The Effects of a Health Promotion–Health Protection Intervention on Behavior Change: The WellWorks Study

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ABSTRACT

Objectives. This study assessed the effects of a 2-year integrated health promotion–health protection work-site intervention on changes in dietary habits and cigarette smoking.

Methods. A randomized, controlled intervention study used the work site as the unit of intervention and analysis; it included 24 predominantly manufacturing work sites in Massachusetts (250–2500 workers per site). Behaviors were assessed in self-administered surveys (n = 2386; completion rates = 61% at baseline, 62% at final). Three key intervention elements targeted health behavior change: (1) joint worker–management participation in program planning and implementation, (2) consultation with management on work-site environmental changes, and (3) health education programs.

Results. Significant differences between intervention and control work sites included reductions in the percentage of calories consumed as fat (2.3% vs 1.5% kcal) and increases in servings of fruit and vegetables (10% vs 4% increase). The intervention had a significant effect on fiber consumption among skilled and unskilled laborers. No significant effects were observed for smoking cessation.

Conclusions. Although the size of the effects of this intervention are modest, on a populationwide basis effects of this size could have a large impact on cancer-related and coronary heart disease end points. (*Am J Public Health.* 1998;88:1685–1690)

Mounting evidence has underlined the importance to cancer prevention efforts of reducing lifestyle and environmental exposures.[1–7] Work sites are an important venue for efforts to reduce cancer risk through health promotion and health protection initiatives[8–10]: through work sites, it is possible to influence the health-related behaviors of large numbers of people.[11–14] Of particular importance is the potential effect that work site–based cancer control strategies may have on risk reduction among less educated workers and those in low-status jobs, among whom behavioral risk factors are particularly high. Blue-collar workers are more likely to smoke than are workers in white-collar jobs.[15–17] Blue-collar workers are also more likely than other workers to be exposed to hazards on the job.[18] Similarly, unhealthy dietary habits are more prevalent among those with low education[19] or low income.[20]

Blue-collar workers are twice as likely to have 2 or more lifestyle risk factors (e.g., smoking, high-fat diets, and sedentary lifestyles),[21] and workers reporting exposures to occupational hazards have higher smoking rates than workers without such exposures.[22] In addition, blue-collar workers are less likely to participate in work-site health promotion programs than are white-collar workers.[23–27] When blue-collar workers do participate, these programs are less likely to result in health behavior change.[27]

This report focuses on an innovation in work-site cancer prevention initiatives of particular relevance for blue-collar workers: an integrated program targeting both behavioral risk factors and exposures to hazards on the job.[10,18] For blue-collar workers, the top health priorities may not be the individual behaviors addressed by work-site health promotion programs but rather those risks that are involuntary, outside personal control, and undetectable and that seem unfair.[28–31] Individual health behaviors may fall within a "zone of nonacceptability" for management actions (meaning that it would not be acceptable to workers for management to take action in these areas), while job-related health and safety issues may be considered a too-often ignored responsibility of management.[32] Reduction of job risks may be required in order to gain credibility and trust with these workers and to increase their receptivity to health education messages regarding their own individual health behaviors.[33,34]

The purpose of this report is 2-fold. First, we present analyses designed to test the effect of the integrated program on changes in 2 targeted behaviors related to cancer risk: dietary habits, including consumption of fat, fiber, and fruits and vegetables; and cigarette smoking. Second, analyses are presented to assess whether the intervention effect differed by job category or exposure to occupational hazards. We hypothesized that this integrated health promotion–health protection intervention would be more effective in producing health behavior changes among blue-collar workers and workers exposed to occupational

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hazards than among other workers, keeping in mind that traditional health promotion programs have been less effective with these groups.

Methods

Design

The WellWorks Study was conducted at 1 of 4 intervention research centers participating in the Working Well Cooperative Agreement (See Acknowledgments).[35] The Working Well Trial was a randomized work-site intervention trial testing the effectiveness of health promotion interventions in 57 matched pairs of work sites, using common elements of study design, intervention methods, data collection, and statistical analysis. All 4 study centers targeted the nutritional outcomes, and 3 of the 4 targeted smoking. Other targeted risk factors varied across the 4 study centers, each of which had sufficient power to detect intervention effects independently.

Data for the study reported here were collected as part of the WellWorks Study, conducted in 24 work sites located in eastern and central Massachusetts.[34] After baseline assessments, work sites were matched into 12 pairs on the basis of the presence of a cafeteria, work-site size, type of smoking policy, company type, distribution by sex, distribution of blue-collar and white-collar jobs, and response rate to the baseline survey in order to assure comparability between groups regarding these factors.[22,35] One work site in each pair was then randomly assigned to the intervention condition and the other to the control condition. Among the Working Well intervention research centers, only the WellWorks Study assessed the effectiveness of a model integrating health promotion and health protection. As in the other study sites, the primary outcomes for WellWorks were smoking cessation, increased fiber consumption, decreased total fat consumption, and increased fruit and vegetable consumption.[35]

Sample

The WellWorks Study recruited work sites from a Dun and Bradstreet listing based on the following criteria: number of workers (250–2500), turnover rate (<20%), non–English-speaking employees (<20%), and use of known or suspected carcinogens in work processes. The types of businesses in the final sample included manufacturers of industrial, chemical, and other products; textile dyeing; firefighting; and newspapers. All participating work sites agreed to be randomly assigned, to administer employee and organizational surveys, and to deliver the intervention if assigned to the intervention condition.[22,34]

Intervention Methods

On the basis of a social ecological model, the WellWorks intervention targeted multiple levels of influence.[14,36] This intervention model has been described previously,[34] and it included 3 key elements targeting health behavior change: (1) joint worker–management participation in program planning and implementation, operationalized through an employee advisory board and a designated work-site liaison; (2) consultation by project staff with management on work-site environmental changes, including tobacco control policies, increased availability of healthy foods, and reduction in the potential for exposure to occupational hazards; and (3) health education programs targeting individual behaviors in each of the risk factor areas.

Data Collection

A random sample of workers was selected at each work site prior to the beginning of the intervention (baseline) and again following completion of the intervention (final). Data were collected by means of a self-administered questionnaire distributed through work-site channels. Three reminders were sent to nonrespondents, and incentives were provided for participation in the survey. In the 24 WellWorks sites at baseline, 9648 surveys were mailed and 5914 completed surveys were received (overall completion rate was 61%; range by work site, 36%–99%). At final, 8667 surveys were mailed and 5406 completed surveys were received (overall completion rate was 62%; range, 43%–92%).

The 2 samples were selected independently, but 2658 subjects responded to both surveys. This report addresses the changes in behavior reported by the cohort of responders to both the baseline and final surveys. Results of the analysis of the complete cross-sectional data for the Working Well Trial as a whole have been reported elsewhere.[37]

Measures

Diet was assessed by means of an 88-item semiquantitative food frequency questionnaire that listed portion sizes (176 items total).[38–40] The percentage of energy from fat and grams of fiber per 1000 kilocalories were also assessed by means of the questionnaire. Following the method used in the Working Well Trial as a whole, servings of fruits and vegetables were calculated on the basis of 2 questions asking about usual intakes of fruit (excluding juice) and vegetables (excluding potatoes and salads), plus responses to items about salad, potato, and fruit juice servings (weighted for serving size).[40]

The primary outcome for smoking was 6-month abstinence, a reasonable approximation of continuous, long-term cessation.[41,42] It was measured by self-reported abstinence in the 6 months prior to the final survey for subjects who reported smoking at the baseline survey.[35]

Self-reported exposure to workplace hazards was based on the response to the question, "Some substances used in work settings may be harmful to your health. In your present job are you exposed to any of the following substances that may be harmful to your health?" Response options included chemicals (including solvents, cleansers, paints, dyes, oils, etc.); dusts (including metal, wood, etc.); gases, fumes, or vapors; pesticides; herbicides; and other. For the purposes of these analyses, workers were considered exposed to workplace hazards if they reported exposure to any chemicals, dusts, gases, fumes, or vapors.

Selected characteristics of the subjects were assessed, including age, sex, educational level, race, ethnicity, marital status, and job category. Job category was derived from responses to a question asking workers to choose the category that best represented their job. Respondents were grouped under 3 categories. The first category, skilled and unskilled labor, comprised those who answered "skill or craft," "machine operator," "manual labor," or "service work." Another category, office work, comprised those who chose scientific technical work or clerical, office, or sales work. The last category consisted of professional, managerial, and administrative work.

Data Analysis

The work site was the unit of randomization and intervention, while the employee was the unit of measurement. Among the 2658 subjects in the cohort, 272 were excluded from the analysis because they had out-of-range or missing dietary values on either the baseline or final survey, leaving 2386 subjects for analysis.

To evaluate the representativeness of the cohort, we compared characteristics of subjects in the cohort with those of subjects surveyed at baseline but not at the final survey; for this analysis, we used the Cochran-Mantel-Haenszel χ^2 or mixed-model analysis of variance, with work site included as a random effect.

For testing the intervention effect, we used repeated-measures linear modeling techniques where the repeat factor was survey (baseline vs final) and work site was included as a random effect. The *P* value for the F test of no survey × intervention interaction was used to determine a significant intervention effect.

We then investigated the effectiveness of the intervention, controlling for sex, occupational category, and self-reported exposure to occupational hazards. To test whether a characteristic influenced the effectiveness of the intervention, we included all 2-way and 3-way interactions of the covariable, intervention, and survey. To obtain the most parsimonious model, we removed higher-order interactions from the analysis if they were not statistically significant ($P < .05$). Main effects were removed only if the effect itself and all interactions with that effect were not significant. The random work-site effect and the fixed intervention and survey effects were always retained because they are elements of the design. The simplest hierarchical models for each outcome are presented.

For continuous outcomes (percentage of kilocalories from fat, grams of fiber per 1000 kilocalories, and number of servings of fruits and vegetables), we used the repeated-measures mixed-model analysis of variance.[43,44] For binary outcomes (exposure to hazardous substances, smoking status, and 6-month smoking abstinence), we used a mixed-model logistic regression analysis.[45,46]

The distributions of the continuous outcomes were examined and scale transformations were performed on several nonnormal continuous variables. For grams of fiber per 1000 kilocalories and daily servings of fruits and vegetables, the natural logarithm of the original value was used in the analyses. For outcomes analyzed in the log scale, change is reported as a percentage increase or decrease from the baseline value. For outcomes analyzed in the natural scale, change is reported as a difference from baseline.

Results

Characteristics of the Sample

No significant differences by age, self-reported exposure to hazardous substances, or fiber consumption were observed between those in the cohort and those responding only to the baseline survey. Compared with those responding only at baseline, the cohort had a higher percentage of men (76% vs 67%), a higher percentage of skilled and unskilled laborers (49% vs 43%), a higher percentage who were married (76% vs 68%), and a lower smoking prevalence (23% vs 26%). Members of the cohort were also less likely to have a college degree (26% vs 30%) but more likely to have some college (37% vs 32%). Other differences were too small to have practical significance.

We also examined the association between self-reported exposures to job hazards and the smoking and nutritional outcomes at baseline among those included in the cohort. Exposure was associated only with fiber intake. Unexposed workers had greater fiber intake in all job categories (7.86 g vs 7.31 g per 1000 kcal, $P < .001$), but the difference was greatest for office workers (8.30 g vs 7.13 g, $P = .02$ for the interaction).

Changes in Risk Factors by Intervention Group

Table 1 presents mean changes in fat intake as a percentage of kilocalories between baseline and final in the intervention and control groups. Those employed in intervention work sites reported significantly greater reductions in fat consumption than did those in the control condition. On average, workers in the intervention sites reduced their fat consumption 0.8 percentage point more than those in the control work site, reflecting a 2.2% difference in the level of observed change. The sex and job categories were significantly associated with fat intake, although controlling for these factors did not change the observed intervention difference. Occupational exposure to harmful substances was not associated with fat intake or with the effectiveness of the intervention in reducing fat intake.

The increase in fiber consumption approached statistical significance when only work site was controlled, as shown in Table 2. There was, however, a significant job category interaction with the intervention effect. Changes in fiber intake were similar between the intervention and control conditions for office workers and for professionals and managers, but these changes were significantly greater among skilled and unskilled laborers in the intervention group than in the control group. Skilled and unskilled laborers in the intervention group increased their fiber consumption by 7 percentage points more than similar workers in the control group, whereas for both office workers and professionals/managers there was greater change in the control group than in the intervention group. Sex of the employee and exposure to hazards on the job were associated with fiber intake but did not moderate the intervention effect.

Workers in the intervention sites increased their consumption of fruits and vegetables 0.23 servings per day, compared with 0.10 servings among workers in the control sites, reflecting a 6% difference in servings per day, as shown in Table 3. Professional and managerial workers increased their consumption of fruits and vegetables more than other workers did, although this difference was apparent for both intervention conditions. Controlling for sex of the worker and job category did not modify the observed intervention effect.

Six-month smoking abstinence rates were 15% in the intervention work sites compared with 9% in the control work sites, controlling for work site ($P = .123$). When we removed work site from the model, the odds ratio for the intervention effect was 1.83 ($P = .04$). Because of the limited sample size for baseline smokers, we added each of the control factors to the model one at a time, controlling for work site. Only job category was significantly associated with smoking. Although the intervention-by-job category interaction was not significant ($P = .18$), the trend is of interest. For skilled and unskilled laborers, the 6-month abstinence rate was twice as high in the intervention as in the control condition (17.9% vs 9.0%). For the other 2 occupational categories, although differences were small, abstinence rates were actually higher in the control work sites than

TABLE 1—Adjusted Mean Percentage of Kilocalories as Fat by Intervention and Survey, Controlling for Work Site and for Significant Covariates: The WellWorks Study, 1989–1994

Intervention Condition	Survey	Controlling for Work Site	Multivariable Model[a]
Control	Baseline	35.72[b]	35.54[c]
	Final	34.20	33.95
	Difference	−1.52	−1.55
Intervention	Baseline	36.14	36.98
	Final	33.83	33.62
	Difference	−2.31	−3.36

[a]Controlling for work site, gender, and job category.
[b]$P = .007$ for survey by intervention interaction.
[c]$P = .01$ for survey × intervention interaction.

TABLE 2—Adjusted Geometric Mean Grams of Fiber per 1000 Kilocalories by Intervention Condition, Survey, and Job Category, Controlling for Work Site and for Significant Covariates: The WellWorks Study, 1989–1994

Intervention Condition	Survey	Controlling for Work Site	Multivariable Model[a]
Control	Baseline, g	4.48[b]	
	Final, g	7.87	
	Change, %	+5	
Intervention	Baseline, g	7.43	
	Final, g	8.01	
	Change, %	+8	
Interaction of job category × intervention condition × survey[c]			
Skilled/unskilled labor			
Control	Baseline, g		7.67
	Final, g		8.03
	Change, %		+5
Intervention	Baseline, g		7.42
	Final, g		8.31
	Change, %		+12
Office work			
Control	Baseline, g		7.55
	Final, g		7.84
	Change, %		+4
Intervention	Baseline, g		7.77
	Final, g		7.88
	Change, %		+1
Professional/managerial			
Control	Baseline, g		8.01
	Final, g		8.58
	Change, %		+7%
Intervention	Baseline, g		8.09
	Final, g		8.56
	Change, %		+6

[a]Controlling for work site, gender, self-reported exposure, and job category.
[b]$P = .08$ for survey × intervention interaction.
[c]$P = .012$.

in the intervention sites (for office workers, 5.1% vs 2.5%; for professionals and managers, 18.6% vs 14.2%).

Discussion

These analyses assessed the effects of the first randomized, controlled study of an integrated health promotion–health protection work-site intervention in changing dietary habits and smoking. These data, from a cohort of workers present throughout the entire intervention period, indicate significant reductions in the percentage of calories consumed as fat and an increase in servings of fruits and vegetables. The intervention also had a significant effect on daily consumption of grams of fiber among skilled and unskilled laborers. Although the 6% difference in 6-month smoking abstinence rates between intervention and control work sites was not statistically significant, the magnitude of the effect was relatively large, and it appeared to be largest among skilled and unskilled workers.

Work-site health promotion programs in the United States have generally emphasized individual behavior changes as a means of reducing disease risk.[14,34] Noting that health behaviors of individual workers are only one part of the equation of worker health, recent discussions have highlighted the importance of the integration of health protection and health promotion efforts.[10,13,14,18,34,47] Despite differing historical roots and philosophical traditions, separate training, and competition for scarce resources, an array of opportunities exist for synergism between the 2 disciplines of occupational health and health education.[10,13,18] By addressing concerns within the broader work-site environment, integrated health promotion–health protection programs are likely to contribute to an environment more supportive of general worker health, including health behavior changes.[48–50]

Prior reports have indicated that traditional health promotion programs are most effective among white-collar workers.[27] To estimate the effectiveness of the addition of the health protection component, we hypothesized that this integrated intervention would be particularly effective for blue-collar workers or for workers exposed to occupational hazards. The intervention had differential effects by job category for 1 of the 3 dietary outcomes examined: for fiber, the intervention was more effective in producing changes among skilled and unskilled laborers than among workers in other types of jobs. Smoking abstinence rates increased substantially among skilled and unskilled laborers in the intervention group compared with the control group. Although the differences by job category were not statistically significant, the smoking abstinence rates among blue-collar workers in the intervention group were comparable to abstinence rates among professional and managerial workers. In addition, we found no difference in intervention effectiveness by job category for the other 2 outcomes, suggesting that this intervention was at least successful in removing the diminished intervention effect often observed among blue-collar workers.

This report does not address the effectiveness of the health protection intervention in reducing potential exposures to hazards on the job. Occupational hazards exposure is more effectively controlled by changes in the work-site environment than by changes in individual worker behaviors.[51] Therefore, reductions in exposure are more appropriately

TABLE 3—Adjusted Geometric Mean Servings of Fruit and Vegetables by Intervention and Survey, Controlling for Work Site and for Significant Covariates: The WellWorks Study, 1989–1994

Intervention Condition	Survey	Controlling for Work Site	Multivariable Model[a]
Control	Baseline, g	2.26[b]	2.31[c]
	Final, g	2.36	2.40
	Change, %	+4	+4
Intervention	Baseline, g	2.29	2.34
	Final, g	2.52	2.56
	Change, %	+10	+9

[a]Controlling for work site, gender, and job category.
[b]$P = .03$ for survey × intervention interaction.
[c]$P = .04$ for survey × intervention interaction.

assessed at the work-site level than through individual self-reports. Self-reported exposure may provide a useful indicator of perceived job risk—an important construct for the hypotheses examined here—but it may not be a useful measure of the effectiveness of the intervention. If effective, the intervention might either increase workers' awareness of exposures in their work environment or reduce reported exposures as a consequence of the introduction of environmental controls. Nonetheless, we tested for a differential change in self-reported exposure and found no change in either group (data not shown). Effective measures to assess work site–level changes in the potential for exposure as well as measures of individual workers' perceptions of exposure potential are needed to track change in future studies.

Cohort analyses provide several advantages over cross-sectional surveys, including assessment of change at the individual level among subjects who are exposed for the full duration of the intervention period. In-migration patterns may dilute the effect observed in the cross-sectional data because the employees who were hired by the work site after initiation of the study may have experienced little or no exposure to the intervention. Data collected from repeated cross-sectional surveys also are subject to greater sampling variability than the estimates of behavioral change obtained from following cohorts of individuals.[52,53] In this study, statistical power may have been reduced owing to the smaller sample size in the cohort. Therefore, despite the potential increased precision in the cohort design, the smaller sample size was a barrier to detecting statistically significant reductions in smoking, as found in the cross-sectional analyses.[35]

This study had numerous strengths. A common intervention protocol was followed across the 12 intervention work sites. Analyses focused on changes observed in a cohort of workers present for the full 2-year intervention period. However, the interpretations of these results also must take into account the study's limitations. Although work sites were randomized to the intervention or control condition, work sites agreeing to participate were not randomly selected for this study. These work sites were selected on the basis of specified eligibility criteria, including the use of known or suspected occupational carcinogens, and on their willingness to participate. Thus, the results can be generalized only to similar work sites that may have high readiness to provide programs promoting worker health. Members of this cohort of workers differed significantly on several important variables from respondents to the baseline survey only. Of particular concern for these analyses was the fact that those in the cohort included a differentially low proportion of smokers and office workers. Our ability to assess the actual impact of the intervention on smoking cessation may have been hampered by these differences. As with other large trials, this study had no feasible alternative but to rely on self-reports for estimates of the intervention effect on behaviors. Although contexts may differ from that of this trial, the methods used here have been validated in prior studies.[54–60]

Despite these limitations, this study represents the first randomized controlled work-site intervention study to assess the effectiveness of an integrated health promotion–health protection intervention. Although the size of the observed effects is modest, the populationwide impact of these effects must be considered.[61–64] For example, recent data indicate that educational interventions to reduce serum cholesterol are reasonably cost effective if serum cholesterol is reduced by only 2% or more.[65] In this study, the levels of behavioral risk factor change among blue-collar workers ranged from 2% for fat consumption to 7% for fiber consumption. Were such changes to persist on a populationwide basis, they would be likely to have a meaningful effect in terms of cancer-related outcomes as well as for coronary heart disease and other diseases.[66]

Increasingly, others have noted that the conceptualization of health promotion must be broadened from its current focus on individual behavior to consideration of the impact of environmental influences and the social contexts of people's lives.[50,67,68] A participatory work-site program aimed at both health promotion and health protection moves beyond an exclusive focus on individual health behavior change to address the complexities and politics of worker health as a concern for both employers and workers alike. The data presented here provide preliminary evidence from a randomized, controlled trial that such a program may be effective in producing meaningful population changes in behavioral risk factors, particularly among blue-collar workers. □

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