Nicotine & Tobacco Research

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Online Publication Date: 01 December 2002

To cite this Article: Gilpin, Elizabeth A. and Pierce, John P. (2002) 'The California Tobacco Control Program and potential harm reduction through reduced cigarette consumption in continuing smokers', Nicotine & Tobacco Research, 4:4, 157 - 166

To link to this article: DOI: 10.1080/1462220021000032708
URL: http://dx.doi.org/10.1080/1462220021000032708

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The California Tobacco Control Program and potential harm reduction through reduced cigarette consumption in continuing smokers

Elizabeth A. Gilpin, John P. Pierce

[Received 10 December 2001; accepted 3 April 2002]

Harm reduction for continuing smokers has been suggested as a public health priority. We evaluated whether tobacco control programs might reduce cigarette consumption among current smokers through strategies aimed primarily at protecting nonsmokers from secondhand smoke (SHS). Data were from adult (18+ years) respondents to multiple (1990, 1992, 1996, 1999), large, cross-sectional, population-based surveys of smoking behavior, conducted to evaluate the California Tobacco Control Program. Adult daily smoking prevalence decreased from 15.9 ±0.4% (±95% confidence interval) of the California adult population in 1990 to 13.0 ±0.3% in 1999. Concurrently, moderate-to-heavy daily smoking (≥15 cigarettes/day) decreased from 10.3 ±0.4% in 1990 to 7.4 ±0.3% in 1999, and heavy daily smoking (≥25 cigarettes/day) from 3.4 ± 0.2% in 1990 to 1.9 ± 0.1% in 1999. Decreased daily smoking was observed in all demographic subgroups except young adults. Among college graduates, the daily smoking prevalence in 1999 was 6.4 ± 0.4%, a level previously observed only among U.S. physicians. In 1999, nearly 30% of current smokers did not smoke daily, and more than 60% said they now smoked less than previously. In 1999, self-reported cigarette consumption was inversely related to believing SHS is harmful to nonsmokers, having a smoke-free workplace, and living in a smoke-free home. In California, tobacco control strategies that educated the population about SHS and resulted in smoking restrictions may have led continuing smokers to smoke less, which should reduce the harm from smoking to the public health in the long term.

Introduction

Tobacco control programs aim to reduce the health consequences of smoking in the general population by encouraging quitting among smokers, reducing initiation among never smokers (mainly adolescents), and protecting nonsmokers from secondhand smoke (SHS) (U.S. Department of Health and Human Services [USDHHS], 1991). The current strategies employed by such programs may also reduce harm in continuing smokers by influencing them to limit their cigarette consumption.

The concept of harm reduction is to limit current smokers’ exposure to the known injurious components of tobacco smoke, such as tar or carbon monoxide. In part, the rationale for harm reduction comes from the considerable evidence that morbidity and mortality from smoking-related diseases are strongly associated with self-reported cigarette consumption (Doll & Peto, 1976, 1978; Moolgavker, Dewanji, & Luebeck, 1989; Pontoni, Toninelli, Zhankui, & Bonassi, 1995; Rogot & Murray, 1980; Thun, Day-Lally et al., 1997; Thun, Lally et al., 1997; USDHHS, 1964, 1982, 1983, 1989). One approach to harm reduction would be to engineer cigarettes to deliver fewer varieties and lower levels of toxic components. Another suggested approach is the substitution of nicotine replacement products for cigarettes (Stratton, Shetty, Wallace, & Bondurant, 2001; Warner, Slade, & Sweeney, 1997). However, harm reduction might also be achieved by markedly reducing smokers’ cigarette
consumption through public health tobacco control approaches.

A comprehensive statewide tobacco control program has existed in California since 1990. Since the program began, cigarette prices have increased, new legislation has placed widespread restrictions on smoking in public and in workplaces, and the population appears more aware of the dangers of secondhand smoke and more accepting of smoking restrictions, even to the extent of adopting them in their own homes (Gilpin et al., 2001; Pierce, Gilpin, Emery, Farkas, et al., 1998). These developments could act to encourage smokers to reduce their consumption levels, thereby reducing the harm incurred by smoking.

In this article, we present trends in the prevalence of daily and occasional cigarette smoking and self-reported cigarette consumption from the large, population-based California Tobacco Surveys, conducted over the past decade. In addition, using data from the most recent survey (1999), we explore associations between current smokers’ self-reported cigarette consumption and potential influences from the California Tobacco Control Program.

Methods

The California Tobacco Surveys

The California Tobacco Surveys (CTS), random-digit-dialed population surveys, are conducted periodically to evaluate the California Tobacco Control Program (Gilpin et al., 2001; Pierce, Gilpin, Emery, Farkas, et al., 1998). After establishing that a telephone number is for a household, a household adult (18+ years) provides demographics, including smoking status, on all household members. From this screener information, adults are randomly selected for an extended interview, with current smokers and those who quit in the last five years having the same higher selection probability compared to never or long-term (>5 years) former smokers. This procedure yielded completed interviews with 24,296 adults (response rate 75.3%) in 1990, 7,263 (response rate 71.3%) in 1992, 18,616 (response rate 72.9%) in 1996, and 14,729 (response rate 68.4%) in 1999. Sample size differed because of budgetary and other design constraints.

Each CTS is weighted so that population estimates can be computed. Base weights are constructed that take into account a respondent’s interview probability, and these weights are then ratio-adjusted to account for differential nonresponse using the population totals for various demographic subgroups.

Smoking status

Smokers in all CTS had to answer yes to the question: ‘Have you smoked at least 100 cigarettes in your entire life?’ The 1990 and 1992 CTS adult extended interview asked, ‘Do you smoke cigarettes now?’ Those who answered yes were then asked, ‘Do you now smoke cigarettes every day or some days?’ In 1996 and 1999, respondents were asked, ‘Do you now smoke cigarettes every day, some days, or not at all?’ We define current smokers as those who reported smoking now when asked in 1990 and 1992, or every day or some days in 1996 and 1999. The definition change should not affect daily smoking prevalence, but increases the number of occasional smokers captured. While some people do not admit to smoking ‘now,’ they will admit to smoking some days. Thus, comparisons between the earlier and later surveys must be made with caution.

Self-reported cigarette consumption.

Daily smokers were asked, ‘How many cigarettes do you smoke per day?’ Occasional (some days) 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 usually smoke per day?’ An average daily consumption for occasional smokers was computed by multiplying the answers to the above two questions and dividing the result by 30 days.

1999 smoking behavior.

Data from the 1999 CTS were analyzed in more detail to characterize the present California smokers’ patterns. The 1999 CTS asked occasional smokers, ‘Have you ever smoked daily for 6 months or more?’ Those answering yes were then asked, ‘How long has it been since you smoked on a daily basis?’ In addition, smokers were asked, ‘Have you ever smoked more cigarettes per day than you do now?’

To characterize smokers’ expectations about future smoking, they were asked, ‘What best describes the number of cigarettes you will be smoking in the next 6 months? Would you say the same as you are now smoking, more than you are now smoking, or less than you are now smoking?’ and, ‘What best describes your intentions regarding quitting? Would you say you never expect to quit, may quit in the future but not in the next 6 months, will quit in the next six months, or will quit in the next month?’ Another question asked, ‘How sure are you that you could refrain from smoking for at least one month? Would you say very sure, somewhat sure, somewhat unsure, or very unsure?’

To assess smokers’ views about how smoking was affecting them, they were asked to agree or disagree with the statements ‘I believe I am addicted to cigarettes,’ and ‘My smoking is harming my health.’

Potential influences on cigarette consumption.

Since promoting the dangers of SHS was a major theme of the California Tobacco Control Program media campaign, respondents were asked to agree or disagree with the statements ‘Inhaling smoke from someone else’s cigarette causes lung cancer in a nonsmoker’ and ‘Inhaling smoke from someone else’s cigarette harms the health of babies and children.’ The screener respondent also was queried about smoking restrictions in the home: ‘What are the smoking rules or restrictions in your household, if any? Would you say smoking is completely banned for
everyone, smoking is generally banned for everyone with few exceptions, smoking is allowed in some rooms only, or there are no restrictions on smoking?’ Households where it was reported that smoking is completely banned for everyone were considered smoke-free.

Respondents were also asked, ‘Do you currently work for money in an indoor setting, such as an office, plant, or store, outside your home?’ Those who responded yes were then asked, ‘Is the building design, where you work completely smoke-free indoors?’ With societal norms increasingly disapproving of smoking, family pressure on the smoker to quit might increase. Accordingly, we analyzed agreement with the statement ‘My family would prefer that I didn’t smoke.’

Statistics

All analyses used the survey weights, and all estimates are shown together with 95% confidence intervals. Because of the complex survey design, a jackknife procedure was used for variance estimation and statistical inference (Efron, 1982).

Over the decade, there have been important demographic shifts in the California population. For instance, the Hispanic population has increased considerably, and this group has a high rate of occasional smoking (Evans et al., 1992; Navarro, 1996; Palinkas et al., 1993). To remove the effect of the demographic shifts from the prevalence estimates for each year, a direct standardization procedure was used. The ‘standard adult population’ was the 1999 California population distribution (18+ years) from the January 1999 Current Population Survey (Current Population Survey, 1999). Preliminary analyses indicated that sample size was adequate to standardize only by race/ethnicity (Non-Hispanic White, Hispanic, African American/other, Asian) and education (no college, some college). When computing standardized rates for race/ethnicity or for education, we employed the standardization procedure, using only the other factor. When examining trends over time, we consider non-overlapping 95% confidence intervals to be a conservative indication of statistically significant differences.

To investigate the associations of demographic and other influences on current smokers’ self-reported cigarette consumption in 1999, we used a general linear regression model with daily cigarette consumption as the dependent variable. Included in the model as independent variables were demographic characteristics and the potential influences hypothesized to be related to consumption (see above). Also included were three interactions of interest: (a) Belief in the harmfulness of SHS by having a smoke-free home, since we hypothesized that having these beliefs might help smokers respect a home ban and therefore smoke less; (b) family preference by smoke-free home, since we hypothesized that home bans may be a more emphatic way for a family to express their preference and have more impact jointly on consumption than a preference alone; and (c) working in a smoke-free workplace by having a smoke-free home, since we hypothesized that smokers subject to both bans may smoke even less. We report the coefficients (standard errors) for the dummy variables defining the categories of each main-effect variable. Adjusted least-square mean daily cigarette consumption was computed for the groups defined by an independent variable, holding all other variables at their mean levels.

All analyses, except for the computation of the adjusted least square mean consumption, were carried out with a special statistical program that incorporates the jackknife procedure (Westat, 1996). A SAS macro (SAS Institute, 1990) was written to do the jackknife variance estimates for the least square means.

Figure 1. Trends in standardized prevalence of daily and occasional smoking. The 1992 and 1996 occasional smoking prevalence estimates are not joined because of the change in the questions determining smoking status (see Methods section).
Results

Prevalence trends

Figure 1 shows the standardized population estimates for the prevalence of daily and occasional smoking computed from the 1990, 1992, 1996, and 1999 CTS adult extended interviews. Over the decade, there was a significant decline in the prevalence of daily smoking, from 15.9 ± 0.4% in 1990 to 13.0 ± 0.3% in 1999. Further, the decline from 1996 to 1999 was significant. At the same time, the prevalence of occasional smoking appeared to increase, but the change in the smoking-status questions makes these results difficult to interpret.

Table 1 shows the prevalence of daily smoking in demographic subgroups of the population. All subgroups except the youngest age group (18 to 24 years, which has always had a fairly low prevalence of daily smoking) showed a significant decline from 1990 to 1999.

Trends in self-reported consumption

Table 1 also shows that the percentage of the California population who are moderate-to-heavy daily smokers (smoke ≥ 15 cigarettes/day) or heavy daily smokers (≥ 25 cigarettes/day) has declined significantly. In 1999, 7.4 ± 0.3% of the California population (or 40.6 ± 1.9% of all smokers) were moderate-to-heavy smokers, and only 1.9 ± 0.1% of the population (or 10.6 ± 0.8% of all smokers) were heavy daily smokers. Further, only 4.3 ± 0.5% of all smokers smoked ≥ 40 cigarettes or 2 packs per day.

For descriptive purposes, Table 2 presents the average daily consumption for various groups of current smokers in 1999. The group of moderate-to-heavy daily smokers (≥ 15 cigarettes/day) averaged more than a pack/day, while mean consumption for light daily smokers smokers (< 15 cigarettes/day) was less than half a pack. Occasional smokers were evenly divided according to whether or not they had ever smoked daily for 6 months, and they averaged 2 to 3 cigarettes/day. In the group who smoked on more than 20 days in the past month (16.8 ± 2.7% of all occasional smokers), only 25.5 ± 7.6% exceeded the mean daily consumption level of light daily smokers (8.2 cigarettes/day, Table 2). The age and sex distribution was similar for the light-daily and former-daily occasional smokers, but the moderate-to-heavy daily smokers were older and the never-daily occasional smokers were younger (p < .0001). A higher percentage of the moderate-to-heavy daily smokers and the never-daily occasional smokers were male (p < .0001).

The mean time since former-daily occasional smokers had smoked daily for a period of 6 months or more was 51 ± 44 months (median = 24 months, indicating considerable conversion to occasional smoking in the past 2 years). Further, 62.4 ± 1.6% of all current smokers reported reducing consumption in the past. As expected, former-daily occasional smokers were the most likely to report reducing consumption. Presumably, those that did not report reducing consumption smoke about the same.
number of cigarettes they used to smoke daily on the
days they now smoke.

Expectations about smoking
The lighter the self-reported consumption level, the more
likely the smokers were to report that they intended to
reduce their consumption in the next 6 months or quitaltogether (Table 2). These two variables were related
(jackknifed \( \chi^2 \), \( p < .001 \)): 65.9 ± 2.4% of smokers
planning to reduce consumption also planned to quit, but
only 23.5 ± 1.9% of smokers not planning to reduce
planned to quit. Both groups of occasional smokers were
much more likely to be certain that they could stay off
cigarettes for at least 6 months than were daily smokers
(\( p < .001 \)).

Health beliefs
The vast majority of smokers (about 85%) in each group
reported that they thought cigarettes were harming their
health (nonsignificant). The moderate-to-heavy daily
smokers were the most likely to agree that they were
addicted, with a marked trend to less agreement across
groups (\( p < .001 \)).

Although beliefs that SHS causes cancer in non-
smokers (\( p < .001 \)) or harms the health of babies and
children (\( p < .001 \)) were high in all smokers, they were
inversely related to smoking level. Notably, 85.4 ± 1.8%
of the moderate-to-heavy daily smokers believed that
SHS harms the health of babies and children, and this
belief was nearly unanimous among occasional smokers
who had never smoked daily.

External influences
Smoking pattern was also associated with living in a
smoke-free home (\( p < .001 \)), with a definite trend to
more smoke-free homes with lighter smoking (Table 2).
However, light daily smokers and occasional smok-
ers were about equally likely to be indoor workers
with a smoke-free workplace, and all these groups
were more likely to report smoke-free workplaces than
moderate-to-heavy daily smokers (\( p < .001 \)). Finally,
more daily smokers than occasional smokers reported
that their families preferred that they not smoke
(\( p < .001 \)).

Factors independently related to self-reported cigarette
consumption in 1999
All the demographic factors were significant in the
multiple linear regression analysis, which also included
the factors hypothesized to be related to self-reported
consumption (Table 3). The \( R^2 \) or explained variation
for the model was 23%. The coefficients in Table 3 represent
the differential in consumption compared to the referent
group. Women averaged fewer cigarettes/day than men.
Older smokers averaged more cigarettes/day than
younger smokers, and minorities averaged fewer than
Non-Hispanic Whites. The more educated averaged
fewer cigarettes/day than those who did not graduate
high school, but high school graduates did not show
significantly different consumption compared to smokers who did not graduate.

Belief that SHS is harmful to both nonsmokers and children was significantly related to lower self-reported daily cigarette consumption, as were living in a smoke-free home and working in a smoke-free workplace. Further, the interaction of the two smoke-free settings was significant ($p = .017$). Figure 2 shows that smokers having smoke-free workplaces or living in smoke-free homes smoked fewer cigarettes/day (least square means) than smokers not subject to any restrictions. Family preference that the smoker not smoke was not significantly related to consumption, and neither was its interaction with a smoke-free home. The interaction of beliefs regarding the harmfulness of secondhand smoke and having a smoke-free home was also not significant.

**Discussion**

Today’s California adult smokers smoke considerably less than those earlier in the decade. While overall smoking prevalence in California has not declined much since 1993, per capita cigarette consumption computed from tobacco industry sales data has continued to decline since then (Gilpin et al., 2001; Pierce, Gilpin, Emery, Farkas, et al., 1998; Pierce, Gilpin, Emery, White, et al., 1998). Thus, even though overall adult smoking prevalence is stable, the reduction in daily smoking and the lower consumption levels documented in this report appear to have resulted from the influences of the California Tobacco Control Program. In 1999, smokers who both worked and lived in smoke-free settings showed a very low mean daily consumption level after controlling for other determinants of daily consumption.

From 1974 through 1985, when U.S. smokers could generally smoke when and wherever they wanted, and the prevalence of smoking was gradually declining, the percentage of heavy daily smokers ($\geq 25$ cigarettes/day) was stable at between 25.5% and 29.8% of all current smokers (USDHHS, 1989). Further, the percentage of heavy smokers was constant over time within demo-

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**Table 3. Multivariate Analysis of Self-reported Daily Cigarette Consumption**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Coefficient (SE) $^b$</th>
<th>$p$ value</th>
<th>Least-square mean daily consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>$-2.69$ ($0.31$)</td>
<td>$&lt;.0001$</td>
<td>$11.6$ ($\pm 0.9$)$^c$</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–24</td>
<td>$2.73$ ($0.40$)</td>
<td>$&lt;.0001$</td>
<td>$7.5$ ($\pm 0.9$)</td>
</tr>
<tr>
<td>25–44</td>
<td>$5.95$ ($0.47$)</td>
<td>$&lt;.0001$</td>
<td>$10.2$ ($\pm 0.8$)</td>
</tr>
<tr>
<td>45–64</td>
<td>$2.46$ ($0.81$)</td>
<td>$&lt;.0036$</td>
<td>$9.9$ ($\pm 1.8$)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>$-7.21$ ($0.41$)</td>
<td>$&lt;.0001$</td>
<td>$14.2$ ($\pm 0.8$)</td>
</tr>
<tr>
<td>African-American</td>
<td>$-5.97$ ($0.49$)</td>
<td>$&lt;.0001$</td>
<td>$8.2$ ($\pm 1.2$)</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>$-3.94$ ($0.65$)</td>
<td>$&lt;.0001$</td>
<td>$10.2$ ($\pm 1.2$)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not high school graduate</td>
<td>$-3.83$ ($0.68$)</td>
<td>$&lt;.0001$</td>
<td>$7.8$ ($\pm 1.0$)</td>
</tr>
<tr>
<td>High school graduate</td>
<td>$0.24$ ($0.53$)</td>
<td>$0.6486$</td>
<td>$11.6$ ($\pm 1.3$)</td>
</tr>
<tr>
<td>Some college</td>
<td>$-1.73$ ($0.52$)</td>
<td>$&lt;.0017$</td>
<td>$11.8$ ($\pm 0.9$)</td>
</tr>
<tr>
<td>College graduate</td>
<td>$-3.83$ ($0.68$)</td>
<td>$&lt;.0001$</td>
<td>$9.9$ ($\pm 1.0$)</td>
</tr>
<tr>
<td>Beliefs about SHS harmful to both nonsmokers and children</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>$1.55$ ($0.58$)</td>
<td>$.0103$</td>
<td>$9.5$ ($\pm 1.0$)</td>
</tr>
<tr>
<td>No</td>
<td>$3.30$ ($0.48$)</td>
<td>$&lt;.0001$</td>
<td>$12.6$ ($\pm 0.8$)</td>
</tr>
<tr>
<td>Smoke-free home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>$0.82$ ($0.39$)</td>
<td>$.0404$</td>
<td>$9.4$ ($\pm 0.9$)</td>
</tr>
<tr>
<td>No</td>
<td>$-0.26$ ($1.01$)</td>
<td>$.7955$</td>
<td>$10.2$ ($\pm 0.7$)</td>
</tr>
<tr>
<td>Family preference that smoker not smoke</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>$-0.26$ ($1.01$)</td>
<td>$.7955$</td>
<td>$10.3$ ($\pm 1.3$)</td>
</tr>
</tbody>
</table>

$^a$ Referent group indicated by $\ldots$; SE is standard error, interaction terms not shown.

$^b$ The dependent variable in the regression analysis is self-reported daily cigarette consumption, computed as described in the methods section.

$^c$ Numbers in parentheses are 95% confidence intervals.

Source: CTS 1999
graphic groups defined by age, gender, and race. In 1999, only 10.6% of California smokers were heavy daily smokers, and nearly 30% did not smoke daily. These trends support other evidence that as a group the remaining California smokers are not more heavily addicted (Emery et al., 2000). Apparently, California smokers have been able to adapt their smoking habits to the prevailing social conditions in the state, including fewer opportunities to smoke.

Further, the decline in daily smoking in California was observed in all demographic groups except young adults. Young adults have consistently had lower levels of daily smoking, since many are still completing the smoking uptake process. One group that now shows a particularly low rate of daily smoking is the college educated. Perhaps this finding reflects a diffusion effect (Rogers, 1983), with the trend in the last decade set by U.S. physicians. In the first half of the last century, the higher-educated were the trend leaders in taking up smoking (USDHHS, 1989), and now they appear to be the trend setters in quitting. In the late 1960s, following the publication of the Surgeon General’s report documenting the health risks of smoking (USDHHS, 1964), about 30% of U.S. physicians smoked (Garfinkel & Stellman, 1976), but by the early 1980s only 5 to 10% were smokers (Buechner et al., 1986; Sachs, 1983), and by 1990, in a survey of 5,426 physicians, only 6.3% labeled themselves daily smokers (Hughes et al., 1992). The 1999 CTS indicated that 6.4% ± 0.4% of California college graduates were daily smokers.

In 1999, about 85% of smokers believed that their smoking was harming their health, regardless of self-reported consumption level. Consistent with this belief, about 60% of moderate-to-heavy (≥15 cigarettes/day) daily smokers reported reducing their consumption in the past, and nearly 70% of lighter (<15 cigarettes/day) smokers had done so. There also appears to be interest in continued reduction; even 40% of the moderate-to-heavy daily smokers thought they would be smoking less in the next 6 months than they smoked when interviewed. These intentions to reduce consumption were related to intentions about quitting, suggesting that a considerable proportion of smokers are actively engaged in the process of quitting and may be using reduced consumption as a strategy for eventual cessation. An earlier national survey of adult smokers indicated that about 30% had reduced consumption before making a serious quit attempt (Pierce et al., 1989).

Our results suggest that reducing consumption, perhaps as a prelude to quitting, may be even more prevalent in the tobacco control era. Recent clinical studies indicate that smokers can be helped to reduce and maintain lower consumption levels over time (Colletti, Supnick, & Rizzo, 1982; Fredericksen & Simon, 1978; Glasgow, Klesges, Klesges, Vasey, & Gunnarson, 1985; Glasgow, Morray, & Lichtenstein, 1989; Hughes, 2000; Hurt et al., 2000; Levison, Shapiro, Schwartz, & Tursky, 1971; McGovery & Lando, 1991), even though exposure to toxins such as carbon monoxide may not decrease proportionately, possibly because of compensation (Hughes, 2000; Hurt et al., 2000). Further, some smokers spontaneously quit smoking following a reduction in consumption (Colletti et al., 1982; Glasgow et al., 1989; Levinson et al., 1971), and recent trials indicate that
controlled reduction is a successful strategy for cessation (Cinciripini et al., 1995; Cinciripini, Wetter, & McClure, 1997). Finally, there is evidence that some smokers in the general population (outside the clinical setting) also seem to have success (Farkas, 1998; Hughes, Cummings, & Hyland, 1999). One study showed that over half of smokers who reduced consumption (by ≥5%) maintained their new level over a 4-year period, but that reduction was not associated with eventual cessation (Hughes et al., 1999). The other study showed that smokers who reduced to below 15 cigarettes/day had a higher likelihood of cessation in the next 2 years than those who reduced but remained at ≥15 cigarettes/day (Farkas, 1998).

A number of previous studies indicate that smoking restrictions in the workplace lead workers to reduce consumption and, less frequently, to quit altogether (Chapman et al., 1999; Farrelly, Evans, & Sfekas, 1999; HHS, 1982; 1983). The decline in per capita cigarette consumption in California correlates with a decline in the rate of acute myocardial infarction and stroke (USDHHS, 1982), but at 20 years post-cessation, the risk may still be twice as high as for never smokers (Enstrom & Health, 1999). Studies of lung cancer risk indicate that the relationship between consumption level and mortality is curvilinear, stronger at lower consumption levels and plateauing at higher consumption levels (Doll & Peto, 1978; Moolgavkar et al., 1989). This implies that very heavy smokers who reduce their consumption only a little may not reduce their risk, and that the gradient for harm reduction at lower levels of consumption might be considerably steeper. About 60% of California smokers are now smoking at levels (<15 cigarettes/day) at which reductions in consumption should have a considerable impact on future risk.

There have been only a few investigations of the impact of reduced consumption on lung cancer incidence, perhaps because it was not anticipated that smokers would be able to reduce their consumption as dramatically as they have in California. One case-control study found that smokers who reported decreasing daily consumption by at least 25% sometime in the past had a 20% reduction in lung cancer risk (Benhamou et al., 1991). Another study found that a 50% reduction in consumption was associated with a 16% lower lung cancer risk (Lubin et al., 1984). However, as the literature on SHS indicates, even low levels of exposure are associated with adverse health effects (Otsuka et al., 2001; Stefandis et al., 1998).

The 1999 CTS analyses suggest some important associations of potential tobacco control influences with self-reported daily cigarette consumption. Since the data were cross-sectional, we cannot establish a temporal relationship. Nonetheless, the trends over the past decade support the contention that such influences on smokers are leading them to smoke less. A potential limitation to this study is that smokers may increasingly underreport consumption as social norms against smoking increase. As mentioned previously, however, the cigarette sales data are consistent with the downward trend in self-reported consumption. Even though self-reported cigarette consumption may be subject to recall bias or underreporting, population surveys and cohort studies have captured this information for many years, and it has proved to be highly related to health and mortality outcomes in numerous studies (Doll & Peto, 1976, 1978; Kandel & Chen, 2000; Moolgavkar et al., 1989; Puntoni et al., 1995; Rogot & Muray, 1980; Thun, Day-Lally et al., 1997; Thun, Lally et al., 1997; USDHHS, 1964, 1982, 1983, 1989; Warner et al., 1997).

It is not yet established that cigarettes engineered to be 'less toxic' would be less harmful for the continuing smoker (Stratton et al., 2001). The evidence that previous tobacco industry attempts to make cigarettes less harmful (primarily via filters) have reduced smoking-related mortality is mixed (Flamant, 1989; Tang et al., 1995; Thun et al., 1995; Thun, Day-Lally et al., 1997; Thun, Lally et al., 1997). Furthermore, there is some suggestion that deeper inhalation (a form of compensation) among smokers of filtered cigarettes

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may be responsible for the increase in adenocarcinoma cancer of the lung seen in recent years (Thun, Lally et al., 1997). The introduction of the Eclipse nicotine delivery device by RJ Reynolds and the unsubstantiated health claims surrounding it incited considerable controversy (Stephenson, 2000). A recent study revealed that particles of glass from the Eclipse combustion device could be ingested by smokers (Pauly et al., 1998). Thus, while it may be possible to develop products that should decrease exposure to some of the harmful components of tobacco smoke, they may bring other dangers or smokers may use them in a way that would defeat their potential for harm reduction. Further, if smokers (who otherwise might quit) think they can safely continue to smoke, or if adolescents think that smoking is no longer really harmful and are more likely to initiate smoking, harm to the public health from cigarettes might actually increase. The role of non-tobacco nicotine delivery or replacement products in reducing overall tobacco exposure must be carefully evaluated; their main contribution may occur only following successful application of the most effective tobacco control strategies.

Encouraging smokers to reduce their consumption may be an important, achievable, and measurable avenue to population harm reduction from smoking. Tobacco control programs in other states should follow California’s lead and emphasize strategies that can reduce consumption, including education of the population about the dangers of secondhand smoke, promotion of smoking restrictions in public and work places as well as at home, and encouragement of anti-smoking norms in general. To the extent that such tobacco control policies can keep young smokers (< 25 years) at relatively modest levels of consumption or reduce consumption in middle-aged adults, who still might not quit for decades, it will decrease the cumulative exposure to smoking that the population experiences. This, in turn, should reduce future harm to the public health from smoking.

Acknowledgments and disclosures

Preparation of this article was supported by the Tobacco Related Disease Research Program Grant 9RT-0036 from the University of California. Data for the California Tobacco Surveys were collected under Contracts 89–97872 and 98–15657 from the California Department of Health Services, Tobacco Control Section, Sacramento, CA.

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