

Clinical and Cost Outcomes of Multifactorial, Cardiovascular Risk Management Interventions in Worksites: A Comprehensive Review and Analysis

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This paper is a critical review of the clinical and cost outcome evaluation studies of multifactorial, comprehensive, cardiovascular risk management programs in worksites. A comprehensive international literature search conducted under the auspices of the National Heart, Lung and Blood Institute identified 17 articles based on 12 studies that examined the clinical outcomes of multifactorial, comprehensive programs. These articles were identified through MEDLINE, manual searches of recent journals, and through direct inquiries to worksite health promotion researchers. All studies were conducted between 1978 and 1995, with 1978 being the date of the first citation of a methodologically rigorous evaluation. Of the 12 research studies, only 8 utilized the worksite as both the unit of assignment and as the unit of analysis. None of the studies analyzed adequately for cost effectiveness. Given this limitation, this review briefly considers the relevant worksite research that has demonstrated cost outcomes. Worksite-based, multifactorial cardiovascular intervention programs reviewed for this article varied widely in the comprehensiveness, intensity, and duration of both the interventions and evaluations. Results from randomized trials suggest that providing opportunities for individualized, cardiovascular risk reduction counseling for high-risk employees within the context of comprehensive programming may be the critical component of an effective worksite intervention. Despite the many limitations of the current methodologies of the 12 studies, the majority of the research to date indicates the following: (1) favorable clinical and cost outcomes; (2) that more recent and more rigorously designed research tends to support rather than refute earlier and less rigorously designed studies; and (3) that rather than interpreting the methodological flaws and diversity as inherently negative, one may consider it as indicative of a robust phenomena evident in many types of worksites, with diverse employees, differing interventions, and varying degrees of methodological sophistication. Results of these studies reviewed provide both cautious optimism about the effectiveness of these worksite programs and insights regarding the essential components and characteristics of successful programs.

Although occupational and worksite-related diseases have been cited since Hippocrates, they were first systematically described in 1713 by Bernardino Ramazzini in *De Morbis Artificum*.¹ Much of the historical interest in occupation and disease has focused on the extent to which occupational exposures pose acute health threats. In recent years, that emphasis has changed to chronic diseases, and occupational settings have attracted interest as potential sites for delivering interventions. Many of these interventions target the modification of the behavioral precursors for disease that are not specific to occupational roles, such as diet, exercise, blood pressure, and tobacco use.² Worksites are attractive points for such interventions in part because large numbers of adults who would not spontaneously seek out risk reduction service through traditional health care outlets can be reached repeatedly and at relatively low cost.³ To the extent that preventive services can be offered at the worksite, even on work time, their convenience may dramatically increase the proportion of individuals who participate.⁴ In addition, it has been argued that environmental factors (ie, cafeteria food choices and no-smoking policies) and social support networks in worksites may make disease prevention programs in these settings more efficacious than similar programs offered in clinical settings.

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Today, there is a heightened interest by employers in worksite health issues since the self-insured and self-administered health and medical plans of large corporations were and are evolving prototypes of disease management within a managed care environment. In short, worksite health promotion and disease prevention programs may offset or exceed their costs in reduced medical expenditures. It is essential to note that worksite-based cardiovascular disease intervention programs need to be addressed and critiqued within this global context of managed care and comprehensive health promotion and disease prevention programs at the worksite. According to a 1995 study by the Boston Consulting Group, managed care and disease management constitute "an approach to patient care that coordinates resources across the entire health care delivery system and throughout the life cycle of a disease. Traditional approaches focus mainly on discrete medical episodes, attempting to minimize the expense of individual cost components, including physician services, pharmaceuticals, and hospitalization. Disease management takes a more systemic approach, focusing on the patient with a disease as the relevant unit of management, with an emphasis on quality as well as cost. Early experience suggests that disease management can lead to demonstrably better outcomes, as measured by clinical results, cost, and patient satisfaction."⁵ Within the managed care plans implemented by large employers, there is a renewed emphasis upon health promotion and disease prevention due to the possibility that such early interventions may help to effectively manage medical cost increases.

A 1992 survey of both employers and health care providers by the US Department of Health and Human Services indicated that the "work setting represents the single most important channel to systematically reach the adult population through health information and health pro-

motion programs."⁶ Among the reasons cited for the increasing prevalence of such programs include that they are popular with employees, and supply management with positive yet relatively low cost benefits for employees.⁷ Also, there is evidence that such programs improve both health and productivity in the short term, reduce absenteeism, are supported by both labor unions and management, and may reduce medical expenditures in the long term.⁸ However, the essence of the reinvigorated interest in prevention is driven by the accelerating movement toward capitated managed care and away from fee for service models.⁹ Within the new systems of managed care and their capitated budgets, there is a renewed attention to health promotion and disease prevention.¹⁰ It is assumed that both primary and secondary prevention at the worksite will have the effect of reducing the necessity of later and more costly interventions for diseases and disorders that have progressed in severity. However, that assumption of clinical and/or cost effectiveness has yet to be empirically demonstrated.

National surveys of corporations have clearly documented a burgeoning interest in worksite health promotion and disease prevention programs.^{11,12} Many of these programs target single risk factors, such as hypertension, lipids, or smoking cessation. However, an increasing number of corporations have developed and implemented multifactorial programs that address multiple cardiovascular risk factors. Multifactorial interventions are increasingly evident since employees who engage in one risk behavior tend to also manifest other risk behaviors. It is frequently cited that among manufacturing workers, only 12% of the smokers had smoking as their only risk factor.¹³ Programs that address multiple risk factors have a greater opportunity of attracting the participation of these "high risk" employees through offering multiple points of access.¹⁴ Employees have a

choice as to which risk factor they choose to modify first.¹⁵ After employees have successfully managed one risk factor, they may be more motivated and more confident to try to change other behaviors.¹⁶ Although this provides a strong rationale for comprehensive risk factor modification programs, the effectiveness of such programs needs to be demonstrated empirically.

For the purposes of this analytic review, comprehensive worksite-based health promotion and disease prevention programs refer to "those programs that provide an ongoing, integrated, program of health promotion and disease prevention that integrates the particular components (ie smoking cessation, stress management, lipid reduction, etc.) into a coherent, ongoing program that is consistent with corporate objectives and includes program evaluation."⁷⁻¹⁰ This review is limited to articles that meet this criteria, while single risk factor interventions—even though they might be reported as clinical and cost-effective—such as smoking cessation and hypertension screening are only briefly discussed. Additionally, there are three important definitions used throughout this review. With reference to cost outcomes, "cost effectiveness" refers to the unit cost of providing a service or for achieving a specific health outcome. "Cost savings" refers to a possible reduction in actual medical care costs. Third, "cost benefit analysis" compares the savings from a program, compared with the cost of providing that program.¹⁷ All three types of outcomes are evidenced in the studies cited here. All cited research has been published in peer-reviewed, professional journals.

Methods

This review of multifactorial, cardiovascular health promotion programs in worksites focused on risk factor management and is one of a series of such reviews sponsored by the National Heart, Lung, and Blood Institute (NHLBI). An international

literature search used a multi-stage process that included a MEDLINE bibliographic search of databases, a manual search of specific journals, a reference list search, and direct inquiries to worksite health promotion researchers. This search resulted in the identification of 12 studies that examined the clinical and/or cost impact of such multifactorial programs. Of those 12, only 8 utilized the worksite both as the unit of assignment and as the analysis.^{26,48,50-53,70} None analyzed adequately for cost effectiveness. Given this limitation, this review briefly considers the relevant worksite research that has demonstrated cost outcomes. Only articles that were published in peer-reviewed journals were included in the final review. Studies that investigated only a single cardiovascular risk factor are only briefly noted in this review. Anecdotal and purely descriptive studies were excluded. Structurally, this review will proceed in four stages, progressing from (1) citation of the overall body of research concerning comprehensive health promotion and disease prevention programs in worksites; (2) a subanalysis of those comprehensive, multifactorial programs focused on cardiovascular disease; (3) a further, more detailed consideration of only those cardiovascular programs evaluated with the greatest methodological rigor; and (4) a final subanalysis of those that also report outcomes regarding cost effectiveness. Based on this review, the paper concludes with a summary of methodological issues and recommendations for future research.

Literature Review

Previous literature reviews of the clinical and cost outcomes of comprehensive health promotion and disease prevention programs in the worksite have been published⁷⁻⁹ by the lead author and other researchers.^{10,16} Each review was designed to assess the state of worksite health promotion science in its respective area. In doing so, the author summa-

rized findings, critiqued methodologies, identified trends, and suggested specific future directions for proactive research. Findings are summarized here in a table format, adapted from these previous reviews, that describes each study by the following: (1) corporate site; (2) study author(s); (3) purpose of the evaluation or comprehensive research; (4) sample size; (5) sample description; (6) comparison group; (7) evaluation period; (8) outcome measure(s); (9) evaluation or research design; (10) clinical findings; and, where possible, (11) cost outcomes.

Because it is crucial to consider the methodological rigor of the research methodology included in each study, the table only includes research that is a proper study with randomized control group or a properly conducted study with comparison group, but no randomized control. Other recent reviews contained in a special issue of the *American Journal of Health Promotion (AJHP)* (July/August 1996) have been conducted and adapted this table format. Among the worksite-based research areas reviewed in the *AJHP* special issue are (1) overall health outcomes¹⁹; (2) nutrition and cholesterol reduction²⁰; (3) health risk appraisals²¹; (4) weight control²²; and (5) fitness and exercise.²³ Also, one of a recent series of reviews, sponsored by the Center for Disease Control in conjunction with the *American Journal of Health Promotion*, utilizes this format in reviewing general worksite health promotion and disease prevention programs.¹⁸ In this review, the studies that are methodologically rigorous and that seem to offer the best evaluation of the health effects of worksite health promotion programs will be briefly detailed.

Based upon these reviews of overall comprehensive health promotion and disease prevention programs in worksites, 77 studies have been cited in a series of three reviews.⁷⁻⁹ In another review,¹⁸ 47 studies were cited, with overlaps in citations be-

tween the 77 and 47 studies. Self-reported risk behaviors, measured on various Health Risk Appraisals (HRAs), were the most commonly cited risk assessment measures. However, only five studies relied solely on self reports. Most of the research relied upon a combination of self-reported behaviors and physiological measures of blood pressure, serum cholesterol, body composition and/or obesity, or aerobic fitness. One study utilized unobtrusive data gathered from cafeteria inventories as a measure of the amount of low-fat food being consumed by employees.²⁴ Two of the studies utilized direct measures of morbidity or mortality outcomes.^{17,25} Elapsed time between the intervention and the final follow-up assessment was seldomly long enough to determine effects on overall mortality. Rarely was the follow-up time long enough to allow potential differences in disease rates to occur.²⁶⁻²⁸ Many factors other than employee health were also measured, including employee morale, productivity, organizational commitment, workteam functioning, organizational policies, absenteeism, individual and/or corporate performance, as well as cost-effectiveness outcomes.

To date, there are no single studies that address all of these issues, and the research literature to date addresses some issues better than others. At present, the primary focus of the research has been to evaluate the short-term efficacy of worksite programs among active participants.²² Participation rates are available for some studies, but it is often difficult to evaluate across studies. Definitions of participation vary widely from completing an HRA questionnaire to attending a series of on-site classes. Separate consideration of subpopulations differing in risk level has typically not been conducted. None have attempted to distinguish between the immediate versus the sustained impacts of health promotion activities. Generalizability and cost evaluation has also been less thoroughly studied. With regard to

generalizability, the cost of replicating programs in multiple sites is a major barrier. Cost evaluation can also be expensive. Also, there are difficulties in estimating the "real world" implementation costs from research applications and attributing health care and productivity cost savings to specific programs in a rapidly evolving work environment. Proper cost accounting related to chronic disease prevention clearly requires an extended time horizon of at least 3 to 5 years.

Multifactorial Comprehensive Cardiovascular Risk Management Interventions in Worksites

All of the programs reviewed here included an initial medical screening and/or a variety of HRAs as the initial step. Physiological measures, ie, blood pressure, cholesterol, weight, height, and aerobic fitness, were often collected at these screenings. These physiological and self-reported measures were then repeated at future points to evaluate the clinical and/or cost impact of the program.

After participation in the screening, employees were often given personalized feedback. Results were reported to them by mail; by forwarding the results to the employee's health care provider with the consent of the employee; by computerized feedback from their health risk appraisals; and/or by individualized risk reduction counseling. Most programs^{22,29} provided only generic information regarding risk behaviors and how to modify them. In a majority of the programs, opportunities to learn and practice new skills were provided through nutrition classes, stress management seminars, back injury prevention programs, and other health improvement activities.^{31,32} Last, some of the programs incorporated modifications in organizational policy or the physical work environment in order to facilitate employee behavioral change.³³⁻³⁶ Such modifi-

cations include policies restricting or banning smoking on the work premises, eliminating cigarette vending machines, providing on-site exercise facilities, and offering cafeteria food that is lower in fat and calories.³⁷⁻⁴⁰ Comprehensive health promotion and disease prevention program interventions vary in the extent to which they focus on the entire employee population versus the subset of employees who exhibit elevated risk factors.⁴¹⁻⁴⁸ Several programs^{5,8,29-31,34} utilized intensive, individualized activities that focused on specific risk factors.

Focusing on multifactorial, comprehensive cardiovascular risk management interventions in worksites, this literature review yielded 17 peer-reviewed, published papers based on 12 studies that utilized a randomized, control trial (RCT) design. Of the 12 studies, only 8 utilized the worksite both as the unit of assignment and as the unit of analysis.^{26,48,50-53,70} These studies constitute the focus of this review and are briefly reviewed here. All 17 papers based on the 12 studies are annotated in Table 1 in chronological order and are broken down into their major findings.

Historically, the first such worksite cardiovascular intervention study was undertaken with 719 employees of the New York State Department of Education in 1976, utilizing a single sample, one year before and after intervention design, with a one-year follow-up.⁴⁹ A series of three studies focused on the same population over 12 years was undertaken to assess the extent to which major coronary risk factors could be changed among currently employed middle-aged men. Worksites were the unit of assignment and analysis in these three studies.^{26,50,51} In the Heart Disease Prevention Project of Great Britain^{26,50,51} the investigators chose to change the intervention protocol halfway through the trial in order to conduct more personal counseling with employees in the intervention worksites. This was initiated because of a perceived "gener-

ally disappointing response to mass advice." Investigators attributed the success of the program among high-risk employees to the extensive personal contact maintained with these employees throughout the 5 years of the trial. However, the Heart Disease Prevention Project trial did not result in reduced mortality or in reduced incidence of myocardial infarction. An analogous trial in Belgium⁵² did result in such reductions and is detailed later in this section.

Both of these research projects, which were sites of the WHO European Collaborative Group Trial, relied to a large degree on the effectiveness of one-on-one risk reduction counseling. For the Heart Disease Prevention Project intervention, 24 factories were selected, with 18,210 male employees between the ages of 40 to 59, and 15,661 (86%) of employees participated in the program. In the intervention, an educational program provided information on diet, smoking, exercise, and heart disease, with treatment of hypertension provided. Also, high-risk individuals identified by a screening HRA received personal counseling from physicians approximately four times per year. A total of 24 factory sites were randomized equally into intervention and control sites.

To evaluate the Heart Disease Prevention Project, a 5% sample of the participants and 10% sample of the control group were identified for periodic assessments. These assessments included smoking, systolic and diastolic blood pressure, plasma cholesterol, weight, general cardiovascular risk, and overall morbidity and mortality in the 12-year follow-up. After 5 years, among the high-risk men, smoking, blood pressure, weight, and overall cardiovascular risk were significantly reduced.^{50,51} These two studies utilized the worksite as the unit of assignment and analysis. Among those members of the general population at the intervention site who did not receive periodic assessments, the effects were much weaker, with only a reduction

TABLE 1

Summary of the clinical and cost outcomes of multifactorial cardiovascular risk management programs in worksites: 1978–1996*

Study	Purpose of Evaluation	Employee Population	No. and/or (%) of Program Participants	No. of Employees Included in Evaluation
Rose et al [†] (1980) ⁵⁰ Rose et al [†] (1983) ⁵¹ Bauer et al [†] (1985) ²⁶	To assess the extent to which major coronary risk factors can be changed among employed middle-aged men	24 factories employing 18,210 men aged 40–59	15,661 (86%)	5% random sample of participants, 10% sample of control group; for 12-year follow-up, 1,204 employees
Kornitzer et al [†] (1983) ⁵²	To assess the extent to which coronary heart disease can be prevented among employed middle-aged men	30 factories in Belgium	19,409 (84%)	71%
Blair et al (1985) ¹¹⁴	To assess the health effects of a comprehensive worksite health promotion program	12,136 employees of a metropolitan school district	3,846 (32%)	2,632
Bellingham et al (1987) ⁶⁷ Holt et al ¹¹⁵ (1995)	To determine the reduction of aggregate risk for cancer and heart disease as a result of a comprehensive worksite health promotion program (AT&T's Total Life Concept Program)	AT&T employees, mostly male	1,623	1228 (629 intervention, 599 comparison)
Erfurt et al ³⁴ (1991) Gregg et al ⁶⁹ (1990)	To compare the effectiveness of four approaches to worksite wellness programs	9,654 employees of four manufacturing plants	81% of employees	Random sample of employees (n = 1,883)
Edye et al (1989) ⁴¹	To assess the impact of a worksite program for the modification of CVD risk factors	4,607 employees in two Australian government organizations	1,1118	1937 (861 intervention, 1,076 control)
Larsen and Simons (1993) ⁷⁵	To evaluate the health impact of a health and fitness program	5000 employees of nine federal agencies; 30% white-collar, 63% female	1,900 (38%)	185 high-risk employees
Goetzel et al (1994) ⁸⁶ (IBM's "A Plan for Life" program)	To evaluate the association of participation in a comprehensive worksite health promotion program with changes in risk factors	All IBM employees	93,807 employees completed at least one health risk assessment	9,162
Glasgow et al [†] (1995) ⁵³	To evaluate the short-term effects of a worksite wellness program	26 worksites with over 6,000 employees	2,791 (48%)	1,222
Shi (1992) ⁴⁵	To assess whether increasing levels of health promotion programs improve health status	4,164 employees in nine divisions of a utility company; 751% male with active physical jobs	2,887 (69%)	1998
Gomel et al [†] (1993) ⁴⁸	To compare the effects of four different worksite health promotion programs	488 ambulance service station employees	431 (88%)	364
Jeffery et al [†] (1993) ⁷⁷	To evaluate the effectiveness of a worksite health promotion program	10,000 employees in 32 worksites	270 smokers (12% of smokers) and 2,041 in weight control (36% of obese employees)	299 randomly sampled employees from each worksite

* Total number of studies: 17. All reported "findings" are significant at $P < 0.05$ or better. CHD, coronary heart disease; MI, myocardial infarction; CVD, cardiovascular disease.

† Worksite as unit of assignment and analysis.

TABLE 1
Continued

Intervention Design	Evaluation Design	Evaluation Period	Outcomes	Findings
Education provided on diet, smoking, and exercise; treatment of hypertension provided; high-risk group received personal counseling from physicians approximately four times per year	Randomization of factories into intervention and control groups; periodic assessments of random samples of male employees	5 years; 12 years	Smoking, systolic blood pressure, plasma cholesterol, weight, overall risk CHD mortality and morbidity	Among high-risk men, smoking, blood pressure and weight were reduced; among general population of employees, effects were much weaker, with only a reduction in smoking being maintained over the 5-year period. At 12-year follow up, cigarette consumption, butter use, and other dietary fat intake were lower in intervention group; largest effects were still among high-risk group
Ongoing personal risk reduction counseling by staff physicians; treatment of hypertension	Randomization of factories into intervention and control groups; periodic assessments of random samples of male employees	5 years	Smoking, systolic blood pressure, plasma cholesterol, weight, overall risk, CHD mortality and morbidity	Total mortality reduced by 17.5%; fatal MI reduced by 24.5% and not-fatal MI reduced by 26.1%
10-week intensive intervention with individual goal-setting and group exercise and education classes	Staggered start design with pre- and post-intervention measures; comparisons made between participants and non-participants for absenteeism	14 weeks; 1 year for absenteeism; significant improvement on most outcomes, including absenteeism	Physiological measures of weight, blood pressure, cholesterol, fitness; self-report measures of health and well-being; absenteeism	Significant improvement on most outcomes, including absenteeism
Multi-component program including screening, health risk appraisal, skills-based risk reduction modules, and environmental modifications	Pre- and post-intervention assessments of participants and non-participants; 5-year assessment of participants compared with a newly constituted group of non-participants	2 years 5 years	Overall health risk, smoking rates, physical exercise, blood pressure, cholesterol, overweight, health attitudes	At 2 years, significant reduction in health risk behaviors for participants, smoking rates decreased in intervention and control groups; physical exercise increased significantly in intervention group At 5 years, self-reported behaviors improved, blood pressure and cholesterol not improved, overweight improved by same as comparison group; health perceptions more positive
Baseline screening for smoking, weight, and blood pressure. Site 1 completed follow-up screening 3 years later. Site 2 provided awareness-enhancing materials and classes. Site 3 provided wellness counselors and followed up with those at risk and had "menu" of interventions. Site 4 added strategies to enhance social support to Site 3 activities.	Changes among high-risk employees were compared across sites; sites randomly assigned to intervention conditions	3 years	Blood pressure, smoking prevalence, weight loss	Major improvements in risk levels with addition of follow-up counseling and a comprehensive menu of interventions (Sites 3 & 4)
Medical screening and initial counseling with physician; three counseling sessions with a nurse over a 3-month period	Randomization of employees into intervention and control groups	1 year	Blood pressure, cholesterol, smoking, alcohol use, and overweight	No statistically significant effects except for a small improvement in blood pressure control
Screening and individual counseling; workshops and seminars; self-help materials; fitness facilities on-site	Pre- and post-intervention assessment of high-risk participants compared to high-risk non-participants	Not clear	Cholesterol; blood pressure VO _{2max} , self-reported health behaviors	Improvements in cholesterol, blood pressure and VO _{2max} found among participants; some self-reported health behaviors also improved
Health risk assessment with individualized feedback and counseling; educational classes offered on-site; tuition reimbursement for participation on community programs	Pre- and post-intervention assessment of high-risk participants and non-participants	1 to 5 years	Blood pressure, serum cholesterol, weight, smoking	Participants more likely than non-participants to no longer be at high risk for blood pressure, non-high density lipoprotein cholesterol, and smoking
Employee steering committees tailor health promotion activities to the worksite, choosing from a menu of motivational, educational, policy and maintenance interventions	Randomized trial comparing 13 early intervention sites with 13 matched delayed intervention sites	2 years	Smoking prevalence, dietary fat intake, serum cholesterol	No significant differences between the intervention and comparison sites on the major outcomes
Baseline and follow-up health risk appraisals and health newsletter at all sites. Level 2 site added a resource center and self-care book level. Level 3 added classes and teams. Level 4 added case management of those at risk and environmental policy changes.	Quasi-experimental comparison of change across sites at different levels of intervention	2 years	Self-reported smoking, drinking, speeding, overweight; cholesterol level; blood pressure	Level 4 sites experienced greater decline in all risk factors; Level 3 sites showed more overall risk reduction than Levels 1 and 2
Model 1: health risk appraisal with feedback and appropriate referral; Model 2: added risk factor education session; Model 3: added behavioral counseling; Model 4: added behavior change incentives	Random assignment of 28 worksites to four intervention models	3 months, 6 months, 1 year	Body mass index and % body fat; serum cholesterol; smoking; blood pressure, aerobic capacity	Continuous smoking cessation rates were higher and weight gain was lower in the two behavioral counseling conditions than in any other intervention
On-site smoking cessation and weight loss programs combined with an incentive system through payroll deduction	Random assignment of 32 worksites to intervention or control	2 years	Body mass index and self-reported smoking status; self-reported absenteeism	Employee smoking rates declined; no treatment effect for weight; small reduction in absenteeism related to smoking cessation

in smoking being maintained over the 5-year interval. At the 12-year follow-up, smoking, butter use, and other dietary fat intake remained lower in the intervention group, with the largest effects most evident among the high-risk group.²⁶ This study was and remains significant because of the sample size, randomization of entire worksites as the unit of assignment and analysis, multifactorial nature of the intervention, duration of the intervention, as well as duration of follow-up. Among the limitations are a lack of statistical rigor in some of the analyses, the inherent limitations of a 5% and 10% subsampling of the intervention and control sites, respectively, and attrition of the intervention groups at both the 5- and 12-year evaluations.

Another early WHO European Collaborative Group Trial study conducted in Belgium randomized 30 worksites with the worksite as the unit of assignment and analysis.⁵² Starting in 1977, this study was also undertaken to determine the extent to which coronary heart disease morbidity and mortality could be reduced among actively employed, middle-aged men. For this study, 30 factories were equally randomized into intervention and control groups, with periodic assessments of random samples of the male employees. Approximately 84% of the employees participated in part of the program at the intervention sites, with 71% included in the subsample evaluation. This intervention consisted of counseling by staff physicians and treatment of hypertension for those individuals at elevated risk. Outcomes over the 5 years of the intervention were smoking, blood pressure, total cholesterol, weight, general coronary heart disease (CHD) risk, as well as overall morbidity and mortality. Relative to the control group, total mortality was reduced by 17.5% in the intervention sites, fatal myocardial infarctions (MIs) were reduced by 24.5%, and non-fatal MIs were reduced by 26.1%. Although this study reported significant outcomes and

employed randomization of worksites, there were numerous methodological problems, including the lack of a sufficiently intact cohort over the 5 years. There was a lack of specificity on the actual numbers of participants either in the intervention or control site. There were inadequate analyses of each of the independent risk factors. Such methodological limitations undermined the reliability of the main morbidity and mortality outcomes.

A later multifactorial cardiovascular risk intervention was conducted in Australia to assess the impact of a worksite program for the modification of CHD risk factors through a comprehensive intervention.⁴¹ This study focused on 4,607 eligible employees in two Australian government organizations. A total of 861 individual employees (rather than worksites) were randomized into the intervention, which also included 1,076 employees as controls, prior to receiving a 1-year intervention. Intervention consisted of a medical screening for cardiovascular risk, followed by an initial counseling with a physician. Following this initial screen and physician counseling, three monthly counseling sessions were provided by a nurse. Outcomes were blood pressure, cholesterol, smoking, alcohol use, and weight. At the conclusion of the 3-month intervention, with the follow-up at 1 year or 9 months after intervention, there were no statistically significant effects detected in any of the risk factors, except for a small, not statistically significant improvement in blood pressure.

More recently, Gomel et al⁴⁸ compared the impact of four different health promotion approaches on ambulance station employees in Australia. Ambulance stations were randomly assigned to one of the following four interventions of increasing intensity to determine a possible dose/response effect: (1) Assessment of only the major risk factors for cardiovascular disease, with personalized feedback provided to each employee. High-risk employees were referred to their physicians, but no other informa-

tion was provided; (2) The same HRA with added the provision of standard risk reduction advice; (3) All of the activities of the second intervention, plus the opportunity for high-risk employees to have individualized behavioral counseling; and (4) Added incentives to the activities of the third intervention. Incentives, such as a chance to win prizes, were provided for making lifestyle changes conducive to cardiovascular risk reduction. In this study, the worksite was both the unit of assignment and analysis. Follow-up assessments on all participants were conducted at 3, 6, and 12 months. Results of this study are not as clear as those in the two previous studies. However, employees in the two behavioral counseling interventions experienced (1) less of an increase in weight; (2) a greater decrease in percent body fat; and (3) a higher continuous rates of smoking cessation than did the employees in the first two interventions. No differences between groups were found in aerobic capacity or total cholesterol.

Last, and most recently, among these five studies is the "Take Heart" program research by Glasgow et al,⁵³ which focused on enhancing the short-term effects of a comprehensive worksite health promotion and disease prevention program, with an emphasis on CHD risk factors. Intervention sites consisted of 26 worksites with a total of approximately 6,000 active employees. For the evaluation design, worksites were randomized into 13 intervention and 13 matched delayed control sites, with the worksite as both the unit of assignment and analysis. Evaluation was based on a baseline survey of 2,791 employees (48% of the workforce). Of these, 1,222 employees (44%) completed the follow-up evaluation at the end of the 2-year intervention. For the intervention program, an employee steering committee tailored the health promotion activities provided to each of the 13 intervention sites by choosing from a range of motivational, educational, policy, and behavioral change

maintenance intervention options. Outcome measures were smoking prevalence, dietary fat intake, and total cholesterol. At the end of the 2 years, there were no significant differences between the intervention and control sites on any of the major outcomes beyond the secular trends observed in the control sites. A key factor cited by the authors in considering the lack of a main effect was the extremely heterogeneous worksites. Intersite variability may have been a primary factor in eliminating demonstrable outcomes.

Results of several of these interventions^{26,48,50-52} suggest that individually focused behavioral counseling should be incorporated into even the most comprehensive, carefully implemented, and rigorously evaluated programs. Before concluding this section, there are two final studies that did not randomize worksites as the unit of analysis but did utilize a "dose-response" model assessing varying levels of intensity of the intervention relative to clinical and/or cost outcomes.

Two evaluation studies directly compared the effectiveness of different levels of the intensity or "dose/response" relationship of comprehensive health promotion interventions focused on cardiovascular risk. For the first of these two studies, the worksite was randomized as the unit of assignment. Also, the intervention randomly assigned the four automobile manufacturing plants to four different health promotion models.³⁴ Site 1 received a "Wellness Screening," during which blood pressure, height and weight, and smoking status were measured. Employees at risk were referred to treatment or risk-reduction resources in the community. At Site 2, employees participated in the same screening activities. The promotion and implementation of on-site health improvement classes then took place. Site 3 added personalized outreach and follow-up counseling for high-risk employees. In addition to the health education classes offered at Site 2, Site 3 offered a "menu" of wellness interventions

that included self-help materials, one-on-one formal consultation, and mini-group interventions. Site 4 offered the most comprehensive program of all. In addition to all of the Site 3 components, Site 4 organized activities to increase peer support for behavior change, such as buddy systems and informal health networks. Also, to increase awareness of risks throughout the plant, there were activities such as weight-loss contests and plant-wide smoke-outs. Results from the 3-year follow-up indicate that although all four sites experienced reductions in risk, the two sites that included individualized outreach and counseling, along with a "menu" of risk reduction strategies, experienced significantly greater gains in terms of blood pressure control, weight loss, and smoking cessation than did Sites 1 and 2.

A similar study was conducted at Pacific Gas and Electric (PG&E) in California.⁴⁵ In this study, organizational divisions were assigned to one of four levels of intervention. Level 1 included an HRA screening that provided feedback to the employees, along with a bimonthly health newsletter. Level 2 provided a health resource center and free self-care materials in addition to the HRA and the newsletter. Level 3 provided behavior-change workshops and the opportunity for employees to join a team of employees who were interested in health promotion activities. Level 4 added organizational changes such as providing exercise space, modifying smoking policies, and providing financial incentives for risk behavior reduction. Additionally, high-risk employees were provided with personal follow-up and counseling. At a 2-year follow-up, employees in Level 4 had the greatest declines in smoking prevalence, percent overweight, cholesterol, and blood pressure. In this intervention, the only risk factor that was not significantly influenced was heavy consumption of alcohol.

These two studies suggest that worksite health promotion interven-

tions that are more intensive and include individualized follow-up with behavioral counseling for high-risk employees are likely to be most effective in reducing cardiovascular risks. However, an alternative explanation for the results cannot be ruled out. In keeping with a possible Hawthorne effect, it may be that the special attention provided to employees may have exerted a beneficial effect. However, the earlier results of the Australian ambulance station indicated that those employees who received the more intensive intervention did not evidence better results.⁴⁸ In this study, the addition of organizational strategies to enhance social support did not consistently enhance the effectiveness of the personalized outreach. Follow-up counseling intervention among manufacturing workers suggest that the factor influencing effectiveness may indeed be the inclusion of individualized counseling. Overall, these two studies, previous literature reviews, and this present review strongly suggests that the administration of an HRA alone results in little, if any, sustained risk reduction.⁵⁴⁻⁵⁶ It seems increasingly evident that intensive, sustained, focused, individualized, multifunctional interventions following a generalized risk assessment is most likely to be effective.

Previous reviews of worksite health promotion programs have pointed out the lack of methodological rigor in the evaluation designs of many of the studies.^{9,11,24,57,58} Previous reviews of worksite programs suggested that the more rigorous the evaluation design, the smaller and less consistent are the effects.^{3,59-63} Such observations raise the possibility that the more rigorously designed research may result in less favorable program effects than would the evaluation designs that utilize no comparison group.^{3,18,62,63} Results of non-experimental studies may be influenced by a number of threats to validity. Comparison groups in the quasi-experimental and experimental studies often show a reduction in

risk.^{33,47,64,65} This is consistent with the possibility that the results of simple before and after comparisons are benefited or artificially enhanced by strong secular trends.⁶⁶ On the other hand, in the context of strong secular trends, it is encouraging that a substantial majority of the experimental and quasi-experimental studies have predominantly positive results.

Methodological Critique

Research Design

Studies reviewed here are highly heterogeneous in design methodology and statistical analyses. Samples ranged from 29 employees to over 16,000. Studies with small sample sizes evidenced a minimal power to detect program effects. Overall, the eight studies utilizing the worksite as the unit of assignment and the subset of seven that also utilized the worksite as the unit of assignment and analysis constitute the minority of studies conducted. Even when an adequate number of multiple sites were randomly assigned to experimental and control conditions, the evaluation designs typically did not permit use of the worksite, as opposed to employees, as the unit of analysis.⁷⁰⁻⁷⁷ A majority of the studies utilized the individual employee as the unit of analysis, even when the unit of randomization was the worksite. Intraclass correlation^{78,79} due to employees working in the same worksite was not addressed. However, it is important to note that the theoretical threat to validity due to individual level versus worksite level analysis has not been thoroughly assessed empirically. The only paper specifically addressing this issue was one study examining intraclass correlations for body mass index (BMI), smoking, and exercise both cross-sectionally and longitudinally in 32 worksites.⁸⁰ This study found excess variance, over and above individual variance, associated with worksite cross-sectionally. However, change over time in response to the interven-

tion had a negligible worksite variance component.

A final difficulty in drawing conclusions from this heterogeneous literature is the differences in how variables are defined. Participation, for example, has a wide range of definitions, ranging from merely filling out an HRA at one extreme to completing a series of repeated individualized interventions at the other. Denominators for effect estimates also vary widely, in part due to differences in response rates to the evaluation surveys and to investigator decisions about how to define "eligibility." Cost effectiveness is also widely variable as investigators rarely use the same methods for imputing intervention costs or cost savings associated with changes in risk factors.

Duration of Follow-Up

Follow-up in the studies reviewed here ranged from 3 months to as long as 12 years. Although a few of the studies only conducted an immediate post-intervention assessment, the vast majority of the studies did utilize a reasonable follow-up period of at least 1 year after intervention. However, length of follow-up does not seem to be associated with a positive measurable impact of the intervention.

Several studies included multiple sequential follow-up assessments. These studies help to evaluate the extent to which early intervention effects endure over time. Only two of the studies utilized direct measures of morbidity or mortality outcomes.^{26,51} In one study, many of the risk reductions between the intervention and control groups at 5 years were maintained at the 12-year follow-up.^{50,51} Even though the intervention ended after the first 5 years, both the intervention and control employees experienced a small reduction in risk during the ensuing 6 years of the follow-up period.

In the Baier et al study,⁷⁴ the intervention consisted of a single screening and counseling activity.

Virtually all of the risk reduction was accomplished prior to the 3-month follow-up. Results from the Gomel et al study are more complex.⁴⁸ Overall, the interventions in the Gomel et al study were concentrated in the first 3 months, followed by incentives offers over 6 months in the most intensive intervention condition. For several of the targeted risk factors, there were detectable reductions during the first 3 months. However, these reductions regressed to baseline levels by the end of the first year. Other studies also demonstrated a tendency for risk reductions to regress to the mean over time. These findings support the necessity of maintaining behavior changes over time by implementing sustained and repeated strategies for assisting employees in sustaining their initial risk factor reductions.

Another limitation of many worksite studies is the reliance on intensive, highly structured, and expensive interventions delivered by highly trained research staff. Such a set of conditions may be difficult to replicate and therefore limits generalizability.^{81,82} A further limitation is the difficulty in differentiating intervention effects from other variables, such as secular trends; other contextual factors, including state or local health policy changes such as indoor air acts; and changes in medical benefits plans.

Participation Rates

Employees need to participate in worksite programs in order to derive any benefit, but the impact of self-selection remains a complex, confounding issue. Since most worksite health promotion programs are voluntary, the issue of self-selection is of the utmost importance and has received considerable attention from researchers and practitioners.^{9,83-85} Evaluations that focus only on changes among the active participants overlook the fact that the program may not attract the participation of large numbers of employees, especially those who may be at ele-

vated or even high risk.⁸⁶⁻⁸⁸ None of the cardiovascular interventions, and few of the general worksite programs, have been implemented with dependents and/or retirees. None of the studies have considered differential responses from the "working poor" or racial and/or ethnic subpopulations in the worksites.

Participation rates are defined and operationalized in numerous variations. Among the most common criteria for defining a participant was simply completing an initial risk assessment and screening. Participation rates of studies that used this criterion ranged from a low of 9.5% to a reported level of greater than 90%. Copayments for the program paid by the employee may be an important influence on employees' decisions regarding participation.^{89,90} Other studies have operationalized more rigorous criteria for participation, such as having to verify the completion of a minimal proportion of the program. Under these more stringent conditions, the participation rates were uniformly lower.

Although some of the studies distinguish between high- and low-risk employees, they rarely report the differential participation by these two distinct groups of employees. For a program to be effective in reducing overall morbidity and mortality, it needs the sustained involvement of high-risk employees.

One very promising future area indicated in the studies to date is an emphasis on secondary prevention with high-risk individuals after an overall worksite screening and intervention program is established. Such an intervention is taking place in a General Electric worksite, in conjunction with the Stanford Center for Research in Disease Prevention, and is funded by Blue Shield of California. This project is the Stanford Coronary Atherosclerosis Program (SCAMP) at the General Electric Nuclear Energy (GENE) site in San Jose, California. The primary objective of this project is to evaluate the operational feasibility and effective-

ness of an intensive, multifactorial cardiovascular risk management program in a worksite environment for persons at increased risk of having a clinical cardiac event. This program, based on the Stanford Coronary Risk Intervention Project (SCRIPT),⁹¹ is designed to provide a cost-effective approach integrating the use of lifestyle changes and medication. At the General Electric Nuclear Power facility, there are approximately 1,200 employees and 60 retiree and spouses living locally who are eligible for the program. SCAMP/GENE emphasizes effective risk screening of employees and retirees, general risk reduction programs and services for personal physician or clinic of high-risk persons, tracking and follow-up assessment of high-risk persons, and integration/enhancement of corporate and community health promotion services for use by all employees. To date, over 1,000 employees have responded to the initial screening. Approximately 600 have been triaged into an intermediate- or high-risk category and invited to participate in a subsequent biometric screening followed by multiple risk factor intervention. Also, corporate policies related to employee health are being evaluated, and changes recommended where indicated.

Attrition From the Sample

Attrition from the sample confounds the internal validity of virtually all of the studies reviewed. This is primarily due to inadequate participation in the postintervention assessments. In several studies, the non-response to follow-up assessments was greater in the intervention condition than in the comparison condition. Paradoxically, attrition was often greater in the more intensive interventions. If this differential attrition is due to high-risk employees in the intensive interventions who drop out of the study, then the effectiveness of the programs may be inflated. Use of archival data in combination with pretest values could be used to minimize this limitation but

is not always possible.⁷⁰ Statistical techniques have been developed to adjust for differential attrition between experimental conditions, but they can be complex and not necessarily effective. One study conducted with the city workers of Birmingham, Alabama, has instituted mandatory assessments as a prerequisite for receiving employer-sponsored health benefits.⁷⁰ While such a "mandatory" program remains controversial, it appears to have a dramatic positive impact upon both compliance and adherence to follow-up. Extensive follow-up efforts that utilize incentives have also proven to be effective.^{88,92-94} In fact it has been argued that the attempts to adjust for attrition may actually result in greater distortion of the intervention outcomes.⁹⁵ Among the possible solutions to the problem of attrition is to inform employees fully regarding the participation requirements; this also ensures that management support for the program is sustained over time and provides incentives to employees for completion of the program.

Multiple Risk Factor Interventions

Numerous clinical interventions and epidemiological studies of cardiovascular disease clearly indicate that behavioral risk factors play an important role in the etiology of cardiovascular disease. Overall, the evidence from this review indicates that multifactorial, comprehensive worksite health promotion programs focused on cardiovascular disease are likely to reduce employee risks for cardiovascular disease. By extension, such interventions may be both a clinically and cost-effective means to deliver comprehensive risk reduction programs to the general population.

First of all, one unequivocal caveat is that a public health model of exposing the entire employee population to such programs is a necessary but not sufficient condition to achieve enduring risk reduction. In-

terventions that depend solely upon educating the general employee population are relatively inexpensive. However, they do not appear to be as effective as a more intensive and expensive approach that adds sustained, periodic, individual counseling and support. Every cardiovascular program included in this review offered individualized risk reduction counseling to high-risk employees in the context of a worksite risk education reduction for all employees. Surely the general health promotion and disease prevention environment of a worksite appears to be a necessary, but not sufficient, prerequisite to engender sustained risk reductions among employees.

Following directly from this observation is that once such a supportive worksite environment is established, the most significant clinical and cost outcomes are likely to be evidenced when a subsequent cardiovascular intervention is introduced that focuses on identified individualized risks. Such an intervention needs to provide focused, consistent, sustained behavioral change, plus medical management.⁹¹ Such a multiple risk factor intervention model is also applicable to single risk factors (ie, smoking, hypertension), as well as to other chronic conditions (ie, stress, arthritis, musculoskeletal disorders, video display terminal (VDT) disabilities, back injuries or pain, and cancer), which also constitute major clinical and cost liabilities to employers.

Cost Outcomes

From the onset it is essential to note that none of the comprehensive cardiovascular risk management interventions with the worksite as the assignment and/or analysis have analyzed cost effectiveness outcomes. With this major caveat clearly in mind, it is illustrative to cite in brief the few comprehensive, multifactorial, cardiovascular interventions that have attempted to analyze for cost outcomes. These studies can provide insights into both the limitations and

applications of adding cost effectiveness outcomes in future studies of multifactorial CHD interventions with the worksites and the unit of randomization and analysis.

In 1993, a 32-worksite consortium of government, finance, education, and manufacturing companies in the Minneapolis/St. Paul metropolitan area participated in a randomized worksite trial. This program focused on weight reduction and smoking cessation as cardiovascular risks.⁷⁰ Of approximately 10,000 total employees, 2,041 enrolled in a weight control program and 270 participated in a smoking cessation program over 2 years. Among program participants, weight loss averaged 4.8 pounds and 43% of the smoking program participants quit. There was a significant net 2-year reduction vs control sites of 2.1 percentage points in cross-sectional and 1.3 percentage points in the cohort surveys, respectively. There were no significant treatment effects for weight. Cost of the smoking program was estimated at \$1,500 for 2 years per site, resulting in 8 to 16 extra quits. Thus the cost of each quitter was estimated to be \$100 to \$200. In 1993, the same investigators analyzed their data to determine the effect of these two programs on absenteeism. According to this study, the percentage of employees reporting illness-related absences in the last month decreased approximately 3.5 percentage points more in the intervention than the control sites. Further analyses also indicated that the effect was most pronounced upon workers who smoked at baseline.

To date, perhaps the best evaluated quasi-experimental series of worksite studies focused on multiple risk factor reduction interventions for cardiovascular disease is the sequence of five studies conducted at General Motors by the late Jack Erfurt, the late Andrea Foote, and Max Heirich with their colleagues at the University of Michigan. Starting in 1987, Erfurt and Foote and their

colleagues focused on using four different levels of intensity of intervention for both wage and salaried employees of General Motors. Their initial study addressed weight loss and smoking cessation among 7,804 employees in four different GM worksites over a 3-year intervention period.⁷² Four worksites, but not individuals, were randomized in a quasi-experimental design, with three worksites given regular classes, two with additional individual counseling, and one control site. In the two sites with counseling, participation was 46% in smoking cessation and 54% in weight loss. Offering classes without individual counseling attracted only about 10% of the at-risk groups—the same percentage as at the control site. In 1987, the research team attempted to identify strategies for effectively engaging at-risk employees into risk-reduction activities and to assess effects of frequency of follow-up counseling on reduction of risks. Working with approximately 2,000 white-collar, clerical, and blue-collar manufacturing employees with hypertension, smoking, and/or overweight risk factors, they intervened in two comparable worksites without a control site. They compared participants in risk reduction activities and changes in risks for employees receiving more versus less follow-up counseling. Overall, they concluded that more frequent worksite counseling is associated with greater participation in smoking cessation, weight loss, and greater reduction in blood pressure among hypertensives.

From a public health point of view, a major strength of the comprehensive, multifactorial interventions reviewed here is the ability to reach relatively large, stable populations and to engage them in sustained behavioral medical change. Although data on participation in health improvement activities in the general population is limited, it is generally conceded that few high-risk individuals voluntarily seek out such services.⁹⁵ In a recent study of mail-based

recruitment in the general population to smoking cessation and weight loss programs, sign-up rates were less than 1% of households for smoking and 3% to 5% for weight loss.¹⁰⁰ Unit costs of recruiting a program participant ranged from a prohibitive cost of approximately \$11 for weight to \$62 for smoking. By contrast, participation rates in similar programs in the worksite studies cited in this review have generally been five to ten times as high, with a resulting decrease in the cost per participant.⁹⁷ Even if the success rates in worksite programs is considerably less than among participants in clinic-based programs, the numbers of people favorably affected is much higher.

Noting the general success of worksite programs for CHD prevention should not, however, be interpreted as a blanket endorsement of every program that has been attempted to date. For instance, Erfurt and Holtyn³⁵ clearly demonstrated that participation in worksite programs is sensitive to cost. Asking or requiring employees to pay out of pocket for such programs dramatically reduces participation rates. An important contribution that future researchers could make to improving practice in this area is to evaluate the various components or combinations of components from multifactorial interventions systematically. This would permit the more efficient use of limited intervention and financial resources.

Other unaddressed issues in worksite-based CHD prevention are the durability of the effects over time and potential impacts on medical care costs. If such programs are to be self-supporting over time, it must be demonstrated that a mature program that is in place over a period of years results in a healthier workforce. Virtually all of the research to date has addressed effects over short time intervals of a year or two. Effects have only seldomly been evaluated using the entire workforce. None of the studies have taken into account changes in workforce size and com-

position as a result of turnover and changes in medical benefits plans. New research focusing on this issue by utilizing the worksite as the unit of both randomization and analysis would be very useful in evaluating the full potential of this type of intervention. A longer time scale of at least 3 to 5 years is also important in evaluating the potential cost effectiveness, which may accrue from worksite health promotion. This is true because health care costs tend to be distributed unevenly, as in "high cost" analyses, and may be manifested most strongly in later years of life after active employees have retired.

It is evident that there is a profound lack of standardization of what constitutes either costs or benefits in such interventions and their subsequent evaluations.¹⁰³⁻¹⁰⁶ Costs such as space, utilities, salaries of on-site health personnel, paid time for employee participation, and other significant cost variables are not standardized. Also, these variables are either included or excluded in cost considerations in an arbitrary manner.¹⁰⁷⁻¹⁰⁹ Likewise, the benefits of such programs in terms of cost savings specific to individuals, savings to the corporation, decrease in the rate of medical expenditure, and overall impact on areas of performance and productivity are equally arbitrarily defined and selected.^{15,37,77,110,111} Given the high degree of variability in both the cost and benefits operationalizations, any interstudy comparisons are virtually meaningless.

It is also extremely important to note the issue of "high cost analysis."¹¹² High cost analysis is based on the observation that medical claims data are highly skewed and violate the statistical assumption of normality. Since a small percentage of employees incur the largest percentage of medical costs, the standard deviation is large and skews the claims data to the upper end of the normal curve continuum. As a result, the mean is generally much higher

than the median. This "inappropriate" use of means in cross-sectional studies underestimates sample bias, overestimates the descriptive difference in cost for high-risk and low-risk employees, and underestimates the statistical significance of large difference observed between the means for the two groups.

These worksite studies engender the problems cited above and two additional issues. Using statistical measures of arithmetic means assumes that an intervention that appears to lower costs for participants achieved a small effects among all high-risk participants. However, it may in fact have substantially reduced the costs for a small number of high-risk employees. This failure to target high-risk employees dilutes the cost effectiveness of the intervention.¹¹³ While comprehensive, multifactorial programs will and should continue, it is increasingly clear that programs of secondary prevention focused on high-risk individuals will be increasingly important in disease management and managed care.

Intervention programs and their subsequent evaluations must be of sufficient duration to demonstrate clinical and/or cost outcomes. Results from this review and others strongly suggest that a program must be sustained for a minimum of 1 year to bring about risk reductions among employees and 3 to 5 years to demonstrate cost effectiveness. A majority of studies indicate that program effects were maintained after the program was completed. Clearly, the preponderance of evidence suggests that program effects are more likely to be maintained if the employer continues to support and reinforce employee risk reductions. Ideally, worksite health promotion programs should be supported by senior management so that they can become part of the underlying fabric and culture of the organization. Studies of the Johnson & Johnson "Live for Life" program,^{88,89} as well as the studies of similar well-executed large-scale corporate initiatives,^{98,100} demonstrate

that when such programs are well-integrated into the human resource strategy of an organization and accepted as the "norm" for the organization, they are likely to be well-implemented and effective.

Discussion and Future Recommendations

None of the cardiovascular intervention programs reviewed here reduced all indicators of risk. However, the majority of programs of sufficient intensity, breadth, and duration did result in a decrease in an adequate number of the risks to result in an overall risk reduction. One major advantage of comprehensive, multifactorial programs is that different employees can benefit from the same program in different ways (ie, controlling hypertension, reducing cholesterol, managing stress, quitting smoking). Future interventions and evaluation efforts should give more attention to developing other nonspecific outcome measures, improved overall health status, and enhanced functional status that will better reflect overall reductions in risk and improvements in general health status.

Few of the interventions cited here focused on the physical, psychosocial, or policy work environment and its role in employee health. Based on earlier reviews of comprehensive health promotion and disease prevention programs in worksites,¹⁰¹ it is evident that employees need to know that their organization is seriously concerned about their health. Also, employees need to be afforded the flexibility necessary to participate in worksite health promotion programs. Employees need to perceive that their senior management, supervisors, and coworkers have positive attitudes toward health since these factors have all been associated with improved employee health status.^{36,102} Feeling valued as an employee, having control over job performance to reduce "job strain," and being satisfied with work appear to

be significant predictors of employee health and health behaviors. Interventions and evaluations of worksite cardiovascular programs should benefit from including such components and measures of the work environment in order to determine the influence of such factors on the overall clinical and cost effectiveness of these interventions.

Every intervention cited here, and virtually every study in the worksite health promotion and disease prevention literature, was provided to active employees only.¹⁰³ Numerous medical insurance surveys have cited the fact that the actual medical expenditures for a corporation are greatest for retirees and dependents rather than for their active employees.^{104,105} Partially this is due to the growing ratio of the number of retired versus active employees as well as to the overall aging of the population. Since cardiovascular disease remains the number one cause of morbidity, mortality, and cost to employers, a future significant direction would be to extend such programs to both retirees and dependents. Such interventions also need to be focused upon and evaluated relative to the unique characteristics of the working poor and racial and/or ethnic subpopulations in the worksite.

Finally, on a positive note, the methodological rigor of worksite health promotion evaluation studies has evolved considerably over the years. Methodological challenges are great, and further innovation and refinement are necessary. Despite the many limitations of current methodologies, the vast majority of the research to date does indicate the following: (1) favorable clinical and cost outcomes^{9,18}; (2) that more recent and more rigorously designed research tends to support rather than refute earlier and less rigorously designed studies⁸⁵; and (3) that rather than interpreting the methodological flaws and diversity as preemptively negative, one should perceive it as equally indicative of a robust phenomena evident in many types of

worksheets, with diverse employees, different interventions, and varying degrees of methodological sophistication.⁶² In any case, even the most rigorous methodology cannot compensate for predictably, unsophisticated interventions that do not take into account over 15 years of increasingly precise, multifactorial, effective intervention strategies.

In reviewing the studies here, the most promising future directions appear to be with programs that combine comprehensive plus high-risk interventions and those interventions that focus on a dose-response model of increasing levels of intensity. Although difficult and expensive to conduct, randomized trials comparing combinations of comprehensive, public health approaches combined with individualized behavioral counseling would be instrumental in furthering our understanding of what constitutes an effective intervention. Such studies should also incorporate more detailed description of the process of the intervention and more explicit objectives and outcomes of each of the program's activities. Including measures of each objective and subobjective in the evaluation plan will help identify at what point in the process the hypothesized linkages are breaking down.¹⁸ Rather than only being able to make statements about the program as a whole, such evaluations can more precisely pinpoint the strengths and weaknesses of specific components of the program. Also, the inclusion of qualitative evaluation method could aid in identifying the strengths and weaknesses of programs from the perspective of the employees.

Conclusion

Comprehensive health promotion and disease prevention programs have evolved in corporate worksites over the last two decades. Large self-insured and self-administered corporate medical plans are prototypes of the increasing emphasis upon comprehensive health promotion and disease prevention programs

in managed care plans. Inherent to managed care is an increasing emphasis on clinical and cost outcomes. Studies here and in earlier reviews are providing corporations, insurance providers, and government with the preliminary data to guide program design, implementation, and evaluation. With the second generation of worksite programs is a greater emphasis upon high-risk employees, combinations of public health and individualized behavioral risk management, the harnessing of telemedicine delivery technologies, and the extension of such interventions to dependents and retirees. Results of the comprehensive, multifactorial cardiovascular risk management interventions in worksites reviewed here provide cautious optimism about the clinical and cost effectiveness of these worksite programs. They also provide initial insights regarding the critical components and characteristics of successful programs. At this time, the most salient issue for insurers and corporations to address is not whether worksite health promotion programs should be implemented in order to reduce risks and enhance productivity, but rather how these programs should be designed, implemented, and evaluated in order to achieve optimal clinical and cost effectiveness.

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