One-Year Follow-Up of Nutrition Education for Hypercholesterolemic Children

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ABSTRACT

Objectives. This study evaluated retention of the effect of a home-based, practitioner-initiated nutrition education model.

Methods. Children with elevated low-density lipoprotein (LDL) cholesterol levels were randomly assigned to one of two nutrition interventions or to an at-risk control group. Intervention effects were evaluated 3, 6, and 12 months postbaseline.

Results. The parent–child autotutorial group demonstrated significant increases in knowledge and, along with the counseling group, decreases in total and saturated fat intake. Also, the autotutorial and counseling groups retained a majority of their initial LDL cholesterol decrease.

Conclusions: Knowledge of heart-healthful eating and dietary fat intake as well as dietary change can be affected and retained via home-based, practitioner-initiated nutrition interventions with hypercholesterolemic children, although some form of ongoing intervention may be necessary to produce lasting decreases in LDL cholesterol levels. (*Am J Public Health.* 1998;88:258–261)

Introduction

The National Cholesterol Education Program has recommended that children with borderline or elevated low-density lipoprotein (LDL) cholesterol levels receive nutrition intervention to lower the fat and saturated fat content of their diet.[1] The program's guidelines suggest the participation of a multidisciplinary team in providing nutrition education to hypercholesterolemic children. However, as a result of financial constraints and a lack of trained professionals, the multidisciplinary team approach is usually not a realistic option. Furthermore, pediatric care providers express concerns about their own individual potential to implement effective nutrition education.[2,3]

In response to this gap between the need for nutrition education and the availability of persons qualified to provide such education, a home-based, practitioner-initiated, parent–child autotutorial nutrition education program was developed for hypercholesterolemic children[4,5] and compared with standard nutrition counseling by a qualified registered dietitian. The current study examined the retention of changes the children initially exhibited in knowledge, diet, and LDL cholesterol levels over a year.

Methods

The Children's Health Project evaluated two educational approaches to lowering LDL cholesterol levels of hypercholesterolemic 4- to 10-year-old children.[4–6] A cholesterol screening program was conducted in nine pediatric practice offices to identify "at-risk" children: those who had plasma total cholesterol levels above 4.55 mmol/L (176 mg/dL; 75th percentile), who did not have a secondary cause of hypercholesterolemia, and who were 85% to 130% of their ideal body weight.[7] Those with elevated mean fasting LDL cholesterol levels (2.77 to 4.24 mmol/L [107 to 164 mg/dL] for boys, 2.90 to 4.24 mmol/L [112 to 164 mg/dL] for girls) were then randomized into one of two nutrition education intervention groups or an at-risk control group. In addition, a group of children matched to the participants on age, gender, and season of involvement was selected at random to participate in the study; these children's total cholestorol levels were not elevated (less than 60th percentile; 4.22 mmol/L [163 mg/dL] for boys, 4.34 mmol/L [168 mg/dL] for girls).

Knowledge of heart-healthful eating, lipid intake (for all groups), and LDL cholesterol (for at-risk groups) were assessed prior to the educational intervention (baseline) and 3, 6, and 12 months thereafter. These assessments have been described previously.[6]

The protocol was approved by the institutional review boards of the Children's Hospital of Philadelphia, Pennsylvania State University, and Abington Memorial Hospital.

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TABLE 1—Selected Characteristics of Sample Groups

	Group			
	Parent–Child Autotutorial	Counseling	At-Risk Control	Not-at-Risk Control
Age, y, mean ± SE	6.3 ± 0.2	6.2 ± 0.2	6.4 ± 0.2	6.4 ± 0.2
Female,%	51	50	48	51
White, %	88	90	84	99
Knowledge score, mean ± SE	34.5 ± 2.4	42.1 ± 2.8	39.6 ± 2.5	42.1 ± 2.5
Fat intake, % calories, mean ± SE	29.2 ± 0.6	29.6 ± 0.6	29.5 ± 0.6	29.9 ± 0.5
Saturated fat intake, % calories, mean ± SE	11.1 ± 0.3	11.2 ± 0.3	11.1 ± 0.3	11.7 ± 0.3
Cholesterol intake, mg/1000 kcal, mean ± SE	100.0 ± 4.5	104.2 ± 4.6	105.8 ± 5.3	102.5 ± 4.5
Caloric intake, kcal, mean ± SE	1536 ± 47	1555 ± 42	1705 ± 44	1722 ± 47
LDL cholesterol, mmol/L, mean ± SE	3.26 ± 0.04	3.30 ± 0.04	3.34 ± 0.04	...
Baseline sample size	88	86	87	81
Evaluation 1[a] sample size	71	77	79	76
Evaluation 2[b] sample size	65	73	76	75
Evaluation 3[c] sample size	66	73	78	75

Note. SE = standard error of the mean.
[a]Approximately 3 months after baseline.
[b]Approximately 6 months after baseline.
[c]Approximately 12 months after baseline.

Nutrition Education Programs

Both intervention programs comply with National Cholesterol Education Program recommendations.[1] The parent–child autotutorial program includes 10 talking-book lessons (audiotaped stories and accompanying picture books) and follow-up paper–pencil activities for children, along with a parents' manual.[4–6] Children and parents (usually mothers) in the counseling program attend a 45- to 60-minute counseling session with a registered dietitian.

Statistical Analysis

A longitudinal data analysis was conducted in which available data from all subjects (intent-to-treat analysis) were used; within-subject measurements were modeled across time. The analysis was based on a mixed-effects linear model, and computations were performed via SAS Proc Mixed software.[8] The analysis yielded model-based estimated means for each group at each evaluation after adjustment for mistimed visits, age, and gender. Contrasts resulting in approximate F tests were constructed in order to compare baseline and subsequent evaluations within each group and to compare the at-risk control group with the intervention groups. When data are missing at random, the mixed-effects linear model yields results equivalent to those of multiple imputation of missing data. Therefore, multiple imputation of missing data was not invoked for this data set. As a result of multiple comparisons, Bonferroni corrections were applied ($P < .017$ for within-group changes from baseline and $P < .025$ for at-risk control group vs intervention group comparisons). Note that the statistical modeling used here was slightly different than the statistical methods used previously.[6]

Results

Of the 3652 children who were screened, 997 were found to have an elevated total cholesterol level. Of the 924 who met eligibility requirements, 458 agreed to participate in confirmatory testing. A total of 271 children were confirmed to have elevated LDL cholesterol levels; these children were randomized to an at-risk group. When informed of the random assignment, 10 parents chose to withdraw their children from the program (4 children were withdrawn from the parent–child autotutorial, 4 from the counseling group, and 2 from the at-risk control group). The not-at-risk control group enrolled 81 children. Table 1 lists the number of children who were included in the analysis (i.e., those who provided data for at least one of three areas of interest [diet, blood lipids, or knowledge]). Of the 342 children observed at baseline, 7, 5, 5, and 4 children in the parent–child autotutorial, counseling, at-risk control, and not-at-risk control groups, respectively, did not return for any follow-up visits.

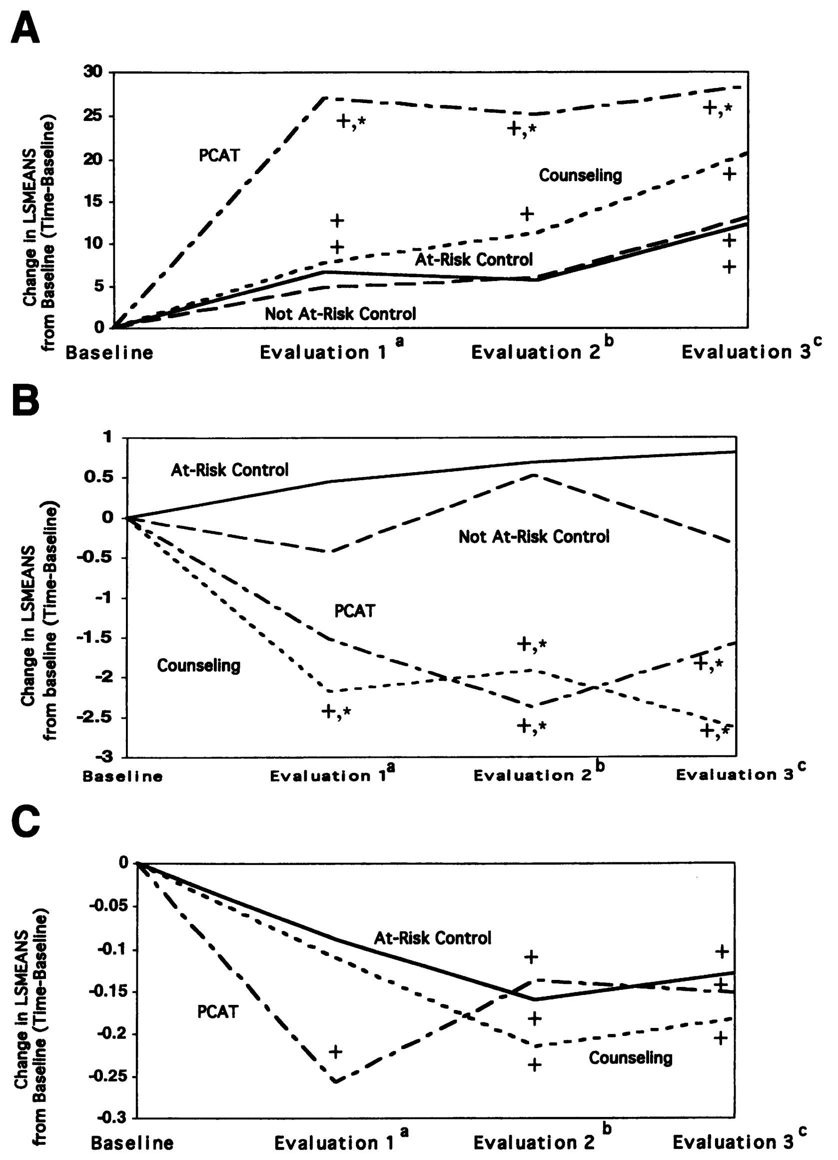
The participants were from predominantly White, middle-to-upper socioeconomic status families; 89% were living with both biological parents. At baseline, the four groups were balanced with respect to the factors listed in Table 1, except for a difference in racial distribution. However, the small number of non-White participants in each group should not have introduced any practical bias. The pattern of dropouts over time also did not differ with respect to age, gender, racial distribution, or study group.

The initial increase in knowledge exhibited by children in the parent–child autotutorial group was maintained over the year and was significantly different from the knowledge gain of the at-risk control group at all three follow-up evaluations (Figure 1). The counseling group showed an intermediate increase in knowledge that was not significantly different from the increase observed for the at-risk control group. The not-at-risk control group's increase in knowledge score was similar in magnitude to the increase observed in the at-risk control group.

The lower fat intakes demonstrated by the parent–child autotutorial and counseling groups were largely retained over the follow-up period (Figure 1). The autotutorial group's intake data at evaluation 3 suggest some degree of recidivism, while the counseling group showed the largest absolute drop in fat intake at evaluation 3. The changes in saturated fat intake were very similar.

The parent–child autotutorial group demonstrated a significant within-group decrease in cholesterol intake, along with a lower caloric intake relative to the at-risk control group, at evaluation 1. No other differences in cholesterol or caloric intake were observed at other times or in other groups.

Significant within-group decreases in LDL cholesterol levels were observed in the parent–child autotutorial group at evaluations 1, 2, and 3 and in the counseling and at-risk control groups at evaluations 2 and 3 (Figure 1). The autotutorial group's decrease in LDL cholesterol level at evaluation 1 reached borderline significance



Note. LSMEANS = least squares (adjusted) mean; PCAT = hypercholesterolemic children who participated in the parent–child autotutorial education program; Counseling = hypercholesterolemic children who received nutrition counseling; At-Risk Control = hypercholesterolemic children who did not receive nutrition education; Not At-Risk Control = nonhypercholesterolemic children who did not receive nutrition education. [+]Significant within-group difference from baseline ($P <$ .05, adjusted via Bonferroni correction). *Change from baseline significantly different ($P <$ .05, adjusted via Bonferroni correction) from change from baseline in at-risk control group.[a]Approximately 3 months after baseline. [b]Approximately 6 months after baseline. [c]Approximately 12 months after baseline.

FIGURE 1—Change from baseline to each evaluation point in (A) LSMEANS knowledge score (%), (B) dietary intake of total fat, and (C) low-density lipoprotein cholesterol.

(P = .03) in comparison with the decrease of the at-risk control group. No other between-group differences for LDL cholesterol change were significant.

The at-risk control and not-at-risk control groups exhibited little change in dietary lipid intake at the second and third follow-up periods in comparison with the first.

Discussion

We have reported the retention of the effect of two nutrition intervention programs for hypercholesterolemic 4- to 10-year-old children with respect to changes in the children's knowledge of heart-healthy foods, fat intake, and LDL-cholesterol level. This project also evaluated a unique practitioner-initiated, home-based nutrition program as an alternative or supplement to nutrition counseling for children.

Little has been reported about the longer term efficacy of nutrition education programs for children. Many of the reported studies also have had significant limitations (e.g., no baseline diet information, no control group). Given these limitations, the reported LDL cholesterol response in children has varied from an increase of 1% to a decrease of 24%.[9–12] In the study most comparable to ours, Kuehl et al.[9] described decreases in total cholesterol levels of 3.7% to 7.8%. In the current study, the parent–child autotutorial group's LDL cholesterol levels decreased by 4.6% to 7.9%, suggesting that the autotutorial approach is an acceptable initial alternative to nutrition counseling for hypercholesterolemic children.

From an educational point of view, the parent–child autotutorial program was especially successful in improving the children's knowledge of heart-healthy foods. Because the autotutorial group's initial score was near the maximum, there was little room for additional improvements as the children developed and were retested. From a dietary modification point of view, both intervention programs demonstrated and maintained modest but consistent decreases in fat and saturated fat intake. The difference between the autotutorial and counseling groups' knowledge scores and diet changes suggests that the parents exerted increasing influence on the latter children's diets.

With regard to LDL cholesterol changes, the parent–child autotutorial and counseling groups retained most of their decrease at evaluation 3. However, these results were not significantly different from those observed in the at-risk control group. A similar control group LDL cholesterol decrease was seen in the Dietary Intervention Study in Children.[13] The difference in statistical significance in terms of LDL cholesterol change between that study and ours may be related to the large sample size (n = 663) of the Dietary Intervention Study, along with its larger intervention group–control group diet difference.

The limited changes in LDL cholesterol level in our study may also be related to the children's relatively low initial lipid intakes, which were lower than those previously reported for children.[14–17] An evaluation of our data suggests that the screening program did not influence fat intake,[18] implying that the baseline fat consumption of the children we studied may have been lower than that of the general US pediatric population. Limitations of dietary evaluations must also be considered. However, an analysis of baseline and evaluation 1 data showed that dietary changes were significantly associated with LDL cholesterol change.[19]

Variability in the evaluation of LDL cholesterol levels could also explain the discrepancy, although appropriate quality assurance techniques were used.[6] Multiple sampling should have minimized regression to the mean,[20–22] but the decrease in LDL cholesterol level of the at-risk control group suggests that further regression to the mean did occur. This, along with the variability inherent in cholesterol levels,[20–22] may have overshadowed the changes in LDL cholesterol levels, given an already relatively low fat intake.

Thus, our experience reported here and elsewhere[4–6,23,24] demonstrates the utility of a practitioner-initiated intervention program for hypercholesterolemic children and provides insight into alternative approaches for nutrition education of children and their parents. Although these results are promising, further evaluations with a broader based population are indicated. Furthermore, the initial drop in LDL cholesterol levels demonstrated in the parent–child autotutorial group suggests the occurrence of behavioral changes that our evaluations did not identify but that could presumably be repeated and reinforced. Therefore, the development of booster educational materials for children and parents should be considered. □

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