

Physical Health: Nutrition

The Health Impact of Worksite Nutrition and Cholesterol Intervention Programs

Karen Glanz, Glorian Sorensen, Anna Farmer

Abstract

Purpose. To summarize and provide a critical review of worksite health promotion program evaluations published between 1980 and 1995 that address nutrition and hypercholesterolemia. The article discusses and critiques both intervention methods and research methodologies to identify the most effective strategies.

Methods. Core articles are 26 original, data-based studies that report on measures of health status, behavior, attitudes, and knowledge as outcomes of worksite nutrition and cholesterol interventions. Only work published since 1980 that clearly describes nutrition or cholesterol interventions and that includes identifiable nutrition-related outcomes is reviewed. The main search method was the same one used for this special issue; supplementary sources included those found in earlier reviews or identified through backward searches or expert contact.

Summary of Important Findings. Ten worksite nutrition education programs were reviewed and were categorized as group education, group education plus individual counseling/instruction, cafeteria-based programs, and group education plus cafeteria-based programs. Four of these were randomized studies, and one used the worksite as the unit of randomization and analysis. Sixteen worksite cholesterol programs were reviewed, in five categories: monitoring; individual counseling; group sessions or classes; mediated methods using print, audiovisual, telephone, and self-help kits; and combination approaches. Of these, eight were randomized controlled trials; most tested interventions for persons with elevated cholesterol levels, although four studies reported cholesterol education programs for the general employee population. Six large controlled trials of worksite nutrition and cholesterol interventions in progress are also described.

Major Conclusions. The conclusions that can be drawn from this review are limited by the study designs used, which often lacked control groups, used nonrandomized designs, or relied on self-selected high-risk or volunteer participants. Our rating for the quality of the evidence in the literature as a whole lies between suggestive and indicative. It is clear that worksite nutrition and cholesterol programs are feasible and that participants benefit in the short-term. Conclusive evidence about a causal relationship between worksite nutrition and cholesterol programs and improved behavior or health is not yet available, although studies currently underway hold promise for providing more solid evidence about the potential efficacy of these interventions. (*Am J Health Promot* 1996;10[6]:453-70.)

Key Words: Worksite Health Promotion, Nutrition Intervention, Hypercholesterolemia, Cholesterol Management, Nutrition Education

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INTRODUCTION

Nutrition is an important part of the national health promotion strategy described in the Healthy People 2000 health objectives.¹ Each year, evidence of the important role of nutrition in health status is growing. Five of the leading causes of death for Americans—heart disease, some cancers, stroke, diabetes, and atherosclerosis—are associated with dietary practices.² Excessive consumption of dietary fat and low consumption of fiber-rich foods, fruit, and vegetables contribute to increased risk for chronic diseases, particularly cardiovascular disease and cancer.^{2,3} The association of nutrition and cardiovascular disease occurs principally through the role of diet in several primary and secondary risk factors, including high blood cholesterol levels, high blood pressure, obesity, and diabetes mellitus.⁴ These highly prevalent risk factors affect an eighth to half of all American adults and can often be prevented or controlled through dietary means.^{2,5}

Healthful eating patterns can reduce the risk of premature morbidity and mortality from these diseases, help many people avoid suffering and disability, and reduce the need for medical treatment.^{2,3} During the past decade, government and health organizations have promulgated recommendations for dietary improvements throughout the U.S. population, including restriction of dietary fat, increased intake of complex carbohydrates (grains, fruits, and vegetables), and avoidance of obesity.^{2,6-9} Cardiovascular disease prevention guidelines emphasize limiting total dietary fat consumption to 30% or less of total calories, and

consuming no more than 10% of calories from saturated fatty acids and no more than 300 mg of cholesterol per day.^{4,9} Recommendations for initial diet therapy for adults with elevated blood cholesterol levels are similar to the primary prevention guidelines.^{10,11}

Worksite-based nutrition and cholesterol interventions have several advantages. They are accessible and convenient, they can be facilitated by support from coworkers and existing communication networks, and they are often less expensive than those offered elsewhere.^{12,13} The workplace also provides special opportunities for reinforcement and environmental supports for healthy eating through changes in cafeterias, vending machines, and catering policies.^{12,14,15} Worksite populations can be enumerated by use of personnel records, and the opportunity for long-term follow-up is greater than in community-based programs, thus potentially improving the quality of program evaluations.

National surveys of health promotion activities conducted in worksites with more than 50 employees in 1985 and 1992 suggest that the prevalence of nutrition and cholesterol-control programs has nearly doubled in the past decade.^{16,17} Nutrition activities (not including weight-control programs) were conducted in 31% of worksites in 1992, up from 17% in 1985.^{15,16} Hypertension and cholesterol management programs (asked in a single question) increased from 17% in 1985 to 35% in 1992.^{16,17} Likewise, there has been an increase in published articles reporting on evaluations of these programs in the past 15 years.

The purpose of this article is to summarize and critically review published evaluations of worksite health promotion programs addressing nutrition and hypercholesterolemia. It describes and critiques both intervention methods and research methodologies, to assess the state of current knowledge about the most effective strategies. In addition, this article describes work in progress and identifies future directions and needs for nutrition and cholesterol interventions in worksite health promotion.

METHODS

The articles used for the core of this review are limited to original data-based studies that report on measures of health status, behavior, attitudes, and knowledge as outcomes of worksite nutrition and cholesterol interventions. To reflect programs conducted since the release of the first U.S. dietary guidelines,⁶ only work published since 1980 was included. Special inclusion criteria were the following: intervention strategies focusing on nutrition or cholesterol control were clearly described; an identifiable nutrition-related outcome measure was reported; and the study focused primarily on employees or a worksite population. Thus some studies reported here include other behaviors or risk factors but provide clear descriptions of the nutrition intervention and results. Because some studies are best understood by referring to multiple publications that describe the interventions, methods, and results, these studies are presented with reference to the full sets of articles.¹⁸⁻²¹ Evaluations not available in peer-reviewed journals are not included; summaries of recent programs in this category are, however, available elsewhere.²² Studies of worksite weight control programs are excluded, because they are covered in another article in this issue.²³

This review on the health effect of worksite nutrition and cholesterol intervention programs is part of a larger review of the effect of workplace health promotion programs on health outcomes sponsored by the U.S. Centers for Disease Control and Prevention, which conducted the initial search for studies with the goal of identifying all the published studies reporting the health effect of worksite health promotion programs. This search is described in detail in the introductory article to these reviews. In addition, we examined review articles and book chapters by the present authors and others,^{12-14,24-27} conducted backward searches of articles cited in earlier literature reviews, and consulted experts active in worksite nutrition and cholesterol management research. Only work published since 1980 that clearly described nutrition

or cholesterol interventions and included identifiable nutrition-related outcomes was included in the analysis of program impact. The core articles are 34 reports on 26 original, data-based studies that present data on health status, behavior, attitudes, and knowledge as outcomes of worksite nutrition and cholesterol interventions.

For studies summarized in the tables, the sample size and description reported are consistent with the unit of analysis. In most cases, this is the number of employees who participated in a project and from whom data were collected, rather than the size of the employee population from whom study subjects were identified or invited. The standard rating system was used with minor modification. On the basis of the inclusion criteria stated above, only studies with ratings of three stars (***) or more are included. For studies in the five-star (*****) category, an (I) is noted where the person is the unit of analysis and/or where there is only one worksite in the study, but subjects are otherwise randomized. An (S) notation appears alongside the rating for studies in the five-star category that used the worksite as the unit of randomization and analysis. The principal limitation of the standard rating system for these studies is its reliance on study design, particularly randomization and control group, as the sole criterion for the quality rating. As will be discussed further in the critique, this rating system does not take into account other important factors, such as the quality of measures used, the unit of randomization and analysis, the impact of subject or worksite attrition, and the extent of intervention implementation.

WORKSITE NUTRITION AND CHOLESTEROL INTERVENTION STRATEGIES

The range of nutrition and cholesterol management programs suitable for worksites is extensive and varied.²⁸ A brief introduction to key features of interventions at various points along a continuum from person-focused to environmental change, and to key theoretical frameworks for worksite nutrition and cholesterol programs, is provided to help readers interpret the

literature and the subsequent critique.

A fundamental distinction has been made between worksite nutrition programs that are *educational* or *individually oriented*, and those that address *environmental* or *structural* changes.¹² Educational strategies provide information, persuasion, and skill-building techniques directly to persons or small groups of employees. In contrast, environmental or structural interventions change the environment first, without requiring individual voluntary participation in educational activities.¹² Examples of environmental strategies include changing the food available in the cafeteria, point-of-choice information, and policies about foods served at company events.¹⁴ A recent conceptualization for cardiovascular risk reduction at worksites proposes a continuum of three avenues: interventions aimed at persons, those aimed at groups, and those that change the worksite environment.¹³ Additional strategies that might be added to this continuum include: individual, group, employee advisory boards or participatory models, on-site health services (e.g., screening), policy, and environmental change.

Individually oriented approaches, also often referred to as clinical approaches, are among the most common type of worksite nutrition and cholesterol interventions.²⁵ They are contrasted with public health approaches, which may be less intensive but have a broader reach and typically cost less per employee than do clinical approaches.²⁸ The distinction is particularly germane to interpreting the effect of worksite nutrition programs: because clinical interventions serve mainly motivated or high-risk volunteers with relatively intensive strategies, they have the potential to show larger effects, whereas population-wide programs are more likely to produce small but significant effects for more people.

Although some published worksite nutrition and cholesterol intervention research does not describe specific theoretical foundations, most reports of clinical approaches describe strategies based on theories of health-related behavior drawn primarily from clinical psychology and social psychol-

ogy.²⁹ More recently, models from community psychology, organizational behavior, marketing, and sociology have been used for worksite-wide, environmental, and public health nutrition interventions.^{13,14} No single theory is dominant, and intervention programs often use combinations of constructs from several models for maximum impact.^{13,14,25} Of particular interest in the studies reviewed here are constructs derived from social cognitive theory, applied behavioral analysis, social support, community organization, and social marketing.^{13,14}

WORKSITE NUTRITION PROGRAMS

The review of worksite nutrition education programs included 10 studies (reported in 16 articles) published since 1980 (Table 1). Of the 10, four were randomized controlled trials, although only one study used the worksite as the unit of randomization and analysis. Effectiveness was evaluated through tracking of purchasing patterns in cafeterias in four studies, and through employee surveys in the other six. Of the six studies using employee surveys, only one had a sample size of more than 100.

The studies evaluated four types of interventions:

- Group education (2 studies)
- Group education plus individual counseling/instruction (2 studies)
- Cafeteria-based programs (4 studies)
- Group education plus cafeteria-based programs (2 studies)

Table 1 summarizes the studies by category, with earlier publications listed first in each category.

Group Education Programs

Two studies examined the effectiveness of group nutrition education programs conducted in the worksite. Sandoval and Mueller³⁰ reported the results of worksite nutrition education classes designed to accompany the American Heart Association's Heart At Work Program. A pretest/posttest design with no control group was used to evaluate changes in nutrition knowledge among 26 participants in the course. Mean scores on a true-false nutrition knowledge test increased

from 17.2 (SD = 3.4) to 19.7 (SD = 2.6), out of 27, between pretests and posttests [$p < .01$].³⁰

In the second study, Sheeshka and Woolcott³¹⁻³³ applied Bandura's Social Cognitive Theory to develop and evaluate a worksite nutrition education program. The intervention consisted of six 1-hour nutrition education sessions focusing on the relationship between diet and body weight, cancer, heart disease, and osteoporosis, and promoting foods high in complex carbohydrates and low in fat. Eighty-five employees interested in a nutrition education program were invited to participate, and the 52 who accepted were randomly assigned to treatment or delayed-treatment groups. Self-efficacy increased and dis-incentives scores decreased significantly more in the treatment group than in the delayed-treatment group. Changes in intentions to adopt healthy eating practices did not differ significantly between the two groups; eating patterns were not otherwise assessed.³¹

Group Education Plus Individual Counseling/Instruction

Two studies examined the combined effect of group education and individual counseling or instruction. Berry et al.³⁴ reported the results of a study of 60 enlisted medical personnel. The sample included only interested personnel, who were randomly assigned to three groups: (1) the goal setting/goal attainment group, which received an 8-week worksite nutrition education program, including goal-setting, fitness information, and skill development taught by use of both group and individual instruction; (2) the goal-setting group, which received two sessions that focused on goal setting; and (3) a control group. Change was assessed by a composite goal attainment scale. The change scores of the goal setting/goal attainment group were significantly higher than those of the control group; the goal-setting group did not differ significantly from either the goal setting/goal attainment group or the control group.

Briley and others^{35,36} reported the results of a 12-month nutrition program conducted in a police department and evaluated before and

Table 1
Summary of Design and Findings of Worksite Nutrition Studies, by Type of Intervention

Study	Purpose of Evaluation	Research Design Rating	Sample Size	Sample Description
GROUP EDUCATION				
Sandoval, Mueller, 1989 ³⁰	To describe a team approach to nutrition education at worksite and assess resulting knowledge change	***	26 participants	Program participants who volunteered; 77% women, aged 18-55 years. A dietitian, health educator, and three dietetic students were involved in the pilot of Heart at Work.
Sheeshka, Woolcott, 1994 ³¹ Sheeshka et al., 1993 ³² Sheeshka, Woolcott, 1993 ³³	To develop and evaluate a theory-based demonstration worksite nutrition program	***** (I)	Of the 85 eligible, 52 participated in study and were randomly assigned to treatment or delayed treatment group	Unionized and technical employees on university campus (14 men, 38 women). Eligible subjects were respondents to pretest measures, aged 40 and over, who were interested in a nutrition program.
GROUP EDUCATION PLUS INDIVIDUAL COUNSELING/INSTRUCTION				
Berry et al., 1989 ³⁴	1. To identify individuals who expressed a desire to improve their nutrition practices and examine their degree of success 2. To examine the impact of goal-setting instruction on nutrition-related behaviors	***** (I)	Of the 77 eligible, 60 participated; 19 in each Goal Setting/Goal Attainment (GSGA) and Goal Setting (GS) groups; 22 in control	Enlisted military personnel at Walter Reed Army Medical Center, Washington, DC. Ages 19-29 years. Interested personnel completed a questionnaire, and those interested in changing dietary habits were identified. Enrollees in a weight control program were excluded.
Briley et al., 1990 ³⁵ Montgomery et al., 1990 ³⁶	To evaluate the efficacy of the nutrition education aimed at lowering dietary cholesterol and fat intakes as a component of the Wellness Program by examining the differences in food intakes before and after implementation	***	40 enrolled in study eligible after screening, 28 completed 12-month program; 24 completed data collection.	Austin Police Department employees, 21-57 years, 13.7 years education. Inclusion criteria: 120% + Ideal Body Weight.
CAFETERIA-BASED PROGRAMS				
Zifferblatt et al., 1980 ³⁹	To evaluate the impact of cafeteria-based nutrition card game on food purchases. Card messages stressed lower-calorie, nutritionally well-balanced meals. Employees could collect 1 card/day; prizes were periodically collected for collecting sets of cards. Promotional flyers and posters used to publicize the game.	***	Unit measured: observations of food items purchased via inventory control cash register system (could not analyze individuals' food choices or meals)	Setting was a National Institutes of Health employee cafeteria, serving about 400 employees per day (clerical, administrative, scientific).
Schmitz, Fielding, 1986 ³⁷	To evaluate the impact of a system of point-of-choice nutritional labeling using comparison cards in an employee worksite cafeteria	***	Approximately 2000 total employees; 1250 accommodated during lunch	Employees at corporate headquarters for Mattel Toys in southern California
Mayer et al., 1987 ⁴⁰	To evaluate if a combination of food labels, a nutrition awareness game, and incentive raffles at a cafeteria will lower caloric intake	***	265 employees; lunch served to 130 employees/day	Blue- and white-collar employees of a Fortune 500 company, mean age 46 years, 67% women, 26% obese.

Table 1, continued

Research Design	Comparison Group	Outcome Measures	Evaluation Period	Findings
Pre-/posttest	None	Nutrition knowledge and opinion related nutrition, diet, and heart disease	10 weeks	Knowledge increased between pretest and posttest. 85% of respondents said lessons accurately covered the material, and 92% would attend future nutrition activities.
Self-selection, pre-/posttest, delayed treatment comparison group design	Delayed treatment	Bandura's Social Cognitive Theory: self-efficacy, outcome expectancy, outcome value, and disincentives; intentions to adopt healthy eating practices	6-week nutrition program	Changes in self-efficacy and disincentives scores are attributable to the nutrition program.
Randomized to three groups: GSGA received 8-week (12 sessions) health promotion based on goal-setting, fitness information and skill development). GS received 2 sessions on goal setting only, and control.	Control received no instruction	A "Change Score" for nutrition-related behaviors on the basis of Goal Attainment Scaling. Desire to improve nutrition practices using Lifestyle Assessment Questionnaire.	8-week health promotion	GSGA had significantly higher Change Scores in nutrition-related behaviors than the control. 84% of GSGA, 64% of GS members, and 37% of control sustained dietary improvements.
Pre-/posttest in one worksite. Intervention included six 1-hr individual counseling sessions with a registered dietitian at 2-month intervals	Subjects serve as their own control	Nutrient intakes (macro and micro) evaluated using 7-day dietary records	12-month nutrition program evaluated before and after program	Decrease in energy, fat, and cholesterol in diet.
Within setting reversal design: Observations of food purchases over 15 consecutive months before intervention, during 8-week intervention period, and for 10-weeks after intervention. Also used post hoc comparisons with 2 nonintervention cafeterias, analyzed using time series analysis.	2 other NIH cafeterias without intervention	Caloric content of food items purchased. Changes in purchase of selected categories of food that were emphasized in intervention.	Observations of food purchases over 15 consecutive months before intervention, during 8-week intervention period, and 10 weeks after the intervention	Skim milk purchases increased. Dessert, bread purchases, and total calories averaged per person per day decreased.
Pre-/posttest design. Intervention provided comparison labeling in the cafeteria.	No control	Decreases in calories, sodium and fat per lunch tray measured by observations in cafeteria using food inventory form.	6 months. Pretest and posttest data collected over 6-day period before and after 6-month labeling program in effect.	Significant decreases in calories and sodium. Near significant decrease in fat. Insignificant decrease in cholesterol.
Withdrawal design, three consecutive phases: baseline 1, intervention, baseline 2 Intervention: 1. Labels 2. Nutrition awareness game 3. Incentive raffles survey	None	Nutrient intake and food choice, based on observations of customer food selections in the cafeteria, using checklist and trained observers.	12 weeks	Mean number of calories per tray delivered did not decrease significantly. Combination of calorie-labeling procedure and a nutrition awareness game was not effective in significantly decreasing caloric intake. Incentives contingent upon specific food selection had a noticeable impact on increasing purchases of the targeted food.

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after the program. They included 40 participants who began the program and 24 who completed the program and dietary assessments. The intervention consisted of nutrition education seminars and individual counseling sessions with a registered dietitian at 2-month intervals. The goal of the nutrition education program was to produce a change in eating patterns that would result in lowered dietary cholesterol and fat intakes. Seven-day dietary records were used to assess changes in energy, fat, and cholesterol in the diet over a 12-month period; significant decreases were noted in protein and fat consumption between baseline and follow-up.³⁵

Cafeteria-based Programs

Four studies reported the results of cafeteria-based programs.³⁷⁻⁴⁰ To assess the effect of the programs, all four tracked purchasing patterns, either

through observation or cash register systems. Therefore the results are not readily comparable with assessments based on changes in individual eating patterns. However, these interventions have the advantage of using the worksite setting as part of the intervention and targeting relatively stable populations who use worksite cafeterias.

One study examined the effectiveness of point-of-choice food labeling in a worksite cafeteria, using a pretest/posttest design without a control group.³⁷ After 6 months, the decreases in calories and sodium per tray were significant, and the decrease in grams of fat approached significance. Jeffery et al.³⁸ examined whether increasing the variety of offerings and reducing prices would increase the consumption of fruits and salad in a worksite cafeteria. The 9-week study in a single cafeteria consisted of a 3-week baseline period, 3 weeks of intervention, and

postintervention assessment for 3 more weeks. Fruit and salad purchases increased threefold during the intervention period compared to the other two periods.³⁸

Two other studies used the cafeteria as a site for nutrition education "games." Zifferblatt et al.³⁹ described an evaluation of the "Food for Thought" game, a media-based nutrition intervention aimed at influencing food choices in cafeteria settings by use of a card game designed to provide nutritional information. Incentives were used to encourage participation. After 15 months, in comparison to two other employee cafeterias, skim milk purchases increased, and there were significant reductions in average calories, bread, and desserts purchased per day per person.³⁹ Mayer et al.⁴⁰ examined the effectiveness of a worksite cafeteria-based intervention that included a combination of food

Table 1, continued

Study	Purpose of Evaluation	Research Design Rating	Sample Size	Sample Description
Jeffery et al., 1994 ³⁸	To determine whether increasing the variety of offerings and reducing prices would increase consumption of fruit and salad in a cafeteria setting	***	One cafeteria, 320-430 cafeteria customers per day	Cafeteria in a physically isolated university office building with about 700 employees
GROUP EDUCATION PLUS CAFETERIA -BASED PROGRAMS				
Ostwald, 1989 ⁴¹	To identify the impact of a health promotion program upon the health habits and physical status of employees in a small company To test the degree of intervention needed to produce desired lifestyle changes	****	89% response to initial survey (N = 261); of 167 volunteers, n = 90 (final 3 groups included 30, 23, 25)	Blue-collar employees in a small privately owned printing company in the upper Midwest. 76.4% male, 69% < 30 years, 41% married, 50% education > high school Employees in a nonequivalent, nonrandom comparison company were also assessed
Sorensen et al., 1992 ¹⁹	To test the efficacy of a worksite nutrition intervention program designed to promote dietary changes associated with the reduction of cancer risk	***** (S)	Of the 16 eligible, 13 workplaces, 8 controls, 5 intervention. Total employees 3076; 74% response at follow-up, 2258; 75% of 2365 baseline, 1762	Companies (insurance, computers, health care and manufacturing) from Massachusetts, and Rhode Island
Sorensen et al., 1990 ¹⁸				
Hebert et al., 1993 ²⁰				
Hebert et al., 1993 ²¹				

Research Design Rating Key

- *** Evaluation without comparison or control group
- **** Comparison group, but no randomized control
- ***** Randomized control group used for evaluation
- (I) Individual employee as unit of randomization and analysis
- (S) Worksite as unit of randomization and analysis

labels, a nutrition awareness game, and an incentive raffle. The study group served as its own comparison; food choices were monitored before the intervention and after it was withdrawn. The study concluded that the combination of calorie-labeling and the nutrition awareness game was not significantly effective in reducing overall calorie consumption. However, incentives had a noticeable short-term impact on increasing purchases of targeted selections.⁴⁰

Group Education Plus Cafeteria-based Programs

Two studies examined the effectiveness of comprehensive worksite nutrition interventions that included both educational and cafeteria programs. Ostwald⁴¹ reported the results of an intervention, conducted in a small, privately owned company, that targeted employees' dietary and

exercise practices through educational and cafeteria programs. Results were compared on two levels. First, 90 volunteers were randomly assigned to three levels of intensity of the intervention. Second, the results were compared with changes among employees of a nonequivalent control company not receiving a program. There were no significant differences among the three intervention groups in self-reported dietary or exercise changes or in changes in cholesterol or triglycerides. Comparison of changes between intervention and comparison companies was complicated by pre-intervention differences.⁴¹

The Treatwell Program^{18,21} is the only worksite nutrition study reviewed here in which the worksite was the unit of randomization, intervention, and analysis. Sixteen worksites were randomly assigned to intervention and control conditions; a 15-month

intervention aimed to reduce fat consumption and increase fiber consumption. The comprehensive intervention included educational programs such as classes and cooking demonstrations, and a cafeteria point-of-choice labeling program. The study used a participatory strategies model, in which employee advisory boards were convened to help design and implement the program. The intervention was evaluated by surveying a random sample of all workers, not only those participating in the program. Although one worksite assigned to the intervention group elected not to participate in the intervention, this worksite was included in the analyses, following an "intention to treat" model. A food frequency questionnaire was used to assess diet. Adjusting for worksite, the decrease in mean

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Table 1, continued

Research Design	Comparison Group	Outcome Measures	Evaluation Period	Findings
Withdrawal design, three 3-week phases: baseline period, intervention, return to baseline	None	Daily sales of fruit and salad, as assessed by cash register receipts	9 weeks (three 3-week periods)	Fruit and salad purchases increased threefold during intervention period as compared to nonintervention periods
Employees from the intervention company were randomly assigned to 3 levels of intervention intensity; results were compared with a comparison company	Control: employees in a nonequivalent company	Dietary and exercise practices, satisfaction with health practices, perception of organizational support for good health practices	12-week intervention, 15-month research study	There were no significant differences among the three intervention groups in dietary or exercise changes, or changes in cholesterol or triglycerides. Intensive intervention lowered mean cholesterol by 8% between pre- and posttest
15-month intervention period, with surveys before and after intervention period	No intervention (control)	Dietary intake of fat, fiber, and nutrient intakes	15-month intervention period, with surveys before and after intervention period	Significant decrease in mean dietary fat was (1.1% of total calories)—difference between intervention and control. No difference in fiber intake. Worksite can effectively influence the dietary habits of workers. Nutrition messages must be food based for comprehension. Program strongly associated with increased intake of carotene and vitamin A. Largest increase (5 servings per month) in vegetable consumption. High level of concordance between a priori intervention and actual behavior. Greater increased consumption of total vegetables and a larger decrease in dietary ground and processed meats among intervention groups

Table 2
Summary of Design and Findings of Worksite Cholesterol Intervention Studies, by Type of Intervention

Study	Purpose of Evaluation	Research Design Rating	Sample Size	Sample Description
INDIVIDUAL COUNSELING				
Crouch et al., 1986 ⁴⁶	To compare the efficacy of face to face counseling vs telephone and mail counseling vs single session for dietary reduction of hypercholesterolemia	***** (I)	83 hypercholesterolemic volunteers (17% dropout during study)	52 men and 17 women Stanford University employees who participated in Stanford Lipid Research Clinic (completion group)—mean age 44.5 years
Gemson et al., 1990 ⁴⁷	To examine the impact of worksite cholesterol screening with brief nonphysician counseling	***** (I)	N = 232 employees; n = 137 with borderline-high cholesterol levels in controlled experiment	Employees of major financial services company
COUNSELING PLUS GROUP PROGRAMS AND MEDIA				
Rose et al., 1980 ⁴⁸ Heller et al., 1981 ⁴⁹	To determine the impact of screening and medical follow-up on CVD ^a risk factors (including cholesterol and dietary intake). Group and media education plus medical consultation strategies	***** (S)	N = 18, 210	Employees of 24 factories or other worksites Middle-aged men aged 40-59 years
Briley et al., 1992 ⁴²	To test the impact of a nutrition education program with counseling, seminars, and monitoring on weight and blood lipid levels	***	40 employees enrolled, 28 (70%) completed the study	Austin (Texas) Police Department employee, various job descriptions; women disproportionately enrolled
Selbst et al., 1992 ⁵⁰	To evaluate various strategies in a worksite cholesterol screening and education program	***** (S)	1701 workers participated at 8 worksites (screening); 587 with elevated cholesterol; 258 (44%) completed all tests	Employees with elevated cholesterol at 8 worksites at Maricopa County, Arizona. Skilled and semiskilled workers, 76% female, 60% aged 20 to 39 years
Baer, 1993 ⁵²	To evaluate the efficacy of a nutrition education program that included anthropometric measures, individual counseling, monthly group classes, phone calls, and monitoring	****	N = 70; 33 in intervention group, 37 in control group	Male management-level employees with elevated total cholesterol levels. Intervention group mean age 44 years, control mean age 35 years
Fielding et al., 1995 ⁵¹	To evaluate incremental effectiveness of a worksite cholesterol management program (CMP) when added to existing worksite health promotion program. CMP included monthly individual counseling and assessment, mailed monthly personal feedback package, incentive coupons for meeting goals, and classes	***** (I)	234 employees (with complete measures): 118 experimental group and 116 control group	Blue- and white-collar employees at 4 worksites; cholesterol levels > 240 mg/dl; 79% male

Research Design Rating Key

- *** Evaluation without comparison or control group
- **** Comparison group, but no randomized control
- ***** Randomized control group used for evaluation
- (I) Individual employee as unit of randomization and analysis
- (S) Worksite as unit of randomization and analysis

Key

- a = Cardiovascular disease
- b = Blood pressure
- c = Medical doctor
- d = Coronary heart disease
- e = High-density lipoprotein
- f = Total cholesterol
- g = Treatment
- h = Low-density lipoprotein
- i = Triglyceride
- j = Body weight
- k = Blood cholesterol
- l = Follow-up
- m = Food frequency questionnaire
- n = Body mass index

Table 2, continued

Research Design	Comparison Group	Outcome Measures	Evaluation Period	Findings
Randomized controlled trial	4 conditions of decreasing intensity: 5 face-to-face sessions; mail and phone; 1 session; and no contact control	Serum cholesterol, triglycerides, weight, blood pressure	1 year	Face-to-face sessions and mail/telephone counseling showed decreases of 6.2% and 4.6%, respectively. Other groups had smaller decreases. No differences in triglycerides, BP, ^b or weight.
Randomized controlled trial	Low-frequency follow-up (LFF) (baseline and 6 months) vs high-frequency follow-up (HFF) (baseline 2, 4, and 6 months)	Self-reported dietary change, cholesterol levels	6 months	Greater dietary change for HFF group vs LFF group (24% vs 10% improvement) Average cholesterol reduction of 8.3% in both groups; no significant differences between groups.
Randomized matched pairs, randomized by worksite and evaluation by repeated cross-sectional samples	Control (cross-sectional sample of controls evaluated every 2 years)	Heart disease risk factors: number of cigarettes smoked, blood pressure, plasma cholesterol, weight, and overall risk for CHD ^d	6 years	Small but significant reductions, mainly in high-risk group. Greatest cholesterol reductions with personal MD ^e advice, more than with similar mail communications. Dietary adherence scores correlated with cholesterol reductions
Pre-/posttest, nonrandomized	None	Total blood cholesterol, triglyceride, HDL ^e	12 months (measures at 0, 4, 8, and 12 months)	Significant group trend toward lower total cholesterol levels and weight loss; triglycerides levels significantly increased; greatest TC ^f and weight reductions in first 4 months, some recidivism by 12 months
Randomized. All interventions had screening and counseling.	Control group (cholesterol screening and counseling only) and Groups B, C, D also had promotional materials. Group C also had 4 1-hour classes. Group D also had 7 mailed newsletters.	Cholesterol levels	8 months: initial, middle, and final measures conducted at 90 and 120 day intervals	Group B, C, and D showed short-term reductions None of the interventions was able to produce reductions in cholesterol levels that lasted even 6 months
Nonrandomized control, Pre-/posttest	Control group of those who chose not to participate	Dietary intake, Total cholesterol, LDL, ^h HDL, ^e TG ⁱ and % body fat	1 year	Intervention group decreased intake of energy, cholesterol, % calories from fat, and protein. Decreases in TC, ^f TG, ⁱ BW, ^l and body fat in intervention group
Randomized, controlled trial with randomization by employee	Control group received ongoing comprehensive health promotion program with screening and referral	Total cholesterol levels (venipuncture) and proportion of subjects who reduced their cholesterol	1 year	Intervention subjects' cholesterol declined more (16.6 mg/dl vs 10.0 mg/dl); not significantly different. Percentage of subjects who reduced their cholesterol to < 240 mg/dl was significantly greater in experimental group (36% vs 21%)

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Table 2, continued

Study	Purpose of Evaluation	Research Design Rating	Sample Size	Sample Description
GROUP PROGRAMS				
Bruno et al., 1983 ⁵³	To evaluate a nonpharmacologic behavioral education program to reduce serum cholesterol (food behavior change techniques, nutrition education, physical activity level planning and self-management skills); 8 weekly sessions, followed by six monthly meetings	***** (I)	97 employees (55% total study completion; 81% completion in experimental group). 66 (68%) attended one session	Employees at New York Telephone Co. (76 men and 21 women in TX ^a group) with elevated cholesterol and no CHD ^a history
Quigley, 1986 ⁵⁴	To examine whether cholesterol screening and a group program would increase participation in worksite health promotion program and achieve cholesterol reduction	***	n = 154 (36%) (472 employees screened)	Employees at L.L. Bean who were identified at high risk for heart disease due to elevated cholesterol and other risk factors
Masur-Levy et al., 1990 ⁴³	To determine the effectiveness of screening and group classes for reducing CVD ^a risk	***	N = 216 (completed both evaluations)	Employees from Sugar Growers Cooperative in Florida. 94% men mean age 43.2 years, 39% black, and 61% white
Hartman et al., 1993 ⁵⁵	To determine whether eating-pattern messages can effectively be used to change eating behaviors	***	N = 91	Municipal employees (service units) of Phoenix, Arizona with elevated cholesterol
McCarthy et al., 1992 ⁵⁶			61 employees (8 focus groups); 23 women, 38 men.	Municipal (blue-collar and white-collar) employees from Arizona
MEDIATED STRATEGIES				
Fitzgerald et al., 1991 ⁵⁷	Examine the effectiveness of a follow-up educational mailing to workers to improve referral completion	***** (S)	N = 272 persons with elevated cholesterol	Employees at Blue Cross & Blue Shield in Baltimore metro areas with elevated cholesterol and who agreed to a phone interview
Greene, Strychar, 1992 ⁴⁵	To examine changes in nutrition knowledge and fat intake after cholesterol screening and a videotaped cholesterol education program	***	N = 422 in cholesterol screening; n = 396 completed 1 or more questionnaire; n = 40 participated in videotape program	Faculty and staff at a northeastern university
OTHER COMBINATION STRATEGIES				
Peterson et al., 1986 ⁵⁸	To report a case study of multi-level nutrition programming to lower employees' blood cholesterol levels	***	N = 329 hospital employees	Memorial Hospital, Pawtucket, Rhode Island, employees attending free cholesterol screening. 194 or 59% with elevated levels included in evaluation
Strychar, Shannon., 1992 ⁴⁴	To evaluate changes in knowledge and intake of high-fat foods, and to examine factors associated with employee participation in worksite cholesterol program (screening plus food display and group education session)	***	n = 58 participants examined for change, n = 304 participated in cholesterol screening (38% of employees)	Employees at Topps Company (bubble gum manufacturer), 90% blue collar
Barratt et al., 1994 ⁵⁹	To evaluate two dietary interventions to reduce cholesterol: behaviorally oriented self-help package, and a 5-hour nutrition course, compared to a control condition (screening only)	***** (S)	2638 screened (80%); n=683 participated (67% of those eligible). Follow-up measures obtained for 63% (cholesterol) and 38% (dietary intake)	Staff at six Australian hospitals with elevated cholesterol. Median age 35 years; 73% participants female; 70% spoke only English

Table 2, continued

Research Design	Comparison Group	Outcome Measures	Evaluation Period	Findings
Randomized controlled trial, Pre-/posttest	Control: met for data collection and received minimal information on cholesterol levels	Serum cholesterol and HDL, ^a % ideal body weight, knowledge	Baseline and 3 months (1 month post-treatment reported)	Significantly greater cholesterol reductions in experimental group (8.8% vs 2.4%). Weight loss significantly greater in experimental group. Knowledge increases in experimental group
Pre-/posttest	None	Total cholesterol	8 months	302 employees attended education (64% of screenees) 54% of elevated workers (77) joined L.L. Bean Heart Club 70% of screenees at high-risk returned after 8 months for rescreen Average cholesterol reductions of 38 mg/dl or 14% in rescreened group
Pre-/posttest	None	Blood pressure, cholesterol, pulse, weight. Cardiovascular risk knowledge and behavior	6-7 weeks	No change in cholesterol; mean weight loss 1.58 lb., decreased intake of dietary fat and cholesterol and increase in exercise, 9.6% improvement in knowledge test scores
Pre-/posttest only reported	None reported. (Control: no intervention—but data presented here only for intervention participants)	Changes in eating patterns (food choices and frequencies) and TC, ¹ HDL, ^a LDL, ^b TG ^c	8 weeks	Change in 11 of 15 eating patterns Changes in eating behaviors are linked to changes in blood lipid profiles. Changes in TC ¹ associated with combined eating pattern message scores and TC ¹ decreased 0.33 mmol/L for each unit decrease in combined message eating score
—	—	—	—	Participants indicated they wanted information presented in a simple, easy-to-understand manner, and they asked for behavioral directives rather than background information or medical jargon
Randomized controlled trial	No treatment Control group	Referral completion Awareness of CHD ^a risk if factors, lifestyle changes	2 months post-screening	No difference due to booster mailing intervention 44% adherence to referral in high BC ^k group 17% referral adherence in borderline BC ^k group Trend toward dietary modification in booster group
Non-randomized with pre-, post-test and follow-up	Nutrition knowledge test and short fat intake measure	Non-participants in videotape program	Baseline, post-test, and 4-month follow-up	Participants increased nutrition knowledge and decreased fat intake, compared with non-participants
Pre-/posttest	None	SCOREs (Screening, Counseling, and Referral Events), weekly follow-up ¹ measures of cholesterol, diet assessment using FFO ^m	3 years	86 participants were re-measured within 6 months (44% of those elevated). Average cholesterol reduction of 10.9% or 26 mg/dl per returning participant
Nonrandomized pre-/posttest survey	None	Nutrition knowledge Intake of high-fat foods	Not stated	Increased knowledge and lower consumption of high-fat foods among participants who attended sessions and completed posttest (n=58)
Randomized control in a 3:3:1 ratio of two intervention groups to control group (screening only)	Screening only (Control) vs. self-help package (low intensity) vs nutrition course (high intensity)	Total and high density lipoprotein cholesterol, BMI, ⁿ weight, height, systolic, and diastolic blood pressure	3- and 6-month follow-up	Nutrition course group reduced reported total energy intake and increased fiber intake All groups reduced dietary fat. No changes in mean cholesterol level for any groups.

dietary intake of fat was 1.1% greater in intervention than in control sites, a small but highly significant difference. Mean changes in dietary fiber intake between intervention and control sites did not differ significantly.¹⁹

WORKSITE CHOLESTEROL PROGRAMS

Sixteen studies of worksite cholesterol programs (reported in 18 articles) published since 1980 were also reviewed (Table 2). Of these, eight were randomized controlled trials, and nine had sample sizes of more than 100 employees. All 16 studies reported including cholesterol screening as part of the study or as a subject identification procedure. Most of the studies tested interventions for persons with elevated cholesterol levels, but four studies reported cholesterol education programs for the general employee population.⁴²⁻⁴⁵ Although most of the studies used combinations of various strategies, the types of strategies tested can be divided into four major, but overlapping, categories:

- Monitoring (4 studies)
- Individual counseling (7 studies)
- Group sessions or classes (12 studies)
- Mediated methods using print, audiovisual, telephone, or self-help kit approaches (9 studies)

Table 2 summarizes the 16 studies grouped into the latter three categories and two types of "combination" strategies, with earlier publications listed first in each category. Because all four studies that used monitoring combined it with other strategies, no separate category for monitoring is included in the summary table.

Individual Counseling

Six studies examined the impact of individualized counseling, but only two^{46,47} focused primarily on counseling approaches. Crouch et al.⁴⁶ compared the efficacy of four counseling conditions of decreasing intensity: five face-to-face counseling sessions, mail and telephone counseling, a single session, and a no-contact control. The multiple in-person counseling sessions and mail-telephone methods were most effective, result-

ing in cholesterol reductions of 6.2% and 4.6%, respectively; the other groups showed smaller decreases.⁴⁶ Gemson et al.⁴⁷ examined the impact of worksite cholesterol screening with brief nonphysician counseling, randomizing 137 employees with borderline-high cholesterol to either a high-frequency follow-up or a low-frequency follow-up condition. Average cholesterol reductions of 8.3% were found in both groups after 6 months, with no difference between groups, although the high-frequency follow-up group reported greater dietary change than the low-frequency follow-up group (24% vs 10%).⁴⁷

Counseling Plus Group Programs and Media

Of five studies that examined the impact of counseling as part of a multi-component cholesterol management program, the earliest and largest was conducted with 18,210 middle-aged male British industrial workers in 24 worksites.^{48,49} In the British Heart Disease Prevention Project, 24 worksites were randomized by matched pairs to receive either a program of risk-factor screening, medical follow-up, group education, and media education, or a no-treatment control program. Evaluation was conducted by assessing repeated cross-sectional samples of treatment and control group employees, and a sub-study was conducted to validate a brief measure of adherence to advice to limit dietary fat intake.⁴⁹ After 6 years, the intervention yielded small but significant reductions in cholesterol levels, mainly in the high-risk group. Cholesterol reductions were greater with personal medical advice than with group and mail communications.⁴⁸

In another randomized controlled trial, Selbst et al.⁵⁰ evaluated several enhancements to cholesterol screening and counseling: promotional materials, a series of classes, and mailed newsletters. After 4 months, groups receiving the classes and media strategies showed short-term cholesterol reductions, although none of the interventions produced lasting changes.⁵⁰ Fielding et al.⁵¹ used a randomized, controlled trial to evaluate the incremental effectiveness of a worksite cholesterol management

program when added to an existing worksite health promotion program. The program included monthly individual counseling and assessment, mailed monthly personalized feedback packages, incentive coupons, and classes. After 1 year, the intervention subjects' cholesterol levels had declined more than those of control subjects (16.6 mg/dl vs 10.0 mg/dl), but the differences were not statistically significant. A significantly greater percentage of experimental group subjects reduced their cholesterol to less than 240 mg/dl (36% vs 21%).⁵¹

Two other studies tested nutrition counseling combined with classes or seminars and counseling, using nonrandomized designs.^{42,51} The study by Briley et al.⁴² of police department employees found trends toward short-term lower cholesterol levels and weight loss, and Baer's study of male management employees found reductions in cholesterol and dietary fat intake after 1 year.⁵²

Group Programs

Group worksite cholesterol programs have demonstrated some positive impact in both controlled and nonrandomized evaluations. A behavior-change group program conducted for 8 weeks with six monthly follow-up meetings resulted in knowledge increases and significantly greater cholesterol reductions and weight losses in experimental group members.⁵³ In a one-group pretest-posttest evaluation at L.L. Bean Co., participants in two 1-hour group sessions and a 15-week lifestyle education program achieved average cholesterol reductions of 14% after 8 months.⁵⁴ Three 1-hour group classes for predominantly male employees of the Sugar Growers Cooperative in Florida produced no change in blood cholesterol but yielded decreased intakes of dietary fat and cholesterol, modest weight loss, and improvement in knowledge test scores.⁴⁸ Finally, Hartman et al.⁵⁵ reported on an 8-week education program emphasizing knowledge and skill-building, using an eating-pattern message focus. After the program, which was developed on the basis of findings from targeted focus groups,⁵⁶ participants changed an average of 11 of 15 eating pattern

messages, and those changes were associated with blood lipid decreases.⁵⁵

Mediated Strategies

Fitzgerald, Gibbens, and Agnew⁵⁷ used a randomized controlled trial to test the effect of an educational "booster" mailing to improve referral completion in 272 employees with elevated cholesterol. Although there was no overall difference due to the booster mailing intervention, there was a trend toward more dietary change in the experimental group and adherence was significantly higher in the high-cholesterol group than in the borderline-high group (44% vs 17%).⁵⁷ Greene and Strychar⁴⁵ examined changes in knowledge and fat intake after cholesterol screening and a videotaped cholesterol education program in a university employee group. Using a nonrandomized design that compared participants and nonparticipants in the videotape program, they found that participants increased nutrition knowledge (average of 0.89 points vs average of 0.16 points) and decreased fat intake (average of 3.06 points vs average of 1.44 point decrease) more than nonparticipants.⁴⁵

Other Combination Strategies

A multi-component cholesterol lowering program for hospital employees in Rhode Island combined weekly screening and monitoring events, dietary self-assessment, educational programs, cafeteria information, and self-help nutrition kits. Among the 86 participants with elevated cholesterol who were reevaluated in 6 months (44% of those elevated), average cholesterol reductions were 10.9%, or 26 mg/dl.⁵⁸ Strychar and Shannon⁴⁴ examined changes in participants in a cholesterol education program consisting of a cafeteria exhibit of the fat content of foods and a 15-minute educational presentation, and found that the 58 participants were more likely to increase knowledge (from 4.98 to 6.81) and reduce consumption of high-fat foods (from 27.71 to 24.45 on a food frequency measure) than were nonparticipants.⁴⁴

In one of the largest recent intervention trials, Barratt et al.⁵⁹ randomized 683 employees from six

Australian hospitals to one of three conditions: screening only, a behaviorally oriented self-help package, or a 5-hour nutrition course. After 6 months, none of the groups showed changes in cholesterol levels; all groups reduced dietary fat intake, but between-group differences were not significant; and the nutrition course group reported reduced energy intake (by an average of 2.1 mJ/day) and increased fiber intake (by an average of 0.6 g/mJ/day).⁵⁹

DISCUSSION

Nutrition Intervention Studies

Critique of methodology. Six of the 10 worksite nutrition intervention studies used nonrandomized designs, either comparing the results instead to a nonrandomized comparison group or reporting changes between pretest and posttest.^{30,35,37-40} One of the four studies randomly assigned employees within the intervention company to varying levels of intervention intensity and compared these results to a nonrandomized comparison worksite.⁴¹ Only one of the 10 nutrition intervention studies randomly assigned worksites to condition.¹⁹ Virtually all of the nonrandomized studies reported some positive outcomes in employee knowledge, or behaviors, or in food purchasing patterns. However, it is not possible to determine whether these positive trends reflect changes resulting from an intervention, self-selection bias, trends occurring in the general population, or, in the case of self-reported change in diet or knowledge, a social desirability bias in responding to questionnaires. The randomized studies also reported generally positive results, although the outcomes varied considerably. Unlike the cholesterol studies, which were able to evaluate results on the basis of objective changes in blood cholesterol levels, most of the nutrition studies relied on self-reported change. Only one study assessed such indicators as blood pressure or cholesterol,⁴¹ and only two of the six studies that assessed changes in employee behaviors used either 7-day food records or a validated food frequency questionnaire.^{19,35}

The four cafeteria-based programs

tracked purchasing patterns to assess program effectiveness, through either direct tray observations or cash register records.³⁷⁻⁴⁰ This method provides the advantage of assessing the effectiveness of the intervention without relying on self-report. However, it does not allow an assessment of dietary changes beyond those that can be observed in the cafeteria, presumably an additional goal of the intervention.

Six of the nutrition education studies tracked changes in employee knowledge or behavior. Five of these six studies reported the results of the program for persons self-selected to the program and therefore already motivated to improve their dietary habits. Four of the studies tracking change in individual participants had to base their results on only 60% to 87% of the initial subjects because of attrition and failure to complete final measures.^{31,34,35,41} In only one study were subjects or worksites included in the analyses on the basis of intention to treat.¹⁹ The self-selection of high-risk or volunteer participants is of concern because motivation for dietary change among workers who are less ready for change is an additional important component of worksite nutrition programs.

What strategies or programs work best?

It is difficult to draw definitive conclusions about the strategies that work best in promoting dietary change through worksite nutrition programs. The studies reviewed here used different research designs and did not consistently assess dietary outcomes. Results from studies without control groups present particular difficulties for interpretation, because it is not possible to isolate the effect of the program from secular trends or subject motivation. We can cautiously conclude that group education programs, particularly in combination with individual counseling and instruction, produce some dietary changes. Although not consistently indicated by these studies, cafeteria programs hold promise for changing food purchases in workplace cafeterias; their effect on global dietary patterns, however, has not been assessed. Comprehensive worksite nutrition education programs that address both individual and

environmental changes deserve further attention, particularly given the potential for significant dietary changes among worksite populations as a whole rather than only among program participants.

Cholesterol Intervention Studies

Critique of Methodology. The majority of worksite cholesterol intervention studies used nonrandomized designs, which either compared participants with nonparticipants or merely reported changes over time among participants (see Tables 2 and 3). Only five of the 16 studies reviewed received the five-star rating with an (S), that is, used randomization and more than one worksite.^{48,50,57,59} Only two studies used the worksite as the unit of randomization.^{48,50} However, as noted earlier, the quality of the intended design does not always match the quality of the findings: three of the randomized trials reported findings based on between 38% and 63% of initial subjects, because of attrition or failure to complete final measures. Virtually all of the unrandomized studies reported positive effects on dietary behavior and/or cholesterol reduction (Table 3); it is not possible,

however, to determine if this reflects change resulting from an intervention, self-selection bias, or, in the case of self-reported dietary change, a social desirability bias in responding to questionnaires. The randomized trials were less consistent in reports of significant diet and cholesterol changes: some of the changes were small or were insignificant trends,^{48,51,56} short-term reductions,⁵⁰ or possible artifacts of selective attrition.^{50,53,59} One study found similar cholesterol reductions in both study groups,⁴⁷ and another found that referral adherence was associated more with risk level (high-risk vs borderline-high) than with intervention status.⁵⁷

Only two of the 16 studies reported outcomes in all three major categories of assessment: knowledge, dietary change, and cholesterol reduction (Tables 3 and 4). Several studies described participation rates and characteristics of participants, but participation was most often used only as the defining feature of evaluation subjects or study completion. None of the studies reported interpretable findings for other possible mediating factors, such as attitudes, self-efficacy, intentions, or stage of change.

What strategies or programs work best?

Table 4 summarizes the results of the studies by type of strategy. It is difficult to make generalizations from the small number of studies in each category because of the varied research designs and the differences in subject demographics and initial risk levels. Strategies that used counseling, particularly when enhanced by frequent follow-up or media materials, consistently improved dietary intake or cholesterol levels, or both, in the short-term. Most studies of group programs and other combination strategies also showed positive results, although attrition and lack of randomization may confound the findings. The two studies of mediated strategies did not assess program impact on cholesterol levels; however, both found some favorable change in dietary practices. Generally speaking, it appears that the more intensive strategies achieved the greatest effects, although not all studies permitted accurate estimates of the actual "contact hours" in the intervention. This must also be balanced by an examination of participation rates and the program impact on the entire worksite population. Less intensive strategies—that is,

Table 3
Effects of Worksite Cholesterol Programs, by Research Design

Study	Effects			Comments
	Knowledge	Dietary Behavior	Cholesterol Reduction	
Nonrandomized Designs				
Baer, 1993 ⁵²	NA	Yes	Yes	
Briley et al., 1992 ⁴²	NA	NA	Yes	Trend only, not high risk
Greene, Strychar, 1992 ⁴⁵	Yes	Yes	NA	Not high risk
Strychar, Shannon 1992 ⁴⁴	Yes	Yes	NA	Not high risk
Peterson et al., 1986 ⁵⁸	NA	NA	Yes	
Hartman et al., 1993 ⁵⁵	NA	Yes	NA	Lipid lowering associated with diet change but lipid results not reported
Masur-Levy, Travis, 1990 ⁴³	Yes	Yes	No	Not high risk
Quigley, 1986 ⁵⁴	NA	NA	Yes	
Randomized, Controlled Designs				
Rose et al., 1980 ⁴⁸	NA	Yes	Yes	Small but significant
Bruno et al., 1983 ⁵³	Yes	Yes	Yes	55% follow-up
Fitzgerald et al., 1991 ⁵⁷	NA	Trend	NA	
Crouch et al., 1986 ⁴⁶	NA	NA	Yes	Change in face-to-face and mail conditions; 83% follow-up
Gemson et al., 1990 ⁴⁷	NA	Yes	Yes	Both groups improved. No difference between groups
Barratt et al., 1994 ⁵⁹	NA	Yes (Nutr. course)	No	63% follow-up for cholesterol, 38% follow-up for diet intake
Selbst et al., 1992 ⁵⁰	NA	NA	Yes	Short-term reduction in enhanced groups; 44% follow-up
Fielding et al., 1995 ⁵¹	NA	NA	No	Absolute reduction in exp. group was larger, but not significant

NA, Not available (not measured or not reported).

public health strategies—are likely to have a lower impact on *more* workers. The initial level of risk may be an important determinant of program impact; other possible predictors and mediators of change were not assessed in the research reviewed here.

Continuum of Evaluation Methodologies

The wide variation in research methods used to evaluate worksite nutrition and cholesterol activities has important implications for what can be learned from the studies reviewed here. Two key, related dimensions of evaluation methods that are fundamental to interpreting worksite nutrition research are whether more than one worksite is studied and whether persons or worksites are the primary units of randomization, observation, and analysis. Studies within a single worksite tend to use strategies that are directed toward persons or small groups. For these studies, randomization is usually by *individual*, if a control group is

included. Such studies may or may not take advantage of the workplace setting to improve the effectiveness of health promotion efforts. Studies that include multiple worksites, randomization by worksite, and analysis at the worksite level, are much stronger methodologically^{60,61} and permit a clearer analysis of environmental intervention strategies. More recent research has moved in this more rigorous direction.

The quality and nature of outcome measures in worksite nutrition and cholesterol intervention strategies are also central to interpreting the findings. There are few standardized or validated measures of knowledge and attitudes related to dietary behavior.⁶² Opportunities for dietary assessment in worksite health promotion present practical challenges, although comprehensive food frequency questionnaires are now widely used and have been validated relative to biological criteria such as plasma carotenoids.²⁰ Biological measures, such as weight or choles-

terol levels, may provide imperfect indicators of dietary behavior change as a result of worksite intervention programs.⁶³

The comparison between worksite nutrition and cholesterol programs points out a few interesting issues for evaluation methodology. The lack of a consistent outcome measure for nutrition programs is a real gap and an area for future research. Cholesterol intervention studies can rely on changes in cholesterol levels as a comparable indicator of impact. The definition of dietary change in nutrition intervention studies varies depending on the focus of the intervention and may include energy, fat, fiber, fruits and vegetables, but some studies do not even assess diet. A short dietary assessment instrument that could be used across studies would permit the comparison of results across studies.

Rating for the Literature as a Whole

An important concern is the extent to which both the nutrition and the

Table 4
Effects of Worksite Cholesterol Programs by Type of Intervention Strategy

Study	Effects			Comments
	Knowledge	Dietary Behavior	Cholesterol Reduction	
Individual Counseling				
Crouch et al., 1986 ⁴⁶	NA	NA	Yes	Change in face-to-face and mail conditions; 83% follow-up Both groups improved. No difference between groups
Gemson et al., 1990 ⁴⁷	NA	Yes	Yes	
Counseling Plus Group and Media				
Rose et al., 1980 ⁴⁸	NA	Yes	Yes	Small but significant
Briley et al., 1992 ⁴²	NA	NA	Yes	Trend only, not high-risk
Selbst et al., 1992 ⁵⁰	NA	NA	Yes	Short-term reduction in enhanced groups 44% follow-up
Baer, 1993 ⁵²	NA	Yes	Yes	
Fielding et al., 1995 ⁵¹	NA	NA	No	Absolute reduction in exp. group was larger, but not significant
Group programs				
Bruno et al., 1983 ⁵³	Yes	Yes	Yes	55% follow-up
Quigley, 1986 ⁵⁴	NA	NA	Yes	
Masur-Levy et al., 1990 ⁴³	Yes	Yes	No	Not high-risk
Hartman et al., 1993 ⁵⁵	NA	Yes	NA	Lipid lowering associated with diet change but lipid results not reported
Mediated Strategies				
Fitzgerald et al., 1991 ⁵⁷	NA	Trend	NA	
Greene, Strychar, 1992 ⁴⁵	Yes	Yes	NA	Not high-risk
Other Combination Strategies				
Peterson et al., 1986 ⁵⁸	NA	NA	Yes	
Strychar et al., 1992 ⁴⁴	Yes	Yes	NA	Not high-risk
Barratt et al., 1994 ⁵⁹	NA	Yes (Nutr. course)	No	63% follow-up for cholesterol, 38% follow-up for diet intake

NA, Not available (not measured or not reported).

cholesterol studies used highly clinical approaches, with self-selected high-risk or volunteer participants. This is of interest in an analysis of the *worksite* literature because the per-participant cost is high and the benefits tend to be limited to persons who are directly involved in the program.^{25,28} The educational interventions used in many of these worksite studies are similar to those originally conceptualized and developed for clinical settings. The only thing that makes these reports different is the setting in which the program was conducted or from which participants were identified, that is, the worksite. Concepts developed in clinical settings were simply transferred to this new arena.²⁵ The few studies that used combinations of worksite-based media^{44,48,58} or

environmental support via changes in food availability in the cafeteria^{18,19,58} took advantage of the worksite setting as more than a convenient location for screening, counseling, or group meetings.

Because of the limitations imposed by the study designs used in these evaluations, our rating for the quality of evidence in the worksite nutrition education and cholesterol intervention literature as a whole lies between *suggestive* and *indicative*. It is better than *weak* but not sufficiently strong to be rated *acceptable* or *conclusive*. It is clear that worksite nutrition and cholesterol programs are feasible and that participants do benefit in the short-term. However, the research published to date has faced barriers that preclude conclu-

sive evidence of a causal relationship between worksite nutrition and cholesterol programs and improved behavior and/or health status.

FUTURE DIRECTIONS AND WORK IN PROGRESS

Six large controlled trials of worksite nutrition and cholesterol interventions are currently in progress or were recently completed. Two of these also address other risk factors for cancer or cardiovascular disease,^{15,64-66} and one simultaneously addresses nutrition and screening for colorectal cancer.⁶⁷ Three more trials that began in 1993 focus on increasing fruit and vegetable consumption and are funded as part of the National Cancer Institute's 5-A-Day research program.⁶⁸ The goals, strate-

Table 5
Work in Progress

Study	Dietary Goals	Strategies	Design	Sample	Comments
Working Well Trial ^{15,64,65}	Decrease energy from fat Increase fiber density Increase fruits & vegetables Improve healthy eating environment	Awareness activities Education, skill-building Cafeteria changes and point of choice info Catering policies Participatory strategies	Randomized trial, matched pairs of worksites Baseline & final surveys	114 worksites across the U.S. with >30,000 employees in diverse companies	Other risk factors addressed include tobacco use, sun exposure, occupational risks, exercise
Take Heart Project ⁶⁶	Reduce dietary fat intake Reduce serum cholesterol Improve healthy eating environment	Motivational/incentive Education, skill-building Maintenance activities Policy/environmental change Employee steering committees	Randomized trial, matched pairs of worksites Early vs delayed interventions after 1 and 2 years	26 worksites in various industries in Oregon, each with 125-750 employees	Also addresses tobacco use interventions
Next Step Trial ⁶⁷	Decrease energy from fat Increase fiber density Increase fruits & vegetables	Skill-building and motivational classes Self-help materials Tailored feedback on dietary intake Posters and newsletters	Randomized trial, matched pairs of sites Baseline, 1-year, and 2-year surveys	22 worksites in auto manufacturing plants with > 50 High-risk employees for colon cancer, in pattern & model making areas	Also addresses screening adherence for colon cancer
Arizona 5-A-Day ⁶⁸ Healthier Eating for the Overlooked Worker	Increase fruit & vegetable intake	Peer health educator program through interpersonal networks	Randomized trial, matched pairs of social networks in worksites	40 matched pairs of networks, blue-collar and trade workers, mostly male and Hispanic	Compares Health Peers Program to standard Worksite Wellness Program
Treatwell 5-A-Day ⁶⁸	Increase fruit & vegetable intake	Worksite intervention vs worksite plus family intervention	Randomized trial, 3 groups: minimal, worksite, worksite plus families	24 community health centers, most workers are minorities	Health center staff and advisory boards used to help diffuse programs
The Seattle 5-A-Day ⁶⁸ Worksite Project	Increase fruit & vegetable intake	Environmental and individual strategies to effect movement through stages of change	Randomized trial, intervention or comparison program	28 worksites in greater Seattle area	Uses cafeteria-based individual and environmental strategies

gies, research designs, and study samples are summarized in Table 5.

Each of the three worksite 5-A-Day studies assesses changes in the consumption of fruits and vegetables by use of a standard dietary assessment. In two of the three studies, the worksite is the unit of randomization, intervention, and analysis. In the third study, at the University of Arizona, 40 matched pairs of interpersonal social networks, identified through extensive worksite assessments, are the basis for randomization, intervention, and analysis; the effectiveness of a peer health intervention is assessed by comparing it to a standard intervention delivered to all workers.⁶⁸

These trials use rigorous research designs with randomized treatment and control groups and the worksite as the unit of randomization. They build on unique features of the worksite environment through efforts to influence policy and organizational factors and through persuasive messages. They illustrate the increasing importance of using the worksite setting in delivering intervention programs; the growing concern with focusing on worksites employing underserved populations, such as workers of color; and the applicability of a stages-of-change model for delivering and assessing the effectiveness of worksite nutrition intervention strategies. These studies are also designed to permit analyses of mediating factors such as stage of change, attitudes, and beliefs, and to evaluate changes in organizational factors affecting healthful eating. The results of these second generation studies, which will be available between 1996 and 1998, will no doubt strengthen the body of evidence on the effect of worksite nutrition interventions and the effects of various strategies.

In addition to these large, multi-site, controlled trials, there are important remaining opportunities to evaluate innovative nutrition and cholesterol intervention strategies directed at individual employees and worksite environments. Further research on the effect of changes in cafeterias, vending areas, and catering policies can yield valuable information about avenues through which health-

ful nutrition can be promoted in the workplace.

CONCLUSION

This article has summarized and critically reviewed evaluations of worksite nutrition (10 studies) and cholesterol intervention programs (16 studies) published since 1980. The main types of strategies reported were individual counseling, group education, mediated strategies, cafeteria-based programs, and combination programs. Fourteen of the 26 studies used nonrandomized designs, and only five studies were randomized controlled studies that used the worksite as the unit of analysis (one nutrition program and four cholesterol programs). Evaluations of worksite nutrition and cholesterol intervention programs to date show that these programs are feasible and provide short-term benefits to participants. Although it is not possible to draw definitive conclusions about which strategies are most effective, it appears that more intensive strategies and strategies that combine both educational and environmental strategies have the greater effect. The overall quality of evidence in the worksite nutrition and cholesterol intervention literature lies between *suggestive* and *indicative*, because of limitations in research methodology and features of intervention programs that do not take full advantage of the unique worksite setting. Research in progress will strengthen the body of evidence regarding the impact of worksite nutrition and cholesterol programs and the impact of various strategies. In addition, important opportunities remain to evaluate innovative nutrition and cholesterol intervention programs directed at individual employees and worksite environments.

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SO WHAT? Implications for Health Promotion Practitioners and Researchers

Evaluations of worksite nutrition and cholesterol intervention programs to date show that these programs are feasible and provide short-term benefits to participants. The overall quality of evidence in the literature lies between *suggestive* and *indicative*, because of limitations in research methodology and features of intervention programs that do not take full advantage of the unique worksite setting. Practitioners should build on worksite settings to improve nutrition and diet-related health status; and researchers should design and conduct rigorous evaluations of innovative programs.

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