Chapter 4
Nutrition Education for School-aged Children

SCOPE

This chapter includes studies of nutrition education directed at the general school-aged population. Studies were conducted primarily in the school setting, but some were conducted outside of school. Excluded are interventions with children who have special needs or medical conditions that require special education or counseling.

Types of programs. Many groups develop materials and provide programs to children, ranging from the activities of an individual classroom teacher to multimillion dollar chronic disease prevention programs funded by the National Institutes of Health (NIH). Those programs that include an impact or outcome evaluation to test effectiveness, however, are limited in number and most typically are those funded by federal or state agencies. The food industry, private voluntary organizations (such as the American Heart Association and American Cancer Society), and other state and local sources produce nutrition education materials and programs; evaluations of these types of interventions are limited. Consequently, the number of studies that meet acceptable evaluation criteria, though increasing dramatically, does not represent total nutrition education activity with school-aged children.

GOALS OF NUTRITION EDUCATION

In the past 2 decades, nutrition programs have been based on two different approaches to goals for nutrition education, in terms of both nutrition content and educational outcome. In one approach, the goal has been to enhance the knowledge, skills, and attitudes needed by children to understand broad, contemporary food and nutrition issues and to select a diet that is good for their general health using a food group approach. Nutrition education is seen as part of general education and is designed to produce nutritionally literate consumers. Many of these programs were originally initiated with funds from the U.S. Department of Agriculture's (USDA) Nutrition Education and Training (NET) program or involved state curricula. Some were developed by the food industry. They grew out of the field of nutrition science and were based on the premise that "nutrition education is the process that assists the public in applying knowledge from nutrition science and the relationship between diet and health to their food practices."[1] The educational outcomes of these programs or curricula could be changes in knowledge, attitudes, and/or dietary intake.

The second approach began in the 1980s with the increasing evidence linking diet to chronic disease and the availability of funding from the NIH, particularly the National Heart, Lung, and Blood Institute (NHLBI), for reducing risk factors in children through school-based health promotion programs.[2] The goal of nutrition education in this approach is to reduce disease risk, as well as enhance health. The educational outcomes are changes in specific behaviors, such as eating patterns that are lower in fat or sodium and higher in fiber, or acquisition of specific behavioral capabilities or cognitive and behavioral skills needed to enact targeted behaviors. These behaviorally oriented interventions grew out of the fields of health education and social psychology or the behavioral sciences and involve the application of strategies found to be useful in other health domains to the domain of dietary intakes. These behaviorally oriented programs are sometimes offered as part of comprehensive health education, which often targets other behaviors, such as physical activity or smoking, as well as diet.

Knowledge-based nutrition education: pros and cons. Those supporting the first type of goal suggest that knowledge-based nutrition education is appropriate in schools, since it models other content areas in the school curricula. In addition, as one leader in the field has noted, if specific behaviors are selected, who decides which behaviors?[3] The same concerns are echoed by another leader in the field:

> . . it is possible to demonstrate changes related to three specific behaviors with approximately 20 hours of instruction. But who decides what the target eating behaviors should be today, tomorrow and far into the future? Are the target behaviors appropriate for everyone? On the other hand, the same 20 hours could be used to teach children an appropriate number of major nutrition concepts that might or might not result in consistent changes in current eating behavior."[4]

Furthermore, given the complexities of food and nutrition issues, other researchers argue that nutrition education needs to teach people not only the knowledge that will help them to choose between foods but also the analytical and evaluative skills necessary to think broadly about food and about nutrition in an ecologically sensitive and globally interdependent world."[5] Can behaviorally focused nutrition education accomplish this goal?

Behaviorally focused nutrition education: pros and cons. Those supporting the second type of goal note that behaviors, or the predispositions and skills to enact them, are important, because nutritional adequacy is important for growth and development during childhood and adoles-

This chapter is based on the technical report titled "Nutrition Education for School Age Children: A Review of Research" by Leslie Lytle, Ph.D., R.D.

cence, and chronic disease processes begin early. Risk factors for chronic disease tend to begin in youth, so that those at the high end in terms of total cholesterol, blood pressure, or weight maintain their ranking in relationship to their peers over time [7,1] In addition, some food-choice-related behaviors tend to track at least between childhood and adolescence.' Knowledge and behavior are poorly related, so that increased knowledge cannot be assumed to result in changed behaviors. [70] At the same time, health behaviors often go together," so that dietary behaviors should be addressed in the context of an expanded concept of comprehensive school health . [2.12] Finally, behaviorally focused nutrition education will help the nation reach Healthy People 2000 goals."

The schism between these two types of goals can be seen in the studies to be reviewed below. However, it is beginning to narrow as nutritionists and behavioral scientists move more closely toward each others' positions. Thus, nutritionists increasingly accept the Dietary Guidelines as the basis of dietary guidance, with its emphasis on eating patterns or behaviors as a means to improve health. At the same time, educators and social psychologists from the behavioral field have developed an increasing appreciation for the complexities and unique features of dietary change compared to other health behaviors and realize that behavioral change strategies derived from research in other health domains cannot be applied to dietary change without modification.

About half of the studies conducted since 1980, including those reported after 1990, did not provide a clear description of the theoretical framework used in developing the intervention, although, in many cases, the framework could be imputed from the nature of the intervention and the evaluation. The general nutrition education programs were more likely not to state the theory informing curriculum development. They seemed to be based on the information dissemination or knowledge-attitude-behavior (KAB) model, which has been described in Chapter 2.

Social learning theory (SLT) was the theory most often cited by the behaviorally based studies as the conceptual framework for the interventions. In most cases, Bandura's version or social cognitive theory (SCT) [14] was used. In this version, cognitive processes are considered to be important influences on behavior, not just incentives and reinforcement. Motivations and values are considered to be part of these cognitive processes. In this chapter, however, the term SLT will generally be used because most of the studies used that term, and it is longstanding. SLT was often coupled with concepts from other social psychological theories, such as expectancy-value, decision-making, or problem-solving models. These theories and models are described in Chapter 2. Nutrition education interventions for youth based on SLT were designed specifically to address personal factors, such as knowledge about health, value placed on health, self-efficacy, and other beliefs; behavioral factors, such as behavioral skills, intentions to act, existing behavioral repertoire, and incentives and reinforcement; and environmental factors, such as parental influence and support, cultural norms and expectations, opportunities and barriers, and peer and adult role models. [15]

The expectancy-value models commonly used in work with adults'" and described in Chapter 2 of this monograph, such as the health belief model, theory of reasoned action, or theory of planned behavior, may not be as useful in understanding preventive health behavior in younger children. For example, in young children, the remoteness of the negative consequences of actions on health and the tenuous relationship between cause and effect greatly reduce the ability of the health belief model to predict behavior." The usefulness of the model increases when specific behaviors are considered as compared to general abstractions such as health, when children's beliefs and expectations are specifically related to the behavior, and when it is recognized that these personal attributes are influenced by families, peers, and social groups, as suggested by the theory of reasoned action." The usefulness of the model also increases with age as children's conception of time, probability, and the future change.

In the theory of reasoned action, behavioral intention is seen as highly predictive of behavior. However, intent does not always translate into behavior in children, because intent can easily be altered by many factors, such as distractions, influence of others, or lack of control over circumstances. On the other hand, the theory emphasizes the important role of perceived positive, as well as negative, consequences in motivating behavior and the important role of social norms and children's willingness to comply with social pressure. The theory of planned behavior adds the additional variable of perceived behavioral control as an influencing force on both intention and actual performance of a behavior. Perceived or actual control over performance of nutrition-related behaviors is an important consideration in interventions with children. Thus, the concepts from these theories can be helpful in suggesting content for nutrition education interventions. Indeed, general expectancy-value theory has been shown to be useful in understanding influences on children's and adolescents' food intake."'"

Cognitive development, or cognitive maturity, is a major influence on what children can learn, [20,21] including what they can learn cognitively from nutrition education. In the early school years, children begin to develop the ability to classify and think causally, but their ability to reason is limited to concrete objects and specific experiences. For example, in one study, the food classification schemes created by children in the prelogical and early logical years relied heavily on the two underlying dimensions of sweetness and meal entrees

versus more flexible items, suggesting that perceptual, functional, and physical properties of foods influenced food classifications.[22] Children's classification systems became more complex with age, as did their understanding of what happens to food in the body. Children also use more behavioral, concrete, and specific cues to define health.[23]

Children in the later school years begin to think more abstractly, can formulate hypotheses to explain occurrences, and can imagine alternative hypotheses. Thus, they are capable of more abstract concepts linking food and health. Studies show that cognitive-motivational processes began to operate in the food choices of children in the concrete operational stage and beyond."[,"] In these studies, the children selected foods based on whether eating the food would bring about desired outcomes. A process of cognitive self-regulation appeared to be operating, whereby behaviors (food choices) are brought into alignment with beliefs and values about the consequences of those behaviors.

Associative conditioning from experience with food itself is an important influence on dietary behavior. From research to date, it is clear that children are not born with the natural ability to choose a nutritious diet, but that food preferences and acceptance patterns are largely shaped through the repeated association of foods' sensory characteristics with the postingestive physiologic consequences of eating them and with the social context.[24] To the extent that these consequences and contexts are positive, children will come to like these foods. Studies have shown that preference is increased with exposure; that tasting or actual ingestion, not just looking at or smelling a food, is necessary; and that a positive social affective context and use of rewards are important influences.[24-26] The effect of exposure in enhancing preference has also been seen in college students[27] and adults." Hence, the sensory affective response to food (including taste) is not only a major determinant of dietary behaviors but can be shaped by experience.

REVIEW OF STUDIES

Two major reviews surveyed nutrition education programs and research with school-aged children in the decade or so before 1980.[2930] Two concurrent, independent reports in 1991 and 1992 reviewed all studies from 1980 to 1990.[31,32] The studies reviewed below include all of the studies described in these two reviews plus those conducted in and outside schools since 1990. In all, a total of 43 studies conducted since 1980 are reviewed in this chapter, 17 of which were conducted since 1990. Five of the latter were follow-up evaluations or diffusion of previous work. Conclusions on elements that contribute to the success of nutrition education programs are based on findings from these 43 studies. Excluded are research studies on school foodservice interventions, except when activities in the school foodservice were part of the overall educational intervention. Some of the studies described here have been concurrently reviewed by Lytle and Achterberg,[33] who have suggested policy implications based on their review, and by the Centers for Disease Control and Prevention,[34] which has developed guidelines for nutrition education as a part of comprehensive school health.

The studies will be reviewed in terms of two categories: general nutrition education interventions and behaviorally oriented interventions. A summary of the studies is provided in Table 2 in the Appendix.

School-based general nutrition education studies. This category includes 17 studies. Almost all used an information dissemination or KAB model, whether explicitly stated or not. The nutrition content was usually based on the surveys of nutrition educators or on existing conceptual frameworks such as the Society for Nutrition Education concepts for food and nutrition education." The curricula covered a variety of topics, such as the role of nutrients in the body, food sources of nutrients, food production and processing, factors influencing food choices, and healthful eating in general. In most studies, the nutrition education intervention was delivered by classroom teachers. While teachers were provided with some degree of training in the use of the curriculum, the degree of supervision by the researchers varied. In most cases, teachers taught the curriculum within real-world constraints.

The NET program for schools was initiated by Congress in 1977 and is administered by the USDA. NET differs from programs such as the Special Supplemental Food Program for Women, Infants and Children (WIC) or Head Start in that it provides direct educational benefits to children, rather than food or funds to purchase food, and serves all children, not just those at economic and/or nutritional risk. "The intent of the [NET program] legislation was to teach children, through a positive daily lunchroom experience and appropriate classroom reinforcement, the value of a nutritionally balanced diet and to develop curricula and materials and train teachers and school foodservice personnel to carry out this task."[36] In most states, NET involves a variety of activities and *projects* directed at teachers, school foodservice personnel, and materials identification or development, with the target being those involved with the elementary school grades.[37] Some states have a centralized model and provide uniform materials and training to multiple local sites. Other states use a system of minigrants to fund local nutrition education projects.

Evaluation of the NET program has been limited, due in part to each state's freedom to use the money to serve the state's own particular needs, in part to the very rapid and dramatic decrease in funding after an initially promising start, and in part to the fact that evaluation is not required. The primary mode of evaluation has been counts of those served by the program. For example, in fiscal year 1978, when the program was initiated and received $20 million, 5,680,023 children, 211,798 educators, and

103,373 f
fiscal year
million, tl
cators, any

The in
ated in foi
of the pro
the projet
did not h2
Overall, i
knowledg
select an(
particular]
impact or
but some
at most gr
program 2
of NET I
some 231
schools arr
see[37] indi
gains in a
where me
effects on
by plate v
to occuri

The it
comprehc
ate curric
in five stu
(exact nu
elementar
and usual
lunchrooi
appreciati
sources, a
grades, er
nutrient i
teenagers,
high scho
health edr
The curri
while attic
scales and
discernibl
food-relai
of ways, s
24-hour(
dense too

Two s
Choice,"
teachers
elementar
high schc
average n

103,373 foodservice personnel received NET services. In fiscal year 1980, when the funding had dropped to $5 million, those totals were 2,295,368 children, 85,034 educators, and 67,393 foodservice staff.[37,38]

The impact of the NET program on children was evaluated in four studies. A national evaluation of the first 2 years of the program was conducted in five states.[38] It found that the projects involving classroom and lunchroom activities did not have consistent results in all states and for all grades. Overall, these projects had positive effects on children's knowledge and on some attitudes, such as willingness to select and taste new foods, in four out of five states, particularly in the early grades. The program had little impact on children's reported food habits and preferences, but some positive effects on intake of meat, milk, and bread at most grade levels, based on plate waste in the school lunch program and other observational measures. Separate studies of NET programs in Nebraska, involving 98 schools and some 2300 students,[39] in New York state, involving 6 schools and 1100 students[40] and, more recently, in Tennessee[37] indicated that the programs resulted in knowledge gains in all cases and in improved attitudes or preferences where measured, particularly in the younger children. The effects on behavioral change were inconsistent, as measured by plate waste or snacking practices, and were more likely to occur in the earlier grades.

The impact of "Nutrition in a Changing World," a comprehensive, sequential, and developmentally appropriate curriculum for kindergarten to grade 12, was examined in five studies involving about 5000 students in 220 classes (exact numbers were not stated in all studies).[3,41-44] In the elementary schools, curriculum duration was 9 to 10 weeks and usually included nutrition education activities in the lunchroom as well. In the early grades, emphasis was on appreciation of a variety of foods, knowledge of nutrient sources, and association of food with health. In the upper grades, emphasis was on food as a source of nutrients and nutrient function, as well as topics of special interest for teenagers, such as weight control. Separate junior and senior high school curricula were taught in home economics and health education classes and were 3 to 10 weeks in duration. The curricula led to knowledge gains in all grade levels, while attitude changes occurred on some, but not all, of the scales and in some grades, but not others, with no consistent discernible pattern. In general, little effect was seen on tood-related behaviors, which were measured in a variety of ways, such as food frequencies within 12 food groups, or '4-hour dietary recalls analyzed for high and low nutrient-lense foods.

Two studies examined the impact of "Food ... Your hoice," another sequential K-12 curriculum taught by chers of 3130 students at several grade levels.[45,46] The nentary school curricula involved 8 to 17 sessions. The h school curricula provided 17 to 22 lessons, but the 'age number of lessons taught was 6 per year. The studies found that significant knowledge gains occurred at all grade levels. Positive attitude changes were found toward the consumption of fruits and vegetables in the elementary grades and for two of the four attitude scales in the high school classes. The intervention group students reported better diets than did comparison group students at both the elementary and high school levels, but the differences in the latter case were not statistically significant. Students in grades 7 through 10 did report greater willingness to eat foods higher in nutrient value.

The effect of parent involvement was examined in one study by comparing a student plus parent intervention condition with a student-only intervention condition and a control group. Impact was assessed immediately after the program and 5 years later.[47,48] The 4-month program involved 421 students in kindergarten through grade 3 in nine randomized schools. Parent involvement produced higher knowledge gain in kindergarten and grade 1, but no difference in food attitude in any grade. Dietary quality and diversity scores were highest in the parent plus student group and lowest in the control group. At 5-year follow-up, when 111 students, now 10 to 14 years old, were located, the parent plus student group still had higher dietary quality scores than did students in the other two groups.

One study used nutrient density as the approach to teach about dietary quality to high schools students, as part of a health curriculum in two schools.[49] Results showed a significant gain in knowledge and no significant differences in attitudes or in behavior, as indicated by a food frequency indicator. Two studies with 5th and 7th graders used a pretest/post-test design without a control group. In one case involving 97 students in grades 5 and 7, teaching was done by high school students, but the method of delivery was traditional.[50] There was a gain in knowledge, but not in dietary quality scores. In the other study, which involved 934 5th graders, self-assessment of dietary intake, decision making, and personal responsibility were stressed.[51] There were significant increases in nutrition knowledge and in servings eaten from the four food groups.

One study was designed to increase female high school students' knowledge and intake of calcium." Sixty-four students from physical education classes in one school were randomly assigned to treatment and control conditions. There were significant gains in knowledge in the treatment group, but no change in calcium or vitamin D intake, as measured via 24-hour recall.

The effectiveness of a statewide nutrition education curriculum in a naturalistic, nonresearch setting was studied." "Nutrition for Life" (NFL) for junior high students consists of three independent modules: nutrition and food choices, nutritional needs over the lifespan, and nutrition and fitness, to be taught in health classes or home and careers classes. The curriculum had been disseminated widely throughout New York state through peer-led training programs. Three groups of teachers were surveyed: those using

NFL (n = 35), those using another nutrition education program (n = 37), and nonusers of any nutrition education program ("no teach") (n = 26); 1863 students were in the classes of these teachers. Significant treatment effects of NFL compared to the "no teach" controls were seen for knowledge in health classes, but not in home and careers classes. There were also treatment effects for attitude in health classes. There was a significant impact on behavior in the home and careers classes, but not in the health classes, based on a 10-item behavior scale measuring several behaviors (such as eating breakfast), and whether the intake of various food groups (such as whole grains, fatty foods, fruits and vegetables, and dairy) was less, more, or about the same as compared to the previous year. The time spent by teachers on the curriculum ranged from 1 to 39 hours, with a median of 3 hours.

In summary, general nutrition education programs almost universally resulted in knowledge gains. Attitude change was inconsistent, but generally positive in the 12 or so studies in which it was measured. There were changes in some behaviors in some grades in the four NET evaluations, and behavioral change was clearly found in 4 of the other 17 studies. In these, the programs tended to be of longer duration. From these results, it would appear that general nutrition education programs, which tend to be knowledge based, are not highly or consistently effective in bringing about changes in behaviors. On the other hand, it should be noted that many of the curricula were taught in real-world contexts without strict research controls and, hence, were not always implemented fully (e.g., in the study of Food ... Your Choice for adolescents and NFL). In addition, the dietary changes measured were quite broad in scope (e.g., using several categories of foods from food lists, 24-hour recalls, or foods consumed in the school lunch).

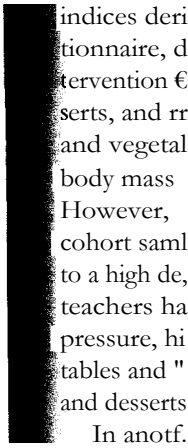
Behaviorally focused nutrition education interventions in school settings. A behaviorally based curriculum uses all three domains of learning (cognitive, affective, and behavioral) but focusses them specifically to address predispositions to act, behavioral intentions, and behavioral change. Cognitive understanding is provided to facilitate changes in eating behavior, but the emphasis is not on teaching the many scientific "whys" but on "how," such as how to choose a healthier diet or how to make decisions. The affective component encompasses not only beliefs, attitudes, and values but also emotional states in relation to food behavior. Thus, attention is given to identifying and addressing motivators of change. The behavioral component focuses on building cognitive, affective, and behavioral skills (e.g., how to identify low-fat foods among alternatives, how to resist peer pressure to eat a high-fat food, or how to prepare a healthy snack).

Most of the behaviorally based curricula used social learning or social cognitive theory to design the intervention strategies. That is, the programs planned activities to address (a) personal factors, such as beliefs, values, self-efficacy, and affective meanings of food; (b) environmental factors, such as parental or peer influence, cultural norms and expectations, opportunities and barriers, and role models; and (c) the behavioral change process, where students monitor what they are eating to identify the problem eating behavior (e.g., too many servings of ice cream per week, or too few vegetables per day); set a goal for changing the eating pattern and make a contract; learn cognitive, affective, and behavioral skills for making the change; monitor progress toward the goal, making adjustments if needed; and provide self-reinforcement for attaining the goal.

Twenty-three studies were identified in this category, most of which are directed at heart health, with the emphasis on reducing fat and salt in the diet and increasing fiber. One study was directed at cancer risk seduction, one at increasing consumption of fruits and vegetables, one at nutrients identified to be problems based on 3-day food records, and another at reducing eating disorders. Most of the curricula were delivered by classroom teachers, but only after training and under the careful guidance of researchers to ensure fidelity to the curricula as designed.

The Know Your Body (KYB) program was the focus of five studies. KYB is an intensive, multicomponent, year-long, sequential and developmentally appropriate curriculum for kindergarten through grade 7, designed to reduce disease risk and based on social cognitive theory. The program consists of screening for serum lipids, percent body fat, blood pressure, pulse recovery index (for assessing fitness), and saliva cotinine (for assessing smoking status), as well as a curriculum component. Screening results are provided to parents and also used in classroom discussion. The curriculum was taught for 30 to 45 minutes each week of the school year. Changes in the school lunch were also often incorporated. A longitudinal study in two New York locations involving 37 classes and 3500 students showed that, at the end of 5 or 6 years, there were significant improvements in knowledge, in intakes of total fat and complex carbohydrate, and in total serum cholesterol." A 4-year longitudinal replication study involving nine classes and 1000 students in Washington, DC[5] also found some positive changes in some physiologic measures, whereas a 2-year study in 18 schools in Los Angeles[56] found an improvement in knowledge, but not in dietary intake. Physiologic measures were not reported.

More recently, the impact of KYB in New York City and Houston, Texas was evaluated in classroom settings in which the researcher's role was minimal.[57] The program was implemented with 2973 students in grades 1 to 4 in three schools.for 2 1/2 years (two schools and 1209 students served as controls) and included changes in school lunch and other schoolwide activities. Teachers implemented the curriculum to different degrees. The intervention resulted in significant decreases in serum total cholesterol and blood pressure, but also in health knowledge. Of six behavioral



indices deri
tionnaire, d
tervention €
serts, and rr
and vegetal
body mass
However,
cohort saml
to a high de,
teachers ha
pressure, hi
tables and "
and desserts

In anotf.
Michigan sc
schools (fou
1200 studer
by incorpor
the SCT fr:
rween base
were seen f
locus of cor
food index.
ing also reps
more frequi

Seven st
Health Pro
curricula ba
Some curri,
environmer
lunch). The
4, "Hearty
schools and
knowledge,
and comple
24-hour rep
made signifi
The 10th gi
ied in 10 cl.
cant gains ii
pared with
reported a s
of heart hea
appeared to

Parent it
pared HH t;
(the Home
ment condil
of packets
containing
volvement
based progr
knowledge
(HT). How
grams had r~

in ices derived from a nonquantified food frequency questionnaire, differences were found between groups; the inte ention group had lower intakes of dairy products, desserts, and meat and higher intakes of "heart healthy foods" an vegetables. No significant differences were found for body mass index (BMI), self-efficacy, or health attitudes. However, attrition rates were high, and only 12% of the cohort sample had a teacher who implemented the program to a high degree. Those students who had high implementer teachers had lower total cholesterol and systolic blood pre sure, higher health knowledge, higher intake of vegetab es and "heart healthy foods," and lower intakes of meat and desserts, compared to studentss in the control group.

In another application, KYB was integrated into the Michigan school health education curriculum in four public schools (four schools served as controls) and included about 1200 students, grades 1 to 6.SS The curriculum was designed by incorporating concepts from the health belief model into the SCT framework. Significant treatment differences between baseline and the 1-year follow-up questionnaires were seen for health knowledge, nutrition awareness, and loc s of control, but there was no effect on a heart healthy too index. Those students who had participated in screening lso reported a lower consumption of high-fat foods and more frequent exercise.

Seven studies that were part of the Minnesota Heart Health Program (MHHP) are described here. Nutrition curricula based on SCT were developed for various grades. Some curricula also involved students taking action on the environment (e.g., student committees to improve school lunch). The 5-week, 15-session curriculum for grades 3 to 4, "Hearty Heart and Friends" (HH), was studied in 30 schools and 2000 students and had a significant impact on kno ledge, preferences, and behavior questions for fat, salt, and complex carbohydrates. Data from group-administered 24-hour recalls showed that intervention group students mad significant changes in 5 of the 12 targeted behaviors.' The 10th grade intervention program "Slice of Life," studied in 10 classes with about 300 students, resulted in significant gains in knowledge in the intervention group as compared with the control group. Females, but not males, also repo red a significant increase in their self-reported choice of heart healthy food items among 18 pairs of foods. Males appe red to modify their salt use. [60]

Parent involvement was examined in a study that compared HE taught in school, a home correspondence course the Home Team [HT]), and a school plus parent involvelent condition with controls." The HT program consisted if p ckets mailed each week for 5 weeks to families, ntaining games and activities that required parental in-.alvement to complete. Results showed that the school-sed programs (HH alone and HH/HT) yielded greater a.wledge gain than did the home-based program by itself T) However, students involved in the home-based pro-3m had reduced fat intake and increased complex carbohydrate intake, as measured by 24-hour recalls. At 1-year follow-up, the effects were still positive, although no longer statistically significant. [62] The effects on sodium intake were less favorable . [63] While significant knowledge gains were achieved in both school-only and school-plus-home conditions compared to the control condition in this study with 31 schools and 1839 students, the behavioral measure of salting foods showed little intervention effect. The 24-hour recall showed small but significant increases in salt intake in the HH group and similar decreases in the control group. Urinary sodium decreased in all but the HH group, though the changes were not significant. These findings in the opposite direction than expected may be due to the fact that (a) salting at the table-the targeted behavior-was not the highest salt source in the children's diet; (b) the salt intake was already low, leaving little room for intervention effects; and (c) the intervention was not powerful enough to facilitate behavioral change.

As part of a larger feasibility study for the Children and. Adolescent Trial for Cardiovascular Health (CATCH), a program to be described later in this section, a study was conducted to examine the feasibility of including a family component in a school-based program. This program involved multiethnic populations in eight schools and 554 families in four states (California, Louisiana, Minnesota, and Texas). Children consumed significantly more fresh fruit, fewer sugary desserts, snacks, and fried foods, and less whole milk after the family intervention, although there was no control group with which to compare these changes . [64] Parents who participated in the family activities, compared to those who did not, were more likely to be between 35 to 44 years old, have higher educational levels, have professional occupations, and be white. They did not differ in behavioral indices, self-reported food intake, exercise level, or in confidence in their ability to make behavioral changes.

The combined effect of nutrition education in the community and in the school was compared to controls in the Class of 89 Study." A cohort of students was followed from 6th through 12th grade in selected MHHP intervention and control communities. This longitudinal study involved 13 schools and 2376 students in the 6th grade year: 1342 students were surveyed in the intervention community and 1034 students in the reference community. By the 12th grade year, there were seven schools and 740 and 325 students in the intervention and reference communities, respectively. Community activities included messages through the mass media, community screening, labeling of heart healthy options in restaurants and grocery stores, and other general campaigns. The classroom component included Lunch Bag, a brief 1-hour session in 6th grade, and Slice of Life in 10th grade, described earlier. A survey was given in April of each year. Results showed that knowledge gains were seen in males and females in the intervention condition for every year except for males in the 8th grade.

Females in the intervention condition reported healthier food choices than did females in the control group in all but the 12th grade, and intervention group males reported healthier choices than did control males in all but grades 11 and 12. The correlation between knowledge and behavior was statistically significant, but the variance explained was only 4 to 7%. The significant result was probably due to the large sample size. Behavior from the previous year was a much stronger predictor of current food choices than were the previous year's knowledge scores. Behavior was measured via an instrument on which students were asked to select from 18 food pairs the "one food they would usually eat when they had the choice."

CATCH,[65] the largest multisite school-based intervention ever funded by NIH, builds on several of the programs described here (e.g., HH, Go for Health, and HT). It includes not only a classroom component, but also changes in the school environment (physical activity and school meals). It also examines whether adding a family component improves effectiveness. CATCH involves 96 schools in sites in four states: 40 control schools, 28 schools with the classroom plus meals intervention, and 28 with the classroom plus meals intervention and a family component, the HT. Results of the outcome evaluations should be available in the next year.

Half a dozen behaviorally oriented studies with elementary school students other than the large projects described above, mostly directed at heart health, also used variations on SLT as a framework. One of the first behaviorally based studies conducted in this 15-year period, the Heart Health Program, was implemented in grades 4 and 5 in two schools and used a time series design." At both schools, the average daily number of heart healthy foods in students' lunches (by observation) increased during the program, remained high after the program, and remained above baseline levels at follow-up several months later. Go for Health, targeting grades 3 and 4 and evaluated in a study involving four schools and 40 classes in Texas, resulted in significant changes in students' behavioral capabilities (knowledge and skills), behavioral expectations or intentions, self-efficacy, and use of salt .[67] However, their selection of "Go Foods" (i.e., those low in fat and salt and high in fiber) did not change significantly, although intervention activities in the school lunch did reduce fat and salt in the meals served to students .[68]

The Chicago Heart Health Curriculum, directed at 6th grade students, had a positive impact on knowledge, attitudes, and behaviors, but the addition of a parent participation component had no additional effect on these variables.[69] Similar findings were obtained in a cancer risk-reducing curriculum with 6th graders. It resulted in improved nutrition knowledge, increased consumption of carrots, and decreased consumption of high-fat dairy foods compared with controls, but adding a parent component did not enhance the effectiveness of the program beyond that achieved by classroom instruction."

The Heart Smart Program included a classroom component, as well as cardiovascular screening, changes in school lunch and physical education, a parent outreach for all students, and a family health promotion program for families of 530 4th- and 5th-grade children at high risk for cardiovascular disease." The classroom curriculum was taught 15 to 35 hours per year for 22 years and emphasized healthful eating habits, exercise, self-esteem, self-care, and healthful lifestyles. There was no significant difference in knowledge gains between the two intervention and two control schools. No data are presented on behavioral differences, although children with the greatest reduction in serum cholesterol and degree of fatness had the largest number of healthful food choices. The intervention group experienced a gain in HDL levels compared to the control group.

Gimme 5, designed to enhance 4th and 5th graders' abilities to ask for and prepare fruits and vegetables, was evaluated in a study involving two schools and 301 students." Significant gains in knowledge and in preferences for fruits but not vegetables and for fruit and vegetable snacks were achieved in the intervention school. Overall, fruit and vegetable consumption was not significantly affected by the intervention. Although fruit consumption was statistically greater in the intervention school compared to the control school, even at post-test, students were eating, on average, less than one serving of fruit per day, and most of the increase was at school lunch.

Several other studies with adolescents have also been reported. The Great Sensations Study[73] was designed to decrease consumption of salty snacks and to increase consumption of fresh fruit snacks among 10th to 12th graders in an inner-city school setting. It involved eight intervention classes with 154 students and seven control classes with 130 students. The schoolwide media program was effective in decreasing the consumption of salty snacks and increasing targeted snack foods immediately after the program, but only those receiving the classroom component maintained the changes until the end of the school year. No changes persisted through the summer vacation. Adding a parent component improved snack consumption immediately after the intervention, but a decrease in desirable snacks was seen at follow-up the next school year.

The Adolescent Heart Health Program from Stanford was directed primarily at 10th graders and was taught by the, researchers rather than the classroom teacher. Three studies are described. One study, involving two schools and 218 students, reported on the effectiveness of a 3-week, five-session curriculum.[74] The results showed that significant increases in knowledge, reported healthful dietary behaviors, and reported availability of healthful foods at home were evident in intervention classrooms, as compared to the control classrooms. There were no significant differences in

attitudes, behavioral intentions, or self-efficacy, and no significant differences in observed snack choices in a postintervention behavioral assessment situation. Significant predictors of positive healthful dietary behaviors, accounting for 14% of the variance, were positive changes in reported availability of healthful foods in the home, in knowledge, and in attitudes. At 1-year follow-up, only differences in knowledge remained. In another study involving 20 sessions in 7 weeks in eight classes in two intervention schools and two control schools with 1447 students, there was a significant increase in knowledge on a multiple choice nutrition test, in self-reported food choices, and in reduction in body fat, with more consistent reductions for girls than for boys. There was no significant change in blood pressure."

Finally, a study investigated the effectiveness of an eating disorders prevention program with 967 6th and 7th graders in four schools, randomized into intervention and control conditions.[16] The program emphasized the harmful effects of unhealthful weight regulation, promotion of healthful weight regulation, and the development of coping skills through a slide show and a workbook for homework lessons. Results show that the intervention produced significantly improved knowledge scores in the treatment group as compared to the control group, but no effects_ on measures of eating restraint, on self-reported unhealthful eating practices and weight regulation, and on the Eating Disorder Inventory. A small but significant effect on BMI was found in the high-risk group. The authors suggests that a prevention intervention may not be effective for girls of this age; instead, at-risk girls should be identified and treated.

Personalized assessment and feedback was examined in a study with 77 high school students in three schools and directed at decreasing fat and increasing fiber in the diet and at weight control.[77] There were three groups: all students completed a Student Health Behavior Survey (SHBS) five times over a period of 12 weeks. One group was sent 14 health tip sheets and then received computer-generated feedback letters regarding their health behaviors at baseline and three more times after completing the SHBS. The second group received the tip sheets only and no personalized feedback on their SHBS results. The third group completed the SHBS five times with no feedback and no tip sheets. Students receiving personalized feedback reported significantly improved scores on both the saturated fat/cholesterol intake index and the fiber/complex carbohydrate intake index. For those 10% above ideal weight, the feedback condition resulted in significant change in self-reported weight. Significant improvement was also seen in the saturated fat and cholesterol intake index for the assessment-only condition, with no positive changes in the health tip sheet group.

A study of special interest is one in which a behavioral framework was used, rather than the KAB framework, for a nutrition education intervention where the nutrition content was more general-any change in nutrient intake as selected by the student.[78] It involved 159 high school students in health classes. Two behavioral change strategy interventions, one with and one without an additional nutrition knowledge component, were compared with a control group. Based on an individualized nutrient intake analysis of a 3-day food record, each adolescent in the intervention group selected improvement in intake of one nutrient as a goal. The behavioral change intervention was based on a combination of systematic problem solving, goal setting, and self-management. Results showed that knowledge increased in both intervention groups, with the behavioral change plus knowledge group experiencing the greatest gains. No changes in attitudes were seen. Both intervention groups had significant changes in intakes of nutrients compared to the control group, and the specific strategy of setting a goal, among the strategies listed above, influenced the consumption of each of six goal nutrients.

In summary, it would appear that behaviorally based programs targeting specific behaviors and involving self-assessment, decision making, and/or behavioral change strategies derived from SCT and related theories are more likely to result in behavioral changes. While most of the studies in this category had mixed behavioral outcomes, some success in achieving behavioral change was seen in 18 of the 23 studies reviewed, whereas behavioral change was present in 8 of 17 general nutrition education programs. Behavioral capabilities, or the behavioral skills needed to enact the behaviors, behavioral intent, and self-efficacy were often also used as outcome measures in these studies. Impacts on these were mixed, but generally positive. It should be noted that most of these studies were taught by teachers, but under research conditions in which they followed protocols under supervision.

Nutrition education in other settings. Few studies reported on nutrition education programs conducted outside of the school setting. Three studies targeted families directly. In the San Diego Family Heart Project, families attended 3 months of weekly intensive intervention followed by 9 months of monthly or bimonthly maintenance sessions, including parent- and child-only instruction, combined instruction, and a social time with healthy snacks.[79] There were significant changes in the behavioral and physiologic outcome measures in the children. Twenty-six percent of invited Caucasian-American families and 48% of Mexican-American families agreed to participate. Average attendance for the 12 weekly sessions was 71% for white families and 58% for Mexican-Americans.

A similar program with 96 African-American families with children in grades 5 to 7 involved 14 weekly sessions conducted during the evening in the library of a high school." The program was based on SCT, social support, and adult education. Educational experiences were pro-

vided to children and parents separately. The dropout rates were high, with only 17% and 19% of parents and children, respectively, attending more than half of the classes, and 43% and 34%, respectively, attending none of the sessions. Based on a food frequency questionnaire, significant favorable effects were seen for consumption of high-fat foods and high-sodium foods and unfavorable effects for high polyunsaturated fat foods and high-calcium foods. The 24-hour recall showed no significant intervention effects, except for sodium intake by boys. There were also no effects on behavioral capability or self-efficacy scales.

The Nutrition for a Lifetime Study (NLS), an innovative program involving an interactive computer video disc in grocery stores, had a component for families with children aged 8 to 16.[81] It was designed to alter the shopping behavior of consumers to comply with recommendations from the National Cancer Institute (NCI). Seventy-seven participants were randomly assigned to a control or intervention group. Parents viewed a different 2- to 8-minute program each week for 5 to 6 weeks, which offered suggestions regarding children's food choices and used SCT strategies, such as simple goal setting, food purchasing and preparation, strategies to overcome barriers to meeting goals, snacks for children, and maintaining long-term commitment to change. Children did not directly interact with NLS. The results showed a significant difference between control and intervention children for snack preference. Trends for change in the desired direction were also reported for children's knowledge gain and entree choice based on a card-sorting task. No differences were seen on a food history questionnaire, but trends were noted for intention to increase low-fat dairy and high-fiber grain consumption.

Two other programs conducted outside of school settings were knowledge based. One was a cardiovascular health education and fitness program conducted with 55 3rd and 4th graders in an after-school daycare setting.[112] The results showed that the intervention had a significant effect on knowledge gain, but not on the children's attitudes or heart rates. There were no behavioral measures. The authors noted that classroom-type teaching after school was not effective, since children wanted more free time and activities at the end of the school day. The second study reported on the nutrition knowledge gain achieved by teenagers teaching younger children about nutrition in a summer youth nutrition education program." The study involved 27 teenagers in the intervention group, who taught nutrition to young children, and 13 controls, who taught other topics. A knowledge test was given before and after the five-session program and included items on nutrient function, food sources of nutrients, balanced lunch menus, and recommended servings. The intervention group (i.e., those teaching the sessions) showed a significant gain in knowledge, compared to the control group.

CONCLUSIONS ON ELEMENTS CONTRIBUTING TO EFFECTIVENESS OF NUTRITION EDUCATION

Nutrition education research studies with school-aged children have become considerably more sophisticated in the past decade or so. Almost all of the studies reviewed here had experimental designs in which classes or schools were randomly assigned to intervention or control conditions. While some of the studies involved only a few schools, sample sizes were often large, involving dozens of schools and hundreds, if not thousands, of children in many cases. About half of the studies provided information on reliability and one-fifth on validity of the assessment instruments. Statistical analyses of data have also now become quite sophisticated. The conclusions described below are thus based on sound empiricism.

As indicated above, there is some debate as to whether nutrition education for school-aged children should focus on providing the cognitive, affective, and behavioral skills needed to enact specific behaviors or more general nutrition education concepts and skills. Yet, virtually all programs subscribe to some overarching aim of "improving the eating practices of children" and use behavioral change as the central criterion of effectiveness, even if knowledge and attitude changes are also assessed. Using that criterion, the elements contributing to the effectiveness of nutrition education are discussed below. All are important, but the most important are emphasized first.

- *Nutrition education is more likely to be effective when it is behaviorally focused.* The studies reviewed to date show that, given the limited time available, those interventions that focus on specific behaviors result in more behavioral changes than general nutrition education programs. For example, 18 of 23 such studies resulted in behavioral change at least on some measures, such as consumption of targeted foods,[5'] decreased fat intake[54,84] or use of salt.' On the other hand, only 8 of 17 general nutrition education studies showed clear evidence of behavioral change. Here, broad dietary changes were used as the outcomes, such as 24-hour recalls, selection of foods from several food groups, and so forth. Behaviorally based curricula are those that are directed at specific behaviors by addressing the predispositions to act, behavioral intentions, and behavioral skills.
- *Nutrition education interventions are more likely to be effective, when they employ educational strategies that are directly relevant to a behavioral focus and are derived from appropriate theory and research.* This review has shown that it is not sufficient for a curriculum to be behaviorally focused only. The educational strategy used must also be relevant and appropriate to its behavioral focus. For example, two studies that focused on behaviors one directed at heart health[82] and the other at increasing calcium intake[52] -re-

lied heavily on information dissemination and didactic teaching methods. They did not systematically address motivations, incentives, or behavioral skills involved in making the desired behavioral changes. The interventions resulted in significant changes in knowledge, but not in behavior.

Effective behaviorally focused curricula are those that address all three domains of learning but use them to facilitate behavioral change. Cognitive understanding is needed to change eating behavior, but the focus is on the concepts and cognitive skills that are needed to carry out the targeted behaviors as well as to understand and analyze the causes, consequences, and contexts of behavioral change. The affective component focuses on exploring the beliefs, values, emotional meanings of foods to individuals, and motivations underlying these behaviors. The behavioral component provides practice in a systematic process of changing these behaviors. In most of the effective behaviorally focused studies reviewed, this process was based on some variation of SLT or combination of SLT with related theories. The elements of SLT that are seen in many of the more successful programs include self-assessment of dietary intake or food-related practices to identify problem behaviors, setting personalized goals for change, observation of modeling of desired behaviors by peers and adults, enhanced self-efficacy through skill building, and reinforcements and incentives for change [65,84] The instructional methods should be experiential, active, and hands on. The successful programs also attempted to build normative support for desired change and to create more supportive school and community environments. [111,611]

This review also shows that interventions based on a KAB theoretical framework, as was the case for most of the general nutrition education curricula, were effective in increasing knowledge but not in improving the eating practices of school-aged children.

- *Interventions need to devote adequate time and intensity to nutrition education to be effective.* Programs with longer durations, more contact hours, and more components result in more positive results than do shorter programs. The KYB program, which resulted in positive effects on both dietary intake and serum cholesterol, is a sequential curriculum for kindergarten to grade 7 that is taught for 30 to 45 minutes per week over the entire school year, usually for several consecutive years." [14] The curriculum is not only behaviorally focused, but classroom methods are based on appropriate theory so that they will facilitate adoption of healthy behaviors. That is, educational strategies draw on the health belief model, SCT, and other relevant theories. In addition, the program involves modifications to the school environment, particularly changes in the school meals, and contact with parents. When the curriculum was disseminated into real-world settings, it was found that greater implementation by teachers was associated with more positive behavioral and physiologic effects on students.[57]

Most of the other programs reviewed, however, involved only 10 to 15 hours of education over a 3- to 15-week period. When curricula were disseminated to teachers to use in real-world settings, even less time was spent on nutrition education (e.g., a median of 3 hours of a potential 39[53] or an average 6 of 17 lessons [46]). In one case, only 12% of teachers were "high implementers" of the curriculum as planned . [57] These findings are similar to those obtained from surveys, which show that teachers spend about 10 to 15 hours per school year on nutrition education.'-' Yet, the School Health Education Evaluation study[86] found that 15 hours could be expected to bringabout only changes in knowledge and that 50 hours were required for changes in attitudes and behaviors as well. Thus, sufficient time and intensity are needed for nutrition education to be effective in improving attitudes or facilitating behavioral change.

- *Family involvement enhances the effectiveness of programs for younger children.* Several studies have shown the usefulness of including a family component for younger children, such as the study by Kirks et al [47,48] with children in kindergarten through grade 3, the HT program for grades 3 and 4,[61] and the family-based programs of Nader et al.[7] and Baranowski et al." involving families of 5th to 7th graders. The programs that were most effective were those of sufficient length and intensity. Also effective were those in which materials were mailed directly to homes and included activities for family members to do with the child, such as worksheets, games, and other activities, rather than newsletters. Parents who participated in such an intensive program in one study demonstrated significantly more positive outcomes than did parents in the control group in terms of knowledge, attitudes, parent-child communication levels, and the availability of healthful foods in the home . [87] After-school meetings or phone calls were not preferred by parents, as indicated by the survey of Crockett et al.'" and by the low attendance rates in after-school programs in the Nader et al [7] and Baranowski et al. [80] studies.

There is little evidence that family involvement is useful for middle or high school students, as shown in several studies reviewed . [69,70,73] Peer involvement, however, may be effective, as shown in the Slice of Life study for 10th graders . [60]

- *Incorporation of a self-evaluation or self-assessment and feedback component is effective in interventions for older children.* Self-assessment is usually viewed as a behavioral change technique and is part of the SCT framework. However, several effective programs reviewed here emphasized self-assessment with personalized feedback, sometimes without other extensive behavioral strategies. Examples are the "Secrets of Success" study with 5th-grade students by Howison et al. [51] the study involving high

school students that used computer-assisted feedback letters," and another where high school students used 3-day food records to identify problem vitamins and minerals in their diets .[78]

- *Effective nutrition education includes intervening in the school environment.* The NET program of 1977 was designed to link school meals and classroom education. Several of the school health promotion studies funded by NIH and reviewed above have included school lunch modifications as part of their overall programs.[65,68] These have shown that school meals can be modified to make them more healthful and that the combined effects of meal modification and classroom education can have some positive effects.[67,68] Because these studies have involved both lunch and classroom components, the independent effects of school lunch as an educational medium in providing modeling of healthful food selections was not investigated. However, the research described earlier, which shows that children's food acceptance patterns are influenced by repeated exposure to food and to the social affective context in which it is offered,[26-28] suggests that the school environment can influence acceptance of healthful foods through familiarity and reinforcement. The research on which SCT is based also points to the important role of environment in influencing behavior.
- *Interventions in the larger community can enhance school nutrition education.* Several of the studies reviewed were part of larger community interventions. In the Class of 89 Study, where a cohort of students was followed from grades 6 through 12, significant intervention effects for food choice behaviors were seen in both boys and girls and in most grades during the 7 years of measurement."[89] Since the school-based interventions were rather minimal (1 hour in grade 6 and 10 sessions in grade 10), the community intervention must take much of the credit for the intervention effect.

IMPLICATIONS FOR NUTRITION EDUCATION POLICY AND PROGRAM IMPLEMENTATION

Based on the results from the review of studies, recommendations for nutrition education program implementation and policy are as follows.

- *Federal agencies, such as USDA, NHLBI, and NCI, should work together and, along with state and local governments, commit resources to nutrition education.* As the department that has for decades provided nutrition education to the public and was designated by Congress to provide nutrition education in the schools, USDA should use programs that are already in place (e.g., NET and the School Meals Programs) to implement the successful nutrition education elements described above. NHLBI and NCI should use results from its previously funded research to advocate and fund the incorporation of nutrition education into the school curriculum. Government agencies should also collaborate with private voluntary organizations to maximize resources and reduce duplication.
- *Effective programs should be widely disseminated and implemented.* Curricula that have been evaluated and shown to be effective should be disseminated to teachers and school districts by the government or some other credible and unbiased funding source, such as private voluntary or nonprofit organizations and professional associations. A system needs to be devised so that teachers and other educators can have access to effective curricula, programs, and materials. A national clearinghouse or diffusion network could be created that collects, describes, and evaluates programs in a way that helps potential users identify which would be most useful in their given situations. Availability of such programs would reduce the redundancy created when teachers, states, and other groups believe there is a need to develop their own curriculum due to lack of information about existing programs and materials.
- *The nutrition education curriculum should be behaviorally focused.* Nutrition education has been defined as "any set of learning experiences designed to facilitate the voluntary adoption of eating and other nutrition-related behaviors conducive to health and well-being."[89] This review has shown that behaviorally focused programs are more likely to be effective in facilitating the acquisition of behavioral skills and the voluntary adoption of more healthful eating behaviors.

Such programs can be considered fragmented and narrow in scope, having so far targeted only a few behaviors relevant to heart disease and cancer risk reduction. It should be noted, though, that while *behaviors are* targeted in this approach, the behaviors do not need to be limited to those important only for chronic disease risk reduction, or even nutritional adequacy. Given that nutrition is the link between agriculture and health, the behaviors can be related to a variety of contemporary food and agriculture-related concerns as well, such as food safety, sustainability of the food system, ecological concerns, or food security. In addition, a behavioral focus does not mean that the curriculum needs to be narrow. Indeed, given the complexity of issues arising from ongoing nutrition research and the rapidly changing food supply, nutrition education needs to teach children and adolescents not only the knowledge and skills that will enable them to enact target behaviors but also an understanding of the historic and cultural context and consequences of these specific food- and nutrition-related behaviors. For older children, this may include teaching the analytic and evaluative skills necessary to think more broadly about the nutrition and food system contexts in which the target behaviors are embedded. What a behaviorally focused curriculum does mean is

that, given the fact that teachers can devote only limited time to nutrition education in any given year, nutrition education must become more focused on clear and specific outcomes so that these few hours are spent as productively as possible.

- *Nutrition education should be sequential, coherent, and of sufficient duration and intensity.* This review of studies suggests that effective nutrition education interventions are those that seek to enhance the valuing of health and other important food- and nutrition-related concerns, improve critical thinking and decision-making skills, and provide practice in changing behaviors and environments. A similar approach is needed for nutrition education designed to foster the health of communities, and the planet, as well as of individuals.

To bring about such nutrition education requires more carefully thought-out and comprehensive planning, spanning kindergarten through grade 12. Haphazard nutrition education units of short duration on topics unrelated to each other and provided sporadically cannot be effective. The nutrition content, as well as the appropriate decision-making skills, attitudes, and behaviors to be encouraged, need to be carefully chosen. Since not all topics or behaviors can be addressed in any given year, these can be addressed in different years. With proper attention to scope and sequence through the grades, it is possible to develop an integrated curriculum that is comprehensive.

Given limited time in the school curriculum, there is pressure for nutrition topics to be covered in a variety of subject areas, such as social science, reading, or mathematics. Most of the general and behaviorally focused curricula reviewed here were taught as a separate unit. There is little research on the integrated approach. In one study, where nutrition was integrated into other subject areas, teachers taught only 6 of the 17 activities in the curriculum." Given that even focused programs did not achieve across-the-board behavioral changes, it is unlikely that integrating nutrition messages into other subject matter would result in behavioral change or even change in some of the antecedents such as values, behavioral skills, or behavioral intent. In particular, the use of an integrated approach would most likely sacrifice the following elements shown to be important: sufficient exposure to nutrition education; a behavioral, skill-building focus; attention to scope and sequence; and adequate teacher preparation. True integration would require teachers from many subject areas to be trained in delivering nutrition education segments that have to add up to a curriculum with a coherent nutrition message. Clearly, that poses a feasibility problem, as well as a conceptual one. This does not mean that food- or nutrition-related concepts cannot be reinforced in other subject areas. Indeed, they can, and such reinforcement should be encouraged.

ce food-related behaviors have been shown to co[illegible]rate with other health behaviors," including nutrition, as part of comprehensive school health provides an opportunity to place nutrition issues in the broader context of overall health and well-being. Five of the studies reviewed above were part of comprehensive school health education. Program implementation will require consideration of the following issues: where nutrition education should fit; whether it should be included at each grade level and, if not, at which grade levels; whether the nutrition component at a given grade level should be imbedded in larger health issues or taught as a separate unit; whether it would be mandated; and who should develop the plan. Some of the concerns expressed above about integration without loss of the nutrition message apply here as well.

- *The content of nutrition education must be appropriate in terms of cognitive development.* Effective nutrition education tailors educational activities to children's cognitive developmental level and abilities as well as addresses food-related behaviors. In this way, behavioral strategies and cognitive approaches can be seen as forming a continuum. The behavioral component is of primary importance in the early years. The cognitive component becomes increasingly important as children get older. The research on children's health beliefs and understandings about food and nutrition indicate that children in elementary school tend to deal in concrete experiences, rather than abstract associations.[17,22,23,90] Food classifications and understandings of the link between food and health and food and the environment are concrete. Self-assessment using a food group approach, modeling by adults, basic discussion about media and social influences, and practice of simple cognitive and behavioral skills should be stressed.

As the child approaches middle school, cognitive-motivational processes become important influences on food intakes. Children become more able to make food choices in light of their perceptions of anticipated consequences from eating foods.[8,9] The educational strategies should target making food choices within a broader social and environmental context. At the middle and high school levels, more abstract concepts and causal relationships can be understood. Connections between food and present and future health can be made, as well as between dietary practices and the physical, social, and political environment. Nutrition education can emphasize increasingly sophisticated critical thinking skills, including analysis of media and social and political influences and examination of the impacts of diet-related practices on health and the environment. That is, at all points on the age gradient, nutrition education interventions should address factors suggested by SCT as important for behavioral change: personal beliefs and values, attitudes, motivations, environmental factors, and behav-

ioral skill and self-efficacy factors. The way in which these factors are addressed should be appropriate for each level of cognitive development.

- *Intervention strategies should address the affective domain.* Research described earlier provides evidence that elementary school-aged children will be motivated to choose foods based primarily on affective and environmental factors, such as familiarity, taste, social learning, and reinforcements.[11,26] Nutrition education curricula should focus on increasing exposure and, hence, familiarity to a wide variety of healthful foods in positive social affective contexts, providing reinforcements and increasing the availability of healthful foods.

  Affective domain factors remain important factors in influencing dietary intake. Lewis and Lewis" note that early experiences with food and social learning from family and culture are the primary modes for acquisition of a repertoire of beliefs and behaviors related to food and health that become well established long before children can deal with abstract concepts, such as causality, prevention, or health. It is not surprising, therefore, that these beliefs and behaviors are so stable.[91]

  Taste remains an important influence on food choices and should not be ignored. Indeed, information that a food tastes good is more likely to encourage not only elementary school-aged children but also high school students to try new foods than is information about the nutritional benefits of the food.[92] More complex motivations can be explored, however, and emotional and functional meanings can be placed on food.[18,19,93,94] The normative influences of peers and community become increasingly important. Students can learn to identify and practice strategies to resist social and media pressures. Decision-making skills and personal responsibility, as well as affective emotion-coping and behavioral skills, are appropriate content areas for older children.
- *Schools should be healthful environments where the cafeteria and food-related policy provide students with access to healthful food choices and allow them to see healthful food practices modeled.* The importance of school environments is suggested by SLT and research reviewed earlier that demonstrated the important role of exposure to foods in positive social-affective contexts in influencing food acceptance. The USDA's School Meals Initiative for Healthy Children has the potential to improve school meals so that the foods served model desired practices, and its Team Nutrition helps to create those conditions that make eating a mediated learning experience for children from preschool through grade 12 by providing foodservice training grants to states and preparing classroom, parent, and community nutrition education resources.[36] In fact, the goals stated for Head Start are just as applicable for older children: school meals should demonstrate that mealtime is a pleasurable and enjoyable experience for socialization as well as eating. Food-use policy in other settings also needs to be discussed and established, such as teachers' use of candy and coupons for items at fast-food franchises as rewards, the types of foods that may be sold in school vending machines and at fundraisers, and rules related to fast-food franchises selling food in the school cafeteria.
- *Since time for nutrition education in schools is limited, other channels should be explored, such as media campaigns and interactive computer technology.* The average time teachers in New York state spend on nutrition education in elementary school is about 11 hours in any given year.[95] As noted earlier, that is not enough time to bring about significant changes in, attitudes or behavior. In addition, adolescents watch an average of 21 to 22 hours of TV per week." In one survey, food messages on prime time occurred an average of 4.8 times per 30 minutes, 60% of which were for low-nutrient beverages, sweets, and salty snacks.[97] Children are estimated to watch an average of 3 hours of food commercials per week on a continuing basis" and, in one survey, the foods requested by children 3 to 8 years old paralleled foods advertised on TV." In a survey of Saturday morning TV programs, 50% of ads were for items that would fit in the fats, oils, and sweets group of the Food Guide Pyramid and 43% in the bread, cereals, and pasta group (mostly breakfast cereals).[100] No ads were for fruits or vegetables. One-third of the commercials appealed to taste; another quarter to food being fun, cool, or hip; and only 2.4% highlighted nutrition. Thus, mass media campaigns would be a promising avenue for government. Paid-for time, rather than donated time, should be used, since, in the latter case, messages may not be broadcast at times when the target audience is watching television. Interactive computer technology is also opening up new avenues for nutrition education, such as the Ship to Shore program[101] and 5 A Day Adventures." More attention should be paid to the evaluation and use of the new technologies.
- *Family involvement should be encouraged for younger children.* Formative evaluation work by Crockett et al.[87,11] found that parents preferred to participate in their child's nutrition education through activity sheets or homework assignments. Parents are less interested in attending weeknight or weekend sessions or receiving telephone calls, as shown also in the low attendance rates in evening sessions in the Nader et al." and Baranowski et al.[80] studies. The parent component should also be of sufficient duration and intensity, involving joint activities with children, not just newsletters. The USDA's Expanded Food and Nutrition Education Program (EFNEP) can be tapped to provide family programs to complement NET activities in the schools.
- *Teachers should be trained in nutrition education* and in the criteria for selecting appropriate curricula and programs. Teachers, in preservice or inservice contexts, should be provided with training in nutrition education. The need

for teacher ii
crease dramaf
becomes mor
tional metho
preparation.
ricula should
ernment or of
such as priva
associations (1
conflict of in
the published
importance o
ness, as well
advocated eat

IMPLICATION
RESEARCH

Based on the res
Mg are recomme

- *Appropriate to(*
  and behavior-,
  sus among tl
  promotion pr
  trition educat
  variety of fac
  values, sense
  cacy, as well,
  "Behaviors"
  takes," as me
  related measu
  targeted food
  instrument. 'I
  foods or patte
  behaviors, su
  chicken. Som
  measured in
  viewed. Mor,
  outcomes ml
  and validity.
- *Careful evalua*
  nutrition educe
  intent of wid
  is important
  using approl
  evaluation ds
  or diagnose c
  by funders a
  done for th
  extensive pry
  foodservice I
  ronmental cc

for teacher inservice education and follow-up will increase dramatically as school-based nutrition education becomes more behaviorally oriented, since such educational methods will call for more substantial teacher preparation. At the very least, criteria for selecting curricula should be published and sent to teachers by government or other credible and unbiased funding sources, such as private voluntary organizations or professional associations (not by organizations where there may be a conflict of interest). During teacher preparation and in the published criteria, there is a need to emphasize the importance of behaviorally based curricula for effectiveness, as well as the Dietary Guidelines as the basis of advocated eating patterns.

IMPLICATIONS FOR NUTRITION EDUCATION RESEARCH

Based on the results from the review of studies, the following are recommendations for research.

- *Appropriate tools are needed* for evaluating eating behavior and behavioral change skills. There is increasing consensus among those involved in health education/health promotion programs that appropriate outcomes for nutrition education are not only behavioral change, but a variety of factors that predict behavior, such as health values, sense of personal empowerment, and self-efficacy, as well as cognitive, affective, and behavioral skills. "Behaviors" are not necessarily accurate "nutrient intakes," as measured by 24-hour dietary recalls or other related measures. Behaviors may refer to the intake of targeted foods from a short checklist or food frequency instrument. They may refer to some composite index of foods or patterns of intake. They may also refer to actual behaviors, such as salting foods or taking the skin off chicken. Some combination of all of these outcomes was measured in the dietary health promotion studies reviewed. More of the tools that are appropriate for these outcomes must be developed and tested for reliability and validity.
- *Careful evaluation should be an integral part of all school-based nutrition education programs* that are developed with the intent of widespread adoption or national distribution. It is important to conduct rigorous outcome evaluations using appropriate designs. At the same time, process evaluation data are extremely important to help explain or diagnose outcome results. These should be published by funders as technical reports and by journals, as was done for the CATCH study. In the CATCH case, extensive process data were published on the classroom, foodservice `program, physical activity, family, and environmental components. [103]

th is needed to determine which strategies are most e ve for different cultural groups. Many of the studies reviewed were conducted with relatively homogeneous school populations (e.g., the MHHP studies). While recent research has increasingly included more ethnically diverse population samples, little has been done to look at the differential effects of interventions on different cultural groups. More work is also needed to assess ethnic-specific needs, motivations, and concerns with respect to food- and nutrition-related issues and to examine the specific role of family and social support. In addition, while, for many children, eating too much food is the major nutritional problem, for an increasing proportion of children, getting enough food, particularly of the more nutritious variety, is a problem. In 1990, 11 million children lived in households of families below the poverty level. Nutrition education for these diverse groups will warrant increased attention and research.

- *Research on the tracking of eating patterns through childhood and into adulthood is extremely important.* From research to date, it is clear that children are not born with the natural ability to choose a nutritious diet and that food preferences and acceptance patterns are learned from exposure to foods through family and cultural influences. The Class of 89 Study reviewed earlier, which followed students from 6th to 12th grade, found that dietary behavior from the previous year, as measured on a single, simple, forced-choice instrument, predicted food choices in the current year. This suggests that some food habits track, at least between the 6th and 12th grades. A more complete tracking study of food-related behaviors, eating patterns, and nutrient intake is needed.
- *More work is needed with families.* While significant gains have been made in developing family components in nutrition education programs, more research is needed on understanding parental motivations and concerns; maintenance of change after the end of a program; and training of parents to positively influence their children's food choices, to be aware of how influential their own food choices and eating patterns are on their children and to recognize the two-way flow of information and influence.
- *More qualitative research on the motivations, understanding, and concerns of children is needed.* More work needs to be done to understand the functional meanings that food has for children of different ages, the motivations and affective aspects of food, perceived benefits and barriers to participation in the school meals and other food programs, desired nutrition education methods, role of parental attitudes, role of advertising, and so forth.
- *More work is needed in how to change communities so* that children grow up in an environment where healthful eating behavior is normative, modeled, and reinforced.