline in Fall 1995 and at follow-up at the end of Year 1 (Spring 1996) and at the end of Year 2 (Spring 1997) through a combination of direct observation during school and parental reports from home [25]. Data were also collected at the beginning of Year 2 (Fall 1996). Total intake for the day was obtained by (1) direct observation of the children as they ate their meals and snacks at the centers with plate waste measurement to determine amounts of foods and beverages consumed combined with (2) telephone interviews with the primary adult food providers to determine types and amounts of foods/beverages consumed outside the Head Start setting on the same day as the meal observation. The latter approach was assisted by completion of a food record by the primary food provider to give the telephone interviewer a more accurate record of the child's food intake. The complete dietary intake assessment protocol was adapted from existing protocols proven to be reliable and valid [26–30].

Measurements

Dietary, anthropometric and physiologic measurements were obtained in the Fall of 1995, and Fall of 1996. Follow-up measures were obtained in the late Spring of 1996 and 1997. A detailed description of the study design, dietary assessment methodology, preschool curriculum content, nutrition knowledge assessment and other measures and outcomes has been published elsewhere [24,25,31–36].

Statistical Analysis

All preschools assigned to the food service intervention arm of the study were grouped together, as were the preschools assigned to the control condition. For all children with home dietary recall data, school dietary intake data was added to arrive at 24-hour dietary intake. Preschool menus were analyzed for nutrient content by obtaining menus, recipes, and food labels for five days each Fall and Spring during the intervention following a protocol modified from the CATCH study [41]. The menu data was analyzed at the Nutrition Coordinating Center, University of Minnesota using the Minnesota NDS software, Version 4.93 [42]. The five-day mean for each school was used to compare baseline and follow-up nutrient values in the six intervention and three control schools using a matched pair analysis (baseline *versus* end Year 1 and baseline *versus* end of Year 2) $p < 0.05$ level, 2-tailed test. For those children with complete one-year data or complete two-year data, an independent samples *t* test procedure (SPSS Version 10.1) was used to compare the differences in the amount of change from baseline to follow-up in the intervention and control groups [37].

All micronutrients were compared to the current Recommended Dietary Allowances (RDA) and for the four-to-eight year-old age group [38]. Folic acid was compared to the Dietary Reference Intakes (DRI) for the four-to-eight year-old group [39]. Fiber intake was compared to the "Age + 5" guidelines [40], while percent energy from total and saturated fat were compared to the National Cholesterol Education Program (NCEP) guidelines for children ages two to nineteen years [16].

RESULTS

School Menus: Changes in Fat Content of Menus

There were no significant differences between the intervention and control preschools with respect to kcal or per cent of calories from total fat or saturated fat at baseline. All menus, as served, both pre- and post-intervention, satisfied federal guidelines for energy and nutrient content appropriate for preschool children in a part-day Head Start program [23].

The percent of kcal in the menus from fat and saturated fat decreased significantly over time in the intervention group (Table 1). Percent of kcal from fat decreased 3.4% at the end of Year 1 and an additional 2.6% by the end of Year 2. Percent of kcal from saturated fat decreased 2.2% at the end of Year 1 and an additional 2.3% by the end of Year 2. There were no significant changes in the total fat or saturated fat content of control menus from baseline to the end of Year 1 or the end of Year 2.

Table 1. Changes in Preschool Menus from Baseline to Follow-up

	Intervention Schools ($\bar{x} \pm SD$)			Control Schools ($\bar{x} \pm SD$)		
	Baseline	End of Year 1	End of Year 2	Baseline	End of Year 1	End of Year 2
KCal	811.5 ± 53.3	787.9 ± 66.1	852.2 ± 95.3	916.4 ± 97.3	866.2 ± 129.3	938.2 ± 178.0
Total Fat (g)	28.1 ± 1.9	24.1 ± 3.0	23.8 ± 4.8	30.8 ± 8.4	29.0 ± 9.3	30.2 ± 10.2
Sat Fat (g)	11.3 ± 1.9	9.0 ± 1.3	7.6* ± 1.7	12.5 ± 4.2	12.5 ± 4.8	12.5 ± 4.9
%Kcal from Total Fat	31.0 ± 2.6	27.6* ± 2.8	25.0** ± 2.6	29.9 ± 5.0	29.7 ± 5.0	28.4 ± 5.5
%Kcal from Sat. Fat	12.5 ± 1.4	10.3 ± 1.4	8.0* ± 1.2	12.1 ± 3.3	12.7 ± 2.8	11.6 ± 2.9
Cholesterol (mg)	94.3 ± 34.7	80.9 ± 33.4	80.5 ± 20.1	88.7 ± 40.9	105.6 ± 50.4	81.6 ± 31.3
Protein (g)	32.4 ± 3.4	34.6 ± 4.1	34.4 ± 3.3	36.2 ± 2.8	37.0 ± 5.4	36.1 ± 5.7
Fiber (g)	6.9 ± 0.5	6.6 ± 0.8	6.6 ± 0.7	7.7 ± 1.1	7.2 ± 0.5	6.9 ± 1.0
Calcium (mg)	627.9 ± 33.5	682.1 ± 87.3	642.7 ± 80.6	675.2 ± 83.1	643.1 ± 72.0	688.6 ± 95.3
Iron (mg)	5.6 ± 0.8	5.9 ± 1.0	5.2 ± 0.6	8.2 ± 2.3	6.7 ± 2.1	7.6 ± 2.5
Zinc (mg)	4.4 ± 0.9	4.4 ± 0.7	3.9 ± 0.4	4.8 ± 0.6	4.9 ± 1.0	4.6 ± 0.7
Magnesium (mg)	128.7 ± 6.9	132.2 ± 19.0	129.0 ± 12.5	143.3 ± 10.3	134.0 ± 13.1	140.3 ± 5.4
Vitamin A (μg)	3896 ± 1098	2817 ± 1388	2702 ± 728	2370 ± 520	2552 ± 1151	2308 ± 1167
Vitamin C (mg)	55.1 ± 11.1	47.7 ± 11.9	68.2 ± 9.7	58.2 ± 6.8	66.8 ± 10.5	71.1 ± 21.2
Vitamin E (mg)	3.0 ± 0.8	2.1* ± 0.3	2.5 ± 0.4	2.5 ± 0.2	2.2 ± 0.5	2.2 ± 0.4
Folic Acid (μg)	115.5 ± 20.4	116.7 ± 28.5	112.8 ± 12.6	143.32 ± 3.1	158.6 ± 6.4	148.4 ± 20.1
Riboflavin (mg)	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.2	1.3 ± 0.1	1.3 ± 0.1
Vitamin B12 (μg)	2.2 ± 0.3	2.4 ± 0.5	2.1 ± 0.2	2.4 ± 0.3	2.2 ± 0.5	2.2 ± 0.1

* $p < 0.05$; ** $p < 0.01$ (Baseline 1 *vs.* end of Year 1, baseline *vs.* end Year 2); N = 6 Intervention schools, 3 Control schools.

At baseline, menus in intervention and control schools were similar in micronutrient content except for magnesium and iron content, which were significantly ($p < 0.05$) lower in intervention menus than in control menus. Based on recommendations for four-to-eight year-old children(Table 2), there were small increases for some nutrients (calcium, magnesium and Vitamin C) from baseline to the end of the second year of intervention. There were also small decreases in some nutrients (iron, zinc, vitamins A, E, B12 and folic acid). Of note, however, menu contributions for vitamins A, C, and B12 still exceeded 100% of recommended daily values. Control school menus showed a similar pattern of change from baseline to follow-up, with the exception of an increase in folic acid and a decrease in magnesium from baseline to the end of Year 2.

The contribution of preschool menus to daily requirements for zinc was within approximately 40% of the recommended intake, both pre- and post-intervention, which is adequate for half-day children having a meal and snack at preschool, but insufficient for full-day children who spend eight or more hours at preschool. The latter should receive one-half to two-thirds of their daily requirement in order to satisfy CACFP requirements.

Dietary Intake at School Meals

Healthy Start food service intervention efforts were aimed primarily at decreasing saturated fat intake at preschool meals. Less effort was aimed at decreasing total fat intake, since baseline total fat intake at preschool meals (27.4%E) already

Table 2. Percent of Recommended Nutrients Provided by Head Start Menus at Baseline and Follow-up: Intervention (Int) and Control (Con) Schools

Nutrient	RDA/DRI Values*	Contributed					
		Baseline		End of Year 1		End of Year 2	
		Int	Con	Int	Con	Int	Con
Fiber (g)¶	8.4	82%	92%	79%	86%	79%	82%
Calcium (mg)	800	78%	84%	85%	80%	80%	86%
Iron (mg)	10	56%	82%	59%	67%	52%	76%
Zinc (mg)	10	44%	48%	44%	49%	39%	46%
Magnesium (mg)	130	90%	110%	102%	103%	99%	108%
Vitamin A (μg)	700	557%	339%	402%	365%	386%	330%
Vitamin C (mg)	45	122%	129%	106%	148%	152%	159%
Vitamin E (mg)	7	43%	36%	30%	31%	36%	31%
Vitamin B12 (μg)	1.2	183%	200%	200%	183%	175%	183%
Folic acid (μg)	200	58%	72%	58%	79%	56%	74%
Riboflavin (mg)	0.6	200%	200%	200%	217%	200%	217%

* [39].

¶ Reference value = mean age of population + 5 g/day [40].

met the recommended NCEP and American Heart Association guidelines of ≤30%E, and was within the American Academy of Pediatrics guideline (total fat intake goal of 20% to 30%E for children two years of age and older) [15].

Total caloric intake for intervention and control preschool children was monitored throughout the Healthy Start food service intervention, and data indicated that energy intake was maintained even though saturated fat intake decreased. At the end of Year 1 after one school-year of food service modification, there was an increase in total energy intake in both intervention and control schools (Table 3). Energy intake from saturated fat at school meals, however, decreased by 5.5% in intervention schools (11.0% to 10.4%E), compared with a 27.5% increase among control preschool children (10.2% to 13.0%E). At the end of Year 2 of the intervention, caloric consumption continued to increase in the intervention schools but decreased among control children. In the intervention schools, %E from saturated fat intake showed an additional decline at the end of Year 2 (27% decrease from baseline). Energy intake from saturated fat decreased in the control schools from the end of Year 1 to the end of Year 2 but did not reach the baseline level.

Total fat intake from preschool meals and snacks met dietary guidelines at baseline (<30%E) in both intervention and control schools. In the intervention schools energy intake from total fat decreased further at the end of Year 1 (from 29.2% to 27.5%) and Year 2 (to 26.4%). Among children in control schools, dietary intake of total fat at school increased from 24.8% to 30.2%E at the end of Year 1 and decreased slightly at the end of Year 2.

Overall, there was a trend towards an increase in micronutrient intake at preschool meals from baseline to follow-up which probably is likely the result of increased caloric intake. Most children participate in Head Start for one year (at age four), while fewer children participate for two years (ages three and four). In the present study there were 567 children who were evaluated at both baseline (Fall 1995) and at the end of Year 1 (Spring 1996). An additional 144 children were evaluated at baseline and at the end of Year 2 (Spring 1997). The differences in nutrient intake from baseline to follow-up were compared between children in the intervention schools and control children (Table 4). From baseline to the end of Year 1, there were significant differences in the amount of change between the groups with respect to total caloric intake, most nutrients and the %E from total fat and saturated fat. For those children enrolled in the program for two years, the differences between the intervention and control children in the amount of change were not significant for total caloric intake and most nutrients with the exception of grams of saturated fat ($p < 0.01$) and %E from total fat ($p < 0.001$), %E from saturated fat ($p < 0.001$), iron ($p < 0.05$) and magnesium ($p < 0.05$), with all changes favoring the intervention group.

24-Hour Dietary Intake (Home + School)

Children consumed about one-third of daily energy at preschool and two-thirds at home. Therefore, it was not expected that a food service intervention aimed at the preschool center itself would be sufficient to make an impact on 24-hour dietary

Table 3. School Meal Dietary Intake: Changes in Fat and Other Nutrient Intake from Baseline to the Follow-up by Year: Children in Intervention *versus* Control Preschools

Nutrient	Intervention			Controls		
	Baseline (N = 374) $\bar{x}$(SD)	End Year 1 (N = 407) $\bar{x}$(SD)	End Year 2 (N = 390) $\bar{x}$(SD)	Baseline (N = 254) $\bar{x}$(SD)	End Year 1 (N = 298) $\bar{x}$(SD)	End Year 2 (N = 318) $\bar{x}$(SD)
Kcal	486 (226)	515 (234)	560 (258)	330 (193)	436 (238)	362 (211)
Fat (g)	16.1 (9.6)	16.5 (11.2)	16.9 (10.0)	10.0 (7.9)	14.4 (8.0)	12.4 (9.0)
Sat Fat (g)	6.1 (4.2)	6.1 (3.9)	5.0 (3.2)	4.1 (3.6)	6.2 (3.9)	5.1 (4.6)
Fat, %KCal	29.2 (8.9)	27.5 (9.7)	26.4 (7.9)	24.8 (11.1)	30.2 (9.5)	29.1 (9.7)
Sat Fat %KCal	11.0 (4.7)	10.4 (4.6)	8.0 (2.8)	10.2 (5.3)	13.0 (5.2)	11.4 (5.7)
Cholesterol (mg)	46.0 (43.6)	51.6 (56.2)	51.4 (46.8)	25.6 (26.2)	51.1 (52.6)	34.4 (31.8)
Protein, (g)	18.2 (10.2)	21.8 (11.1)	22.7 (11.7)	11.8 (7.1)	17.5 (11.0)	14.2 (10.2)
Fiber (g)	3.8 (2.0)	3.9 (1.9)	3.9 (2.1)	3.2 (2.2)	3.5 (2.5)	2.7 (1.8)
Calcium (mg)	318 (192)	374 (212)	357 (188)	211 (155)	263 (184)	206 (188)
Iron (mg)	3.7 (3.3)	4.1 (3.3)	3.6 (2.1)	3.5 (4.0)	3.7 (4.5)	2.7 (2.7)
Zinc (mg)	2.5 (2.6)	2.7 (1.6)	2.4 (1.2)	1.7 (1.3)	2.2 (1.6)	1.7 (1.3)
Magnesium (mg)	72.3 (31.1)	80.0 (35.9)	75.9 (31.8)	48.6 (30.1)	57.2 (33.6)	46.8 (26.7)
Vit A (μg)	892 (1863)	595 (1010)	540 (679)	250 (214)	408 (396)	382 (1054)
Vit C (mg)	34.9 (32.7)	35.7 (31.0)	42.5 (33.5)	20.7 (25.7)	35.9 (33.7)	30.7 (26.0)
Vit E (mg)	2.4 (3.1)	1.7 (1.3)	2.4 (1.4)	1.0 (0.8)	1.2 (0.9)	1.1 (0.8)
Folic acid (μg)	69.6 (68.9)	71.1 (44.6)	67.3 (48.6)	52.7 (45.1)	74.9 (54.4)	55.4 (41.4)
Riboflavin (mg)	0.6 (0.4)	0.7 (0.4)	0.7 (0.3)	0.4 (0.3)	0.6 (0.4)	0.4 (0.3)
Vit B12 (μg)	1.1 (1.2)	1.5 (1.0)	1.2 (0.7)	0.7 (0.7)	0.8 (0.7)	0.7 (0.6)

¶ BGD = Between Group Differences-Intervention *vs.* Control.

Table 4. Differences between Baseline and Follow-up by Year of Study: Children in Intervention Schools and Controls

	Mean Change Baseline to End of Year 1			Mean Change Baseline to End of Year 2		
	Intervention N[¶] = 333	Control N = 234	*p* Int *vs.* Con	Intervention N = 103	Control N = 41	*p* Int *vs.* Con
Kcal	34.67	116.0	<0.001	188.74	124.05	
Fat (g)	0.73	4.33	<0.001	3.47	6.73	
Sat. Fat (g)	.001	1.86	<0.001	0.26	2.82	<0.01
Fat, %KCal	−1.51	4.97	<0.001	−4.45	6.47	<0.001
Sat Fat %KCal	−0.71	2.16	<0.001	−3.14	2.01	<0.001
Cholesterol (mg)	7.02	25.66	<0.001	18.50	18.02	
Protein, (g)	3.60	6.14	<0.05	9.02	5.37	
Fiber (g)	0.09	0.41		0.90	0.12	
Calcium (mg)	52.46	57.04		130.63	72.94	
Iron (mg)	0.51	0.27		0.77	−0.76	<0.05
Zinc (mg)	0.20	0.58		0.46	0.24	
Magnesium (mg)	7.57	9.11		18.73	6.44	<0.05
Vit A (μg)	−291.24	152.90	<0.001	−137.94	406.88	
Vit C (mg)	−0.94	15.23	<0.001	15.83	19.29	
Vit E (mg)	−0.60	0.27	<0.001	0.34	0.40	
Folic acid (μg)	1.07	22.24	<0.001	17.51	9.69	
Riboflavin (mg)	0.09	0.18	<0.01	0.24	0.10	
Vit B12 (μg)	0.40	0.08	<0.01	0.29	0.001	

[¶] N's reflect the number of children attending at baseline and follow-up period.

intake. For the intervention group, %E from saturated fat did decrease somewhat from 12% at baseline to 11.6% at the end of Year 1 and 10.9% at the end of Year 2. For the Control group, there was little difference between the three time periods (Table 5).

At baseline, on the day the diet was assessed, 28.4% of Healthy Start preschool children met AAP dietary guidelines [15] for saturated fat intake (<10%E) and 42.8% met the guideline for total fat intake (≤30%E) based on the 24-hour dietary intake. More children (89%) met dietary goals for cholesterol intake (<300 mg/day). For fiber intake, 64.5% of the children achieved the 'Age + 5' goal for two-to-five year-old children [40]. Micronutrient intake varied from over 80% meeting the RDA or DRI guidelines for riboflavin, magnesium and vitamins C and B12 to less than 50% meeting the requirements for calcium, vitamin E and zinc (Fig. 1).

Table 5. 24 Hour Energy, Macro and Micronutrient Intake of Children: Baseline to Follow-up

Nutrient	Intervention			Controls		
	Baseline (N = 267) $\bar{x}$(SD)	End Year 1 (N = 241) $\bar{x}$(SD)	End Year 2 (N = 248) $\bar{x}$(SD)	Baseline (N = 170) $\bar{x}$(SD)	End Year 1 (N = 203) $\bar{x}$(SD)	End Year 2 (N = 201) $\bar{x}$(SD)
Kcal	1491 (491)	1467 (517)	1559 (657)	1387 (439)	1498 (541)	1259 (474)
Fat (g)	51.3 (21.0)	50.1 (25.5)	53.8 (29.7)	48.1 (20.0)	51.8 (24.3)	44.1 (21.0)
Sat. Fat (g)	19.9 (9.2)	19.5 (11.0)	19.3 (11.3)	19.0 (7.1)	20.9 (10.6)	17.7 (9.1)
Fat, %KCal	30.9 (6.8)	29.9 (7.5)	30.2 (6.9)	31.0 (6.8)	30.7 (7.1)	31.1 (6.4)
Sat Fat %KCal	12.0 (3.7)	11.6 (3.5)	10.9 (3.1)	12.4 (3.2)	12.4 (3.6)	12.4 (3.5)
Cholesterol (mg)	166 (112)	165 (119)	170 (118)	173 (111)	200 (137)	166 (127)
Protein, (g)	55.0 (20.7)	57.3 (24.0)	59.0 (25.3)	53.9 (18.0)	58.9 (24.9)	48.7 (21.5)
Fiber (g)	10.8 (5.2)	10.3 (5.1)	10.8 (5.8)	10.7 (5.2)	11.2 (5.9)	8.7 (4.3)
Calcium (mg)	806 (374)	837 (510)	843 (386)	743 (308)	782 (387)	683 (369)
Iron (mg)	13.5 (9.1)	13.5 (8.8)	12.1 (7.9)	12.4 (7.5)	14.0 (9.3)	10.5 (6.6)
Zinc (mg)	8.8 (5.5)	9.4 (6.0)	8.2 (5.0)	8.5 (4.7)	9.4 (5.8)	7.2 (4.7)
Magnesium (mg)	205 (75)	202 (78)	203 (84)	190 (72)	197 (74)	163 (65)
Vit A (mcg)	1566 (2061)	1236 (1318)	1121 (868)	903 (664)	1027 (657)	951 (1346)
Vit C (mg)	118 (85)	119 (83)	111 (72)	112 (91)	127 (83)	99.7 (68.2)
Vit E (mg)	9.3 (7.4)	8.1 (7.6)	8.0 (6.5)	7.6 (7.8)	7.7 (6.8)	6.3 (7.3)
Folic acid (mcg)	287 (188)	269 (185)	250 (167)	277 (195)	303 (191)	237 (159)
Riboflavin (mg)	2.1 (0.9)	2.1 (1.0)	2.0 (0.9)	1.9 (0.9)	2.0 (0.9)	2.1 (7.1)
Vit B12 (mcg)	4.5 (3.1)	4.6 (3.1)	4.2 (2.9)	4.1 (2.7)	4.2 (3.2)	3.8 (7.4)

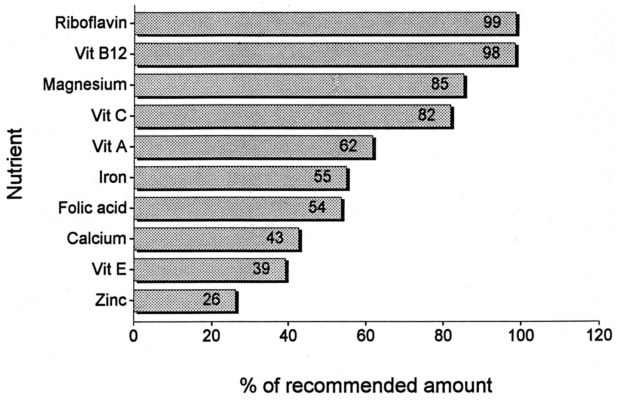

Fig. 1. Percent of children at Head Start schools meeting dietary guidelines.

DISCUSSION

Dietary guidelines endorsed by more than 26 U.S. health organizations recommend that a fat-modified diet begin after two years of age [16]. As recently as 1995, however, 77% of U.S. preschool children, two-to-five years of age, still exceeded the dietary recommendation for saturated fat [43]. This is of particular concern with respect to the primary prevention of atherosclerosis and coronary artery disease, since saturated fat raises blood cholesterol levels and therefore contributes to increased risk of atherosclerosis. Although there is recently more debate regarding optimal levels of *total* fat in the diet, the vast majority of health professionals agree that *saturated* fat intake should not exceed 10% of energy intake after two years of age.

In the past, concern has been voiced that fat-controlled diets in early childhood might fail to provide adequate energy for normal growth and development. Reports from the STRIP study in Finland, however, suggest that a diet low in saturated fat and cholesterol, even when started at seven months of age, can be compatible with normal growth and development as long as caloric and essential nutrient intake is adequate [44]. In a recent report, neurological development was similar in intervention and control groups at five years of age, providing further evidence of the safety of the "heart-healthy" diet in early childhood [45].

The dietary intake of the "Healthy Start" preschool children reported at baseline was similar to two U.S. studies: a survey of three-year-olds surveyed in the 1995 Continuing Survey of Food intake by Individuals, CSFII [46], and the 1987–88 Nationwide Food Consumption Survey, NFCS, [47]. Baseline saturated fat intake was 12% to 13%E in all surveys. Baseline total fat intake was 31%, 32% and 35%E in the Healthy Start sample, CSFII 1995 survey and NFCS surveys, respectively. Total energy intake in the Healthy Start survey and the other U.S. surveys varied between 1305 and 1576 Kcal per day. These values are more consistent with measured TEE (total energy expenditure) of four-to-six year-olds [48–50], despite the fact that the RDA for energy for four-to-six year-olds is 1800 Kcal/day, a 12% to 23% overestimate of energy requirements.

Recently the United States Department of Agriculture (USDA) compared the macro- and micronutrient content of menus of young children who participate in the Child and Adult Care Food Program (CACFP) to nutrient standards [51]. An analysis of these menus from the preschool day care programs indicates that the total fat and saturated fat content of their lunches exceed levels recommended in the *Dietary Guidelines for Americans* [21].

Promoting heart healthier behaviors during childhood has become the focus of school-based programs aimed at the primary prevention of atherosclerosis and CHD [54–61]. The majority of school-based programs have targeted elementary school children and include dietary intervention studies targeting both food service and individual dietary behavior change. In general, these studies demonstrate that the total and saturated fat content of school meals can be improved without compromising physical growth or micronutrient intake.

The Healthy Start food service intervention was modeled after methods developed by the Child and Adolescent Trial for Cardiovascular Health, CATCH, [51,54,57], and similar magnitudes of change in fat content of school menus were achieved by both projects. The CATCH intervention decreased the saturated fat content of school lunch menus by 18.9% compared to 9.3% among control schools. The Healthy Start intervention decreased the saturated fat content of preschool menus by 36% at the end of Year 2 of the intervention, while control schools decreased saturated fat content by 4%.

While a number of strategies were used in the present study to reduce the saturated fat content of preschool meals and snacks, reducing the fat content of milk and other dairy products used in the preschool centers was commonly employed. This is consistent with the findings of Sigman-Grant [62], who suggested that, although a number of strategies could be effective in lowering the saturated fat content of children's diets, use of skim milk only as a minimum strategy could be effective in achieving saturated fat goals in young children while maintaining adequate intake of other essential macro and micronutrients. Implementation of a few key strategies, such as switching from whole or 2% fat milk to 1% fat milk, draining and rinsing cooked ground meat, as well as removing skin and all other visible forms of fat from poultry and meats, respectively, all contributed to the overall reduction of saturated fat content of school meals and dietary intake by children.

The present study demonstrates that in the preschool population it is possible to decrease the saturated fat content of children's diets, without compromising energy intake or the overall nutritional value of the diet. Except for a significant decrease in Vitamin E at the end of Year 1 of the intervention, there were no significant differences in mean micronutrient values from baseline to Year 1 or Year 2 of follow-up. Vitamin E increased at the end of Year 2. The mean levels of most

nutrients were at or above recommended levels at baseline, but the proportion of children meeting the recommended daily levels based on a 24 hour dietary intake was less than 100% for almost all nutrients. This disparity would indicate that although some children are adequately nourished, many are not. This is not unexpected since most of the children's intake came from home, where incomes are at the poverty level.

National surveys conducted over the past two decades have shown a decreasing secular trend in dietary intake of both total and saturated fat by children [46,47,63–66]. The Bogalusa Heart Study [67,68] has also reported the same secular trend downward in total and saturated fat intake by children between 1973–1988. In the present study, total fat in the diet was already close to goal at baseline, similar to national trends, since preschool children in the 1995 CSFII survey had similar total fat intakes. In addition, there are regional differences, with dietary intake of preschoolers in the Northeastern part of the U.S. somewhat lower in total and saturated fat than that of preschool children in other parts of the U.S. [66]. Dietary intake for the preschool children in the present Healthy Start population appears to reflect this Northeastern pattern of intake.

There are certain limitations of this study. Assignment to intervention or control schools could not be randomly carried out. However, this is believed to have a minimal effect on the outcome since we are looking at change from one point in time to another point in time within each group, rather than a difference between the groups at one endpoint in time. Individual variation is therefore controlled within the group and confounding is minimized. Although we monitored menus at control preschools over time, we made no recommendations regarding meal or snack content or food intake by children. These schools could have instituted changes over time that would influence the fat content of the diets. Changes made, however, appear to be minimal, based on an analysis of menus and interviews with food service personnel at baseline and at the end of Year 1 and Year 2.

Despite the multitude of factors which influence dietary behaviors and nutrient intakes in childhood, the present study demonstrates that a structured food service intervention implemented in preschool centers can be a safe and effective way of increasing the proportion of children who consume heart healthy, lower saturated fat meals and snacks consistent with current dietary guidelines. For children, this is one part of an integrated chronic disease prevention agenda aimed at the primary prevention of atherosclerosis and coronary heart disease, as well as other chronic diseases linked to dietary patterns of overnutrition.

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