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Lower Levels of Cigarette Consumption Found in Smoke-Free Workplaces in California

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Objective: We examined the relationship between workplace smoking policies and smoking prevalence and cigarette consumption.

Methods: California residents were questioned by telephone with the 1990 California Tobacco Survey. All respondents (11 704) above age 18 years who were employed indoors were used. Respondents were asked about smoking status, workplace smoking policy, desire to quit, and smoking history. Logistic regression was used to determine the relationship of workplace smoking policy to smoking status, accounting for demographic variables.

Results: Prevalence of regular smokers was significantly lower in smoke-free workplaces than in those with no restrictions (13.7% vs 20.6%, $P < .001$). Continuing regular smokers in smoke-free workplaces smoked fewer cigarettes than those in workplaces with no restrictions (296 vs 341 packs per year, $P < .001$). More comprehensive smok-

ing policies were associated with smokers more likely to contemplate quitting ($P = .014$).

Conclusions: Employees in smoke-free workplaces have a lower smoking prevalence and, among continuing smokers, lower cigarette consumption than individuals working where smoking is permitted. We estimate cigarette consumption among employees indoors is 21% below that if there were no smoking restrictions in California workplaces. Furthermore, if all California workplaces were smoke-free, cigarette consumption among employees would be 41% below that if there were no workplace smoking restrictions, approximately a \$406 million annual loss in sales to the tobacco industry. This study supports the hypothesis that smoke-free workplace policies are an effective public health measure for decreasing smoking prevalence and cigarette consumption among continuing smokers.

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THE ACCUMULATING evidence that environmental tobacco smoke (ETS) injures nonsmokers has led to a growing number of policies in the workplace that eliminate or restrict smoking.¹ Studies have linked ETS to lung cancer and other respiratory illnesses^{2,3} and heart disease^{4,6} in nonsmokers. The Environmental Protection Agency (EPA) has classified ETS as a Group A (proven human) carcinogen.⁷

Most exposure to ETS for nonsmokers occurs in the workplace.⁸ Thus, policies controlling smoking in the workplace can be an effective method for decreasing nonsmokers' exposure to ETS.⁹⁻¹⁴ These policies are becoming increasingly more accepted,^{9,10,15,16} making their implementation easier. While the purpose of restricting smoking in the workplace is to protect work-

ers from the toxins in ETS, studies of individual work sites have shown that such policies also result in less smoking, a health benefit to smokers. Most studies show that policies limiting or ending smoking in workplaces reduce the total number of cigarettes smoked by continuing smokers.^{10,12,14,16-19} Two other studies did not find a decrease in total cigarette consumption but did find a decrease in the percentage of smokers who smoked at work⁹ and a decrease in the number of cigarettes smoked at work.¹² It is less clear whether policies

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See Methods on next page

METHODS

DATA

Subjects were interviewed about their smoking behavior through a detailed telephone survey conducted in California between July 1990 and February 1991 as part of the 1990 California Tobacco Survey. A stratified random-digit dialing technique²² was used to survey the head of the household in 32 125 homes in either English or Spanish. In this initial screening interview, the number of household members and the smoking status of each member 10 years of age or older were determined. The response rate for the screening interview was 75.1%. Every household member who had smoked in the last 5 years and 28% of all other adults (18 years or older) were scheduled for an in-depth interview. The lower probability of selection of nonsmokers was undertaken to increase the efficiency of the survey in describing smoking behavior. The response rate was 75.3% for the in-depth interview. A total of 24 296 adults were interviewed.

Of the 24 296 respondents, only the responses of the 11 704 who worked outside the home and primarily indoors were analyzed. The data were weighted to take into account the design effect on the probability of selection (eg, households with multiple phones had a greater chance of selection). Poststratification weighting was then used to adjust the sample to be representative of the 1990 California population, based on the 1990 census, by age, sex, county/region, education, and race/ethnicity.

SURVEY

The standard questions for the United States were used to assess the smoking status of the respondents.^{1,23} The survey began by asking respondents, "Have you ever smoked at least 100 cigarettes in your lifetime?" "Do you smoke cigarettes now?" and "Do you now smoke cigarettes every day or some days?" Respondents were classified into the following four smoking status categories using the answers to the previous questions: (1) regular smoker (someone who was smoking at the time of the survey and 25 or more days per month); (2) occasional smoker (someone who was smoking at the time of the survey but less than 25 days per month); (3) former smoker (someone who had smoked more than

100 cigarettes in his or her lifetime but was not smoking at the time of the survey); and (4) nonsmoker (someone who had not smoked more than 100 cigarettes in his or her lifetime and was not a smoker at the time of the survey).

The number of packs of cigarettes smoked per year was calculated for the regular and occasional smokers. Regular smokers were asked, "How many cigarettes on average do you smoke per day?" To obtain the number of packs per year, we multiplied the answer (cigarettes per day) by 18.25 (365 days per year divided by 20 cigarettes per pack). Regular smokers were also asked what brand they smoked so that the number of packs of cigarettes smoked per year by brand could be calculated. Occasional smokers were asked, "On how many of the past 30 days did you smoke cigarettes?" and "During the past 30 days, on the days that you did smoke, about how many cigarettes did you smoke per day?" The two numbers from these questions were multiplied to determine the number of cigarettes smoked per month, multiplied by 0.6 (12 months divided by 20 cigarettes per pack) to obtain number of packs smoked per year.

Smoking policies in the workplace were assessed later in the survey using three questions. First, the respondents were asked, "Does your employer have an official policy that restricts smoking in any way?" If the respondent answered "yes," then she or he was asked the following two questions: (1) "Which of the following best describes your employer's smoking policy for indoor public or common areas, such as lobbies, rest rooms, and lunch rooms?" and (2) "Which of the following best describes your employer's smoking policy for areas in which employees work?" The respondents could answer (a) "not allowed in any areas," (b) "allowed in some areas," or (c) "allowed in all areas." The workplace smoking policies were then classified into one of four categories: (1) smoke-free workplace (no smoking in public or common areas or in work areas); (2) work area restrictions (smoking not allowed in the work area but allowed in some or all of the public or common areas); (3) lesser restrictions (smoking allowed in some of the work area); or (4) no restrictions. A respondent's workplace was classified as "no restrictions" if she or he answered "no" to the first question (whether there was a policy) or if she or he answered "yes" to the first question and (c) "allowed in all areas" to the second two questions (level of restrictions).

Smokers were also asked about their willingness to quit and when they thought they might attempt a quit. Accord-

restricting smoking in the workplace lead to a decrease in smoking prevalence. Several investigators found a decrease in the prevalence of smoking and an increase in smoking cessation^{13,14,16} after implementation of policies restricting or ending smoking in the workplace. Some studies found no change in the prevalence of smoking before and after the institution of policies limiting smoking.^{9,10,17-19} Often, it is difficult to measure an effect because baseline data are taken too close to the date of policy implementation, there

is an inadequate follow-up period after the implementation of the policy, or limited smoking restrictions are implemented, which may have a weaker effect.

These public health benefits also translate into savings for the employer. Smoking in the workplace is expensive for the employer because of associated absenteeism, decreased productivity, occupational injuries, industrial accidents, and long-term health costs.^{20,21} Workplace policies that reduce smoking can benefit employees and em-

ing to their answer they were classified into the following three "quit" categories: (1) "preparation," smokers who are contemplating quitting in the next 30 days; (2) "contemplative," smokers who are not thinking about quitting in the next 30 days but who are contemplating quitting within the next 6 months; and (3) "precontemplative," smokers who are not thinking about quitting within the next 6 months.

DATA ANALYSIS

All computations were done with SAS version 6.04. Results are reported for the population-weighted estimates, including the associated SEs. The SEs for the observed rates were calculated using a variation of the jackknife procedure.²⁴ Briefly, we created 33 subsamples from the original sample and computed a weight for each of the 33 subsamples as if it were the total sample (replicate weight). The replicate weights were then used to determine 33 estimates of the variables of interest, which were then used to determine the SEs of the statistics. For example, the percentage of smokers under a smoke-free workplace was computed by weighting the number of regular smokers and the total number of workers under a smoke-free workplace up to the population estimates and then dividing the number of regular smokers by the number of workers under a smoke-free workplace. Next, 33 other estimates of the percentage of regular smokers under a smoke-free workplace were computed by using the 33 replicate weights in place of the population weights. These numbers were then used to calculate the SEs and the 95% confidence estimates, which were used for hypothesis testing.

Spearman rank correlation analysis was used to look for trends in the data, in particular to see if more comprehensive smoking restrictions in the workplace were associated with more smokers in the "preparation" stage of the "quit" categories. The weights of the responses were adjusted so that, after weighting, the number of responses added up to the sample size. Briefly, for each individual the adjusted weight was obtained by dividing that individual's weight by the sum of all the weights and multiplying by the total number of relevant observations. The *P* values from the Spearman rank correlations are reported.

Logistic regression²⁵ was used to determine the likelihood of being a smoker under the different workplace pol-

icies on smoking, taking into account demographic variables. Smoking status (regular or occasional vs nonsmoker) was used as the dependent variable, and work-site policy, age, education, ethnicity, and sex were the independent variables. Stepwise logistic regression was initially used to determine whether any variables did not contribute significantly to predicting smoking status. Ethnicity was divided into Hispanic and non-Hispanic groups, because blacks, Asians, and others were found not to contribute significantly to the variance in smoking status.

The workplace policies were coded using three dummy variables, *W* (work area restrictions), *L* (lesser restrictions), and *N* (no restrictions), as follows: $W=L=N=0$ for a smoke-free workplace; $W=1, L=N=0$ for a workplace with work area restrictions; $W=L=1, N=0$ for a workplace with lesser restrictions; and $W=L=N=1$ for a workplace with no restrictions. With this coding, the coefficients associated with each dummy variable for workplace policy in the logistic regression quantified the incremental effect of each weakening of restrictions on smoking in the workplace. Similar types of dummy variables were used for education, $12Y$ (12 years), $13-15Y$ (13 to 15 years), and $16+Y$ (16 years or more), as follows: $12Y=13-15Y=16+Y=0$ if the respondent had less than 12 years of education; $12Y=1, 13-15Y=16+Y=0$ if the respondent had 12 years of education; $12Y=13-15Y=1, 16+Y=0$ if the respondent had 13 to 15 years of education; and $12Y=13-15Y=16+Y=1$ if the respondent had 16 or more years of education. As with smoking policy variables, the coefficients associated with each dummy variable for education in the logistic regression quantified the incremental effect of increasing number of years of education on smoking. We used this scheme for coding the dummy variables so that the associated coefficients in the logistic regression would quantify the incremental effect of increasingly comprehensive workplace smoking policies or increasing number of years of education. Had we used the more common reference coding (0, 1), the coefficients associated with each term in the logistic regression would have quantified the difference between each type of workplace policy with workplaces with no restrictions (the reference condition) or the difference between each level of education with less than 12 years of education (the reference condition), and we wanted to examine the incremental effects of these variables on tobacco consumption. The logistic regression was weighted in the same way as the Spearman correlation analysis.

ployers, but they represent a significant cost to tobacco companies because they lead to a reduction in sales and lower profits. Previous studies examined the effects of individual smoking policies on the changes in smoking characteristics of individual employees. In this report we examine four different types of workplace smoking policies (smoke-free workplace, work area restrictions, lesser restrictions, and no restrictions) and investigate how the smoking characteristics associated with different smok-

ing policies are generalized to the population level in California. The responses from the 1990 California Tobacco Survey are used to examine the public health benefits, measured by the difference in the number of smokers and the difference in the number of cigarettes smoked per smoker for each of the four types of workplace smoking policies. Other smoking characteristics examined by workplace smoking policy included smokers' views on quitting and the change in smoking status over the last year.

Workplaces with more comprehensive controls on smoking had significantly lower regular smoking rates than workplaces with lesser or no restrictions (**Figure 1**). Only 13.7% of people in smoke-free workplaces were regular smokers compared with 20.6% in workplaces with no restrictions ($P < .001$). Thus, the prevalence of regular smokers in smoke-free workplaces was 33% less than in workplaces with no restrictions. Workplace smoking policies were not significantly associated with lower occasional smoking rates in workplaces that were smoke-free. Regular smokers smoked significantly fewer cigarettes per year in workplaces that were smoke-free vs workplaces with no restrictions (**Figure 2**). Regular smokers employed in smoke-free workplaces consumed 296 packs of cigarettes per year compared with 341 packs per year among regular smokers employed where there were no restrictions ($P < .001$), a 13% difference in per-smoker consumption. Workplace smoking policies were significantly associated with a lower mean number of cigarettes smoked by occasional smokers in workplaces that were smoke-free (Pearson correlation, $P = .0035$). These two outcomes associated with smoking controls in the workplace—decrease in the number of regular smokers and decrease in cigarette consumption among continuing smokers—together were associated with a significant reduction in total cigarette consumption. Both Figures 1 and 2 show a dose-response relationship: the more restrictive the smoking policy, the lower the percentage of smokers and number of packs smoked.

Our data also indicate that the percentage of smokers who were contemplating quitting was greater in workplaces with smoking restrictions than in workplaces with no restrictions. Smokers' attitudes about their willingness to attempt to quit are shown in **Table 1**. A Spearman rank correlation showed a relationship between more comprehensive workplace policies and the likelihood of attempting to quit ($P = .014$). In workplaces with a more comprehensive policy, more smokers were contemplating quitting within 30 days of being asked and fewer smokers were not thinking about quitting at all.

Current and former smokers were asked about their smoking habits 1 year before the survey. Respondents who were occasional smokers 1 year ago were analyzed separately from those who were regular smokers 1 year ago. More comprehensive workplace policies were associated with remaining an occasional smoker rather than progressing to regular smoking (**Table 2**). Of those who had been occasional smokers 1 year ago, 21% had become regular smokers in smoke-free workplaces but 33% had become regular

smokers in workplaces with no restrictions. A Spearman rank correlation of respondents who were occasional smokers 1 year ago showed a relationship between more comprehensive smoking policies and being a former or occasional smoker at the time of the survey ($P = .008$). A separate analysis of respondents who were regular smokers 1 year ago did not show a relationship between workplace policies and a change in smoking status (Table 2).

Comprehensive workplace smoking policies are related to education level, ethnicity, and gender.²⁶ More comprehensive workplace policies are associated with workers who have more education and with non-

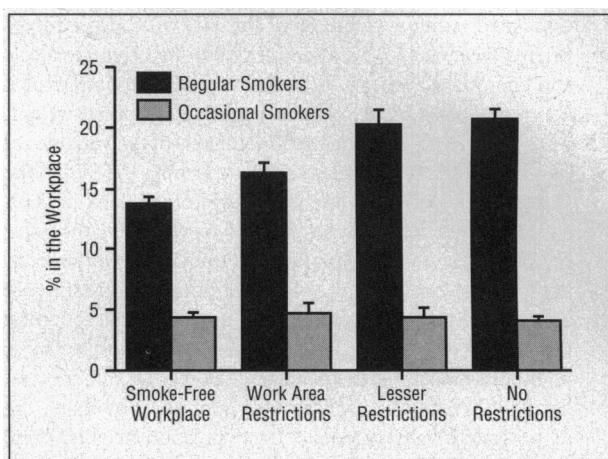


Figure 1. The percentages and SEs for regular and occasional smokers in the workplace by workplace smoking policy. Only 13.7% of people in smoke-free workplaces were regular smokers, compared with 20.6% in workplaces with no restrictions (χ^2 , $P < .001$). Note the presence of a dose-response relationship, with an increasing prevalence of regular smokers as there are fewer restrictions on smoking in the workplace (Mantel-Haenszel extension to χ^2 , $P < .001$). More comprehensive policies were not associated with fewer occasional smokers.

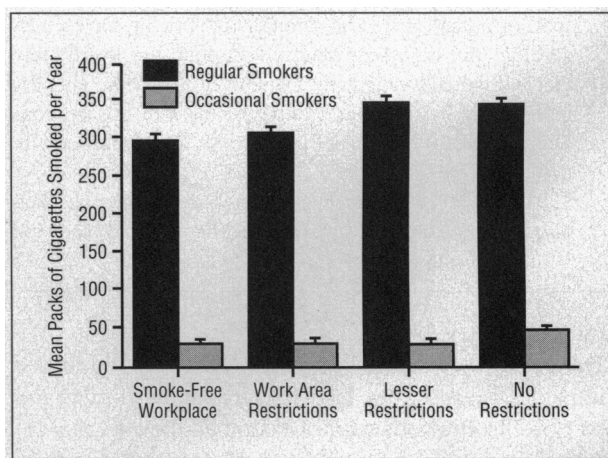


Figure 2. The mean number and SEs of packs of cigarettes smoked per year by regular and occasional smokers under the four types of workplace policies. Regular smokers smoked significantly fewer cigarettes per year in workplaces that were smoke-free vs workplaces with no restrictions (t test, $P < .001$). Workplace smoking policies were also significantly associated with a lower mean number of cigarettes smoked by occasional smokers in workplaces that are smoke-free (Spearman rank correlation, $P = .0035$).

Table 1. Smokers in Each of the Three Types of 'Quit' Categories by Workplace Policy

Quit Category	Workplace Smoking Policy, %*			
	Smoke-Free	Work Area Restrictions	Lesser Restrictions	No Restrictions
Precontemplation	29.7	29.0	32.1	34.0
Contemplation	38.5	39.3	41.3	36.3
Preparation	31.8	31.7	26.6	29.7

*More comprehensive workplace smoking policies were associated with a greater fraction of smokers contemplating quitting smoking (Spearman rank correlation, $P=0.014$).

Hispanic workers. These variables are also related to smoking status (eg, smokers tend to be less educated, Hispanic, and male), so we were concerned that the relationship we found between work-site smoking policy and smoking status might merely be an artifact of this relationship. To control for the effects of these demographic variables in the analysis of the association between work-site smoking policies and smoking, a logistic regression was performed that included these demographic variables and the type of smoking policy to predict smoking behavior. **Table 3** shows the odds ratios from the logistic regression of the influence of workplace policies on smoking status after controlling for other demographic variables. The type of workplace smoking policy was still significantly associated with being a smoker after adjusting for demographic variables. Workers in workplaces with only work area restrictions were 1.15 times more likely to be smokers than those who worked in a smoke-free workplace ($P<.05$). Workers under lesser restrictions or no restrictions were about 1.3 times more likely to be smokers than those in a smoke-free workplace ($P<.05$). Lesser restrictions in the workplace were not incrementally more significant than work area restrictions, but the confidence intervals for the incremental odds ratios for lesser restrictions indicate that more comprehensive policies were associated with workers who were nonsmokers. No significant difference was found between the odds ratio for lesser restrictions and that for no restrictions. The cumulative odds ratios indicate that people under lesser restrictions and no restrictions were approximately 30% more likely to be smokers than were those working in smoke-free workplaces, even after accounting for demographic confounding variables.

The presence of smoking restrictions is associated with lower total cigarette consumption for two reasons: (1) The percentage of smokers is lower in smoke-free workplaces. (2) Continuing smokers smoke fewer cigarettes in smoke-free workplaces. These two outcomes are associated with a substantial reduction in cigarette consumption. The total number of packs of cigarettes

Table 2. Current Smoking Status of Respondents Who Were Regular Smokers and Occasional Smokers 1 Year Previously by Workplace Smoking Policy*

Smoking Status 1 Year Ago	Current Smoking Status	Workplace Smoking Policy, %			
		Smoke-Free Workplace	Work Area Restrictions	Lesser Restrictions	No Restrictions
Occasional	Regular	21	28	40	33
	Occasional	65	45	48	52
	Former	14	24	12	15
Regular	Regular	85	81	85	85
	Occasional	3	5	3	2
	Former	11	14	11	12

*A Spearman rank correlation of respondents who were occasional smokers 1 year previously showed a relationship between more comprehensive smoking policies and being a former or occasional smoker at the time of the survey ($P=.008$). A separate analysis of respondents who were regular smokers 1 year previously did not show a relationship between workplace policies and a change in smoking status.

Table 3. Odds Ratio From the Logistic Regression, Predicting the Odds of Being a Smoker From Workplace Smoking Policy, Controlling for Demographic Variables

Variable	Cumulative Odds Ratio	Incremental Odds Ratio (95% Confidence Interval)
Type of smoking policy		
Smoke-free	1.00	1.0
Work area restrictions	1.15	1.15 (1.01-1.52)
Lesser restrictions	1.36	1.18 (0.93-1.49)
No restrictions	1.26	0.94 (0.76-1.15)
Age, y		
18-24	1.0	1.0
≥25	1.35	1.35 (1.09-1.66)
Education, y		
<12	1.0	1.0
12	0.63	0.63 (0.50-0.79)
13-15	0.47	0.74 (0.63-0.87)
≥16	0.23	0.48 (0.42-0.56)
Ethnicity		
Non-Hispanic	1.0	1.0
Hispanic	1.82	1.82 (1.41-2.36)
Sex		
M	1.0	1.0
F	0.82	0.82 (0.74-0.92)

smoked per year in California by people employed indoors was computed for two different scenarios: (1) smoke-free workplace for all workplaces and (2) no restrictions for all workplaces, and these projections were compared with current consumption. In this calculation, we assumed that there was no self-selection of nonsmokers to work at smoke-free work sites beyond that associated with the demographic factors discussed above and that the reduced level of consumption by smokers at smoke-free work sites was related entirely

to restrictions on their ability to smoke at work. We repeated this calculation, allocating to all indoor workers (1) the consumption levels associated with smoke-free workplaces and (2) the consumption levels associated with workplaces with no restrictions on smoking. For example, 20.6% of 2 855 480 people working under no restrictions are regular smokers, and 13.7% of 3 507 309 people under a smoke-free workplace are regular smokers. These individuals smoke a mean of 341 and 296 packs of cigarettes per year, respectively. Under the current situation, regular smokers under no restrictions smoke a total of 201 million packs of cigarettes per year ($0.206 \times 2\,855\,480 \times 341 = 201$ million). If regular smokers under no restrictions were to be in a smoke-free workplace, we assume that only 13.7% of the workers would be regular smokers (6.9% less) and that they would smoke a mean of 296 packs of cigarettes per year, which would come to a total of 116 million packs of cigarettes per year ($0.137 \times 2\,855\,480 \times 296 = 116$ million). These results together with the numbers calculated for occasional smokers are shown in **Figure 3**.

If there were no restrictions on smoking at these indoor work sites and if the smoking experience of all indoor workers matched that of workers in our survey who experienced no smoking restrictions, we estimate that cigarette consumption for California among people employed indoors would have been 705 million packs of cigarettes in 1990 (Figure 3) and the amount spent on cigarettes in California would have been \$963 million (**Table 4**) compared with \$760 million in estimated actual sales, a 26% difference. Alternatively, if all work sites were smoke-free and the smoking experience

of indoor workers matched that reported in our survey for people who worked in a smoke-free workplace, cigarette consumption would have been 411 million packs of cigarettes in 1990 and the amount spent on cigarettes in California would have been \$557 million. The estimated effect of implementing smoke-free workplaces across society (compared with having no restrictions) would be to reduce the consumption of cigarettes by people employed indoors by 41% and to reduce the amount of money spent on cigarettes by \$406 million below the level expected if there were no restrictions on smoking in the workplace (Table 4). Taking into account the systematic underreporting discussed above, these numbers could be one third larger.

Thus, we estimate that the 1990 level of restrictions in California designed to protect nonsmokers in the workplace from ETS could have already had the side effect of reducing total cigarette consumption by people employed indoors in California by 148 million packs of cigarettes, to 21% below what it would have been without any restrictions. If all workplaces in California were totally smoke-free, we estimate consumption would drop another 146 million packs of cigarettes, to 41% below what it would have been without any restrictions. This result is consistent with the drop in total cigarette consumption observed in the data reported by Stillman et al¹⁴ in their longitudinal study of what happened when a smoke-free workplace was instituted at The Johns Hopkins Medical Institutions, Baltimore, Md.

From our survey we estimate that there were 4.68 million adult smokers in California in 1990 and that 45.6% of these worked at indoor work sites outside the home. We also estimate that there were a total of 1.41 billion packs of cigarettes sold in California in 1990. The average price per pack, excluding all state and federal taxes, in California from July 1, 1990, through June 30, 1991, was 135.8 cents.²⁷ Thus, we estimate that \$1.91 billion was spent on cigarettes in California in 1990. This estimate is about 68% of the sales figures reported by tobacco companies, which is consistent with previously published data suggesting that survey data consistently and systematically underestimate consumption by about one third.²⁸ Thus, our computations probably significantly underestimate the effects of workplace smoking restrictions on total cigarette consumption and tobacco industry sales.

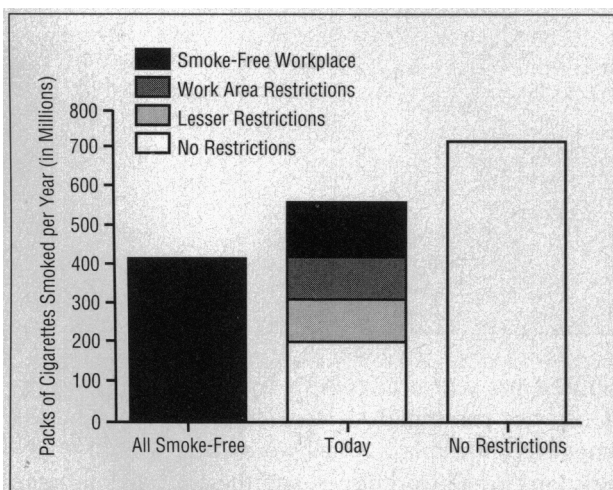


Figure 3. Packs of cigarettes smoked per year by people employed indoors in California if all workplaces in California were smoke-free or had no restrictions, compared with today. If there were no restrictions on smoking in workplaces in California, we estimate 21% fewer cigarettes were consumed by people working indoors than if there were no restrictions. If all workplaces were smoke-free, we estimate a 41% drop in cigarette consumption compared with a scenario in which no indoor workplace smoking restrictions existed.

COMMENT

Our results show that more comprehensive smoking policies in the workplace are associated with a decrease in the percentage of people who are smokers and a decrease in the number of cigarettes smoked per continuing smoker. While it is not possible to determine a causal relationship

Table 4. Packs of Cigarettes per Year Smoked by Californians Working Indoors and Revenue to Tobacco Companies Under the Indoor Workplace Policies in California in 1990 and If All Workplaces Were Smoke-Free or Had No Restrictions

	Market Share, %	Consumption in 1990, Millions of Packs*			Tobacco Company Sales in 1990, Millions of \$†		
		Reported	Estimated Effects		Reported	Estimated Effects	
			All Workplaces Smoke-Free	No Restrictions		All Workplaces Smoke-Free	No Restrictions
Philip Morris	57.8	321	238	408	439	323	557
RJ Reynolds	17.6	98	72	124	134	98	169
American Tobacco	6.8	38	28	48	52	38	65
Brown & Williamson	5.7	32	23	40	43	32	55
Lorillard	4.9	27	20	35	37	27	48
Liggett Group	0.8	4	3	6	6	4	8
Other	6.4	36	26	45	49	35	61
All Companies	100	557	411	705	760	557	963

*These estimates do not account for underreporting of cigarette consumption; actual effects may be one third larger. Numbers may not add up exactly because of rounding.

†Sales prices of individual cigarette brands were not available, so we used the average reported price for all cigarettes. Numbers may not add up exactly because of rounding.

between the policy and smoking status from these data alone, they are consistent with longitudinal studies of individual work sites that observed an increase in cessation following the implementation of smoking restrictions in the workplace^{13,14,16} and a decrease in cigarette consumption.^{10,14,16-19} The dose-response relationships we observed are also consistent with a causal relationship. Thus, there is reason to believe that implementing smoke-free workplaces leads to a decrease in total cigarette consumption.

Workplace restrictions appeared to have had little effect on regular smokers over the last year, with approximately 85% of regular smokers remaining regular smokers under all workplace policies. This result seems counterintuitive given the previous result of a decrease in the percentage of regular smokers with more comprehensive smoking policies. Because most of the smoking policies had been implemented before the survey date of July 1990,^{1,29} we suggest that smokers who were most likely to quit probably did so closer to the date of the implementation of the policy and before the survey. Therefore, the smokers left were those who were less likely to have quit or become occasional or former smokers during the 12 months before the survey was conducted. Thus, it may be that workplace smoking policies in the long term help keep occasional smokers from becoming regular smokers³⁰ but do not affect the prevalence of more addicted smokers. Such restrictions may, however, help regular smokers reduce the total number of cigarettes smoked.

In interpreting these results it is important to remember that we have data from one point in time rather than a longitudinal study at a single work site. Longitudinal studies of individual work sites have in-

dicated that people stop smoking in response to implementation of a new policy ending smoking in the workplace.^{13,14,16} Again, the primary effect on quitting may occur around the time the policy is implemented. Additional changes over time may occur, but our study did not detect them.

More comprehensive workplace smoking policies were not significantly associated with changes in the percentage of occasional smokers in the workplace. The difference in percentage of all smokers is due to a reduction in the percentage of regular smokers; the percentage of occasional smokers remains fairly constant over the four types of workplace policies. However, more comprehensive policies were associated with a decrease in the number of cigarettes smoked by occasional smokers, probably because they smoked less on the job after the policy had been implemented. Also, in smoke-free workplaces, 10% fewer occasional smokers became regular smokers than in workplaces with no restrictions.

Gottlieb et al¹² suggest that 20% of smokers in the workplace is a threshold below which smoking prevalence is less responsive to environmental policies. However, as shown here, a smoking prevalence as low as 13.7% in the workplace is possible now, and the prevalence of smoking is significantly associated with environmental policies, such as workplace smoking restrictions.

There are two potential sources of bias in this study: (1) self-selection bias (eg, nonsmokers find work in smoke-free workplaces) and (2) underreporting of cigarette consumption. It could be argued that the difference in the percentage of smokers by workplace policy is due to other factors that are associated with

working in smoke-free workplaces and with being a nonsmoker. For example, more highly educated workers tend to be nonsmokers and to work in smoke-free workplaces and they choose to work in a smoke-free environment. However, even when demographic variables are taken into account, fewer or no restrictions on smoking in the workplace were still associated with a 30% increase in the odds of being a smoker compared with working in a smoke-free workplace. Longitudinal studies are needed to corroborate these findings. As discussed above, such longitudinal studies have already been conducted at individual work sites. The California Tobacco Surveys offer the opportunity to study the impact of such policies in population-based longitudinal surveys. As discussed above, underreporting of cigarette consumption may be as large as one third, which indicates that our estimates of the changes in actual cigarette consumption are conservative.

Our data, in combination with those of other longitudinal studies of individual work sites, suggest that smoke-free workplaces are the most effective workplace smoking policies for reducing the percentage of smokers and the number of cigarettes smoked. Work area restrictions probably also affect smoking (Figure 1 and Table 3). Lesser restrictions were not significantly different than no restrictions, indicating that having any policies less comprehensive than a smoke-free work area are not effective for reducing total cigarette consumption. The correlation analysis showed a dose-response relationship of more comprehensive restrictions associated with fewer smokers, fewer cigarettes smoked, and more people contemplating quitting. Thus, assuming that there is a causal relationship between workplace smoking policies and reductions in cigarette consumption, the relationship indicates that the most effective policy for reducing smoking is a smoke-free workplace.

If workplaces in California were smoke-free, we estimate that 146 million fewer packs of cigarettes per year would be smoked than under current conditions. Such change would provide important health benefits for workers and would represent a significant step toward the public health goal of a smoke-free society. We estimate that the existing workplace smoking policies in California cost the tobacco companies \$201 million per year in lost sales compared with sales if there were no smoking restrictions in workplaces in California. Given that 57.8% of smokers smoke Philip Morris brand cigarettes in the workplace (41.1% are Marlboros), this represents a \$118 million annual loss to Philip Morris alone (Table 4). If all of the workplaces in California were smoke-free, the tobacco companies would lose an additional \$203 million in annual sales, bringing the total loss to \$406 million annually compared with what would be expected if there were

no restrictions on smoking in the workplace. Given the underreporting of tobacco consumption discussed above, these losses could be one third larger. The decrease in revenues could explain why the cigarette companies are dramatically increasing spending in California state politics^{31,32} and elsewhere to slow the enactment of smoke-free workplace legislation.

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