

# The Case Against Hardening of the Target

David M. Burns

**INTRODUCTION** One of the most compelling arguments for the hypothesis that past successful smoking control interventions have left behind a group of smokers who have more difficulty quitting and are therefore a hardened target is that of direct logic. Those who have already successfully quit must, as a group, have less difficulty quitting than those who continue to smoke, a group that includes substantial numbers of smokers who have failed in past cessation attempts.

An extension of this logic provides the following argument against hardening: if smokers who have more difficulty quitting are left behind, then the residual population of smokers should show an increasing prevalence of those smokers' characteristics that predict reduced cessation activity or failure to maintain abstinence. For example, if smokers of greater numbers of cigarettes per day (CPD) have more difficulty quitting, then, over time, as smokers of fewer CPD preferentially quit, the residual population of smokers should show an increase in the mean number of cigarettes smoked per day. Because the mean CPD reported in surveys has fallen rather than risen over the last decade (see Chapter 7), this logic would argue that the target is not hardening.

Evidence presented throughout this monograph suggests that neither of these "logical" arguments is compelling. In each case, the single dimension of change in smoking behavior on which the logic is based does not fully account for the other changes over time in both smoking behavior and in the environment in which smoking occurs. Much of this monograph is devoted to a presentation of evidence on trends over time in various measures of smoking behavior that have been associated with difficulty in achieving long-term abstinence. Changes in these measures over time do not provide a convincing demonstration that cessation of about one-half of ever-smokers has produced a residual population of smokers which is increasingly composed of heavier smokers, more-addicted smokers, or smokers with greater comorbidity. Therefore, even in the presence of the compelling logic that the smoking population must be hardening, there is little objective evidence that it is actually occurring.

The following section addresses the paradox of a logical inevitability that the target must be hardening when there is little evidence that the residual population of smokers has actually hardened. The section explains why leaving behind a population of smokers who have more difficulty achieving abstinence on an individual level may not translate into lower rates of successful cessation on a population level.

**EFFECT OF  
INDIVIDUAL FACTORS  
ON HEAVY SMOKERS**

A comprehensive review of the predictors and determinants of cessation is beyond the scope of this section and has been presented elsewhere (U.S. DHHS 1990, 2000, 2001). However, in general terms, the factors influencing cessation can be divided into those that are characteristics of the individual and those that are characteristics of the environment in which the smokers smoke. Individual factors are those most often considered in discussions of whether the target is hardening, but consideration of changes in both individual and environmental factors over time is important for examining whether achieving successful cessation is becoming less likely over time.

Among the individual factors that might influence cessation are the strength of the addiction to nicotine, the extent of comorbidity with other substance dependence disorders or with psychiatric illness, and the personal resources that the smoker brings to the cessation attempt (Fiore et al. 2000). Studies of cessation interventions have demonstrated an inverse relationship between the number of cigarettes smoked per day and the likelihood of cessation success (U.S. DHHS 1990). However, there has been a decline rather than an increase over the last two decades in the fraction of smokers smoking 25 or more cigarettes per day (U.S. DHHS 2001), and the mean number of cigarettes smoked per day as reported by smokers has declined as well (see Chapter 7).

This paradoxical outcome was confirmed in a five-year follow-up of cigarette smokers conducted as part of the Community Intervention Trial for Smoking Cessation (COMMIT) evaluation (Hymowitz et al. 1997; see Chapter 5). In the longitudinal sample of smokers followed for the entire study, the likelihood of quitting over the five-year interval was much lower among heavy smokers and among those who reported smoking within the first 30 minutes after waking. However, cross-sectional surveys performed over the same five-year interval in the same cities where the longitudinal study was conducted showed a decline in mean number of cigarettes smoked per day and no change in the fraction of smokers who reported smoking within the first 30 minutes of waking. The longitudinal data are consistent with observations that higher levels of addiction predict lower rates of cessation (U.S. DHHS 1990), and they present a convincing case that individual characteristics of smoking behavior, particularly those reflecting the degree of addiction, define how hard it is for an individual to achieve long-term abstinence. However, the cross-sectional COMMIT data point to the paradox of heavy and more-addicted smokers having more difficulty achieving abstinence without the population of residual smokers being composed of higher percentages of heavy smokers or smokers who are more addicted.

Defining a group of individuals at one point in time and following them for short periods of time examines smokers' responses to a fixed set of environmental factors. Over a short period of time, factors that influence cessation, such as cost, restrictions on where smoking is allowed, and social norms about smoking, change only modestly. Therefore, the individual characteristics that define how much difficulty a smoker may have in quitting will be more powerful in predicting cessation success. Short-term

evaluations have difficulty examining the possibility that changes in environmental factors that promote cessation may have a greater effect on heavy smokers than on light smokers. Within a fixed set of environmental factors, more-addicted smokers will have more difficulty quitting than less-addicted smokers; but as environmental factors change, it is possible that the impact of these environmental factors on cessation may be more powerful on heavier smokers than on lighter smokers.

The discordance between the longitudinal data and the cross-sectional data in the COMMIT observations cannot be explained by differences in the duration of observation, since the duration is the same for the longitudinal and cross-sectional measures. One potential explanation is the possibility that some of the environmental changes taking place may shift smokers downward in the amount that they smoke, or in their level of addiction, and this shift might be more pronounced for heavy smokers or more-addicted smokers. For example, increased restriction on where smoking is allowed in California is suggested as one reason for the marked decline in the percentage of California smokers over the last decade who report smoking 15 or more cigarettes per day (Brownson et al. 1997; Burns et al. 2000b; Gilpin et al. 2001).

It is also possible that heavy smokers are currently more likely to shift downward over time than light smokers are to shift upward. If this trend occurs, the mean number of cigarettes smoked per day in a population will shift downward unless current populations of heavy smokers are replaced by future generations of smokers with equally high numbers of heavy smokers. If those smokers who initiated smoking in the recent past are less likely to become heavy smokers than previous generations of smokers because of restrictions on where smoking is allowed or other factors, then the mean number of cigarettes smoked per day among all current smokers in cross-sectional surveys can fall.

Some evidence on the stability of smoking behavior over a one-year interval is available from the 1996 California Tobacco Survey (CTS) (Burns et al. 2000a) and is presented in Table 3-1.

The population examined was restricted to those who were daily smokers one year prior to the survey and were 25 years of age or older. Table 3-1 compares the number of cigarettes respondents reported smoking one year prior to the survey to the smoking status and amount smoked at the time of the survey. Among those who reported smoking 5 to 14 or 15 to 24 cigarettes per day one year prior to the survey, 74% reported still smoking the same number of cigarettes per day at the time of the survey. In contrast, only 69% of those who smoked 25 or more cigarettes one year prior to the survey reported smoking the same number of cigarettes per day at the time of the survey. This difference was statistically significant and suggests that the likelihood of heavy smokers reducing the number of cigarettes that they smoked per day over the one-year interval was greater than the likelihood of lighter smokers changing their smoking behavior in any direction, either increasing or decreasing it. The data in Table 3-1 are subject to biases resulting from self-reporting and recall, but they suggest that heavy smokers

may be less stable in their smoking intensity than are lighter smokers, and this differential instability over time could explain the paradoxical result observed between the longitudinal and cross-sectional observations made over the five-year interval of the COMMIT study.

It is possible that smokers who shift downward in the number of cigarettes they smoke per day remain heavily addicted and retain the same difficulty quitting that they had when they were smoking a greater number of cigarettes per day. However, it is also possible that the reduction in the frequency with which they smoke may modify the strength of their addiction in ways that facilitate their ability to quit. If this happens, the shift downward in number of cigarettes smoked per day would be accompanied by a shift upward in their likelihood of quitting. Changes in environmental factors over time may modify the strength of addiction for individual smokers.

The COMMIT data suggest that reducing the number of cigarettes smoked per day may have some impact on the strength of addiction, at least for smoking within the first 30 minutes of waking as a measure of addiction. Smokers who reported smoking within the first 30 minutes of waking had a lower likelihood of quitting, but, over the five-year interval, the fraction of smokers who reported smoking within the first 30 minutes of waking did not increase. This suggests that, as the continuing heavy smokers reduced the number of cigarettes that they smoked, they may also have reduced their likelihood of smoking within the first 30 minutes of waking and possibly reduced their level of addiction.

The discussion above points out that the validity of individual smoking characteristics for predicting cessation success can coexist with a residual population of smokers that is not hardened by containing a higher percentage of smokers with those same characteristics that predict poor cessation outcomes. The logical imperative that supports an argument that the population of residual smokers is hardening is driven by the impact of individual characteristics of smokers on the likelihood of cessation success. Environmental factors that promote cessation may not affect all smokers equally, and those same individual characteristics that make a smoker less likely to quit may make the same smoker more likely to be influenced by environmental factors. To the extent that environmental factors shift the behavior of heavy smokers to that of lighter smoking, the behavioral shifts may improve the likelihood of that smoker successfully quitting.

It is possible that a differential impact of environmental factors on heavy smokers could counter the effect of heavy smoking on the likelihood of cessation success, with the two forces canceling each other out as environmental influences increase over time. The residual smoking population may be composed of individuals who are having more difficulty achieving abstinence, but the impact of environmental factors is also increasing, creating a circumstance in which the hardened smoker has more motivation and support for cessation and therefore does not have a lower likelihood of successful cessation.

Table 3-1

**California Tobacco Survey:****Current Smoking Status Compared to Smoking Status 1 Year Ago for Daily Smokers 1 Year Ago, 25 Years and Older**

Cigarettes Smoked 1 Year Ago	Current Smoker: Cigarettes Smoked per Day										Former Smoker: Quit Duration						Population Size (N)	Sample Size (n)				
	25+		15-24		5-14		1-4		Unknown		Occasional Smoker		<3 Months		3+ Months				Unknown			
	%	± CI	%	± CI	%	± CI	%	± CI	%	± CI	%	± CI	%	± CI	%	± CI	%	± CI	%	± CI		
<b>Overall</b>	18.3	1.1	37.6	1.3	26.0	1.5	2.9	0.5	0.3	0.2	4.6	0.7	4.8	0.7	5.0	0.8	0.4	0.2	2,894,421	6,211		
<b>25+</b>	69.5	2.8	13.2	1.8	3.9	1.1	0.6	0.6	0.0	0.1	1.8	0.6	5.2	1.4	5.5	1.1	0.3	0.3	703,264	1,542		
<b>15-24</b>	2.7	0.7	74.4	1.6	10.1	1.4	0.8	0.5	0.0	0.0	3.2	0.9	4.2	0.8	4.2	0.9	0.4	0.3	1,266,356	2,835		
<b>5-14</b>	0.5	0.4	5.6	1.3	74.1	2.8	1.8	0.7	0.1	0.2	7.0	1.6	5.0	1.3	5.6	1.6	0.4	0.3	779,441	1,560		
<b>1-4</b>	0.5	1.1	1.1	1.0	12.6	8.1	50.7	11.0	0.4	0.7	18.3	8.2	8.3	5.9	6.8	3.5	1.3	1.6	106,769	203		
<b>Unknown</b>	9.5	8.9	26.1	12.3	20.3	9.6	2.6	3.5	20.8	9.7	11.3	8.5	2.7	3.0	6.7	8.3	.	.	38,593	71		

NOTE: CI = 95% confidence interval; "." = insufficient data.

Data source: CTS 1996 (Burns et al. 2000a).

**EFFECT OF ENVIRONMENTAL FACTORS ON HEAVY SMOKERS**

A variety of tobacco control interventions are intended to influence the environment around the smoker in order to promote cessation and abstinence (U.S. DHHS 2000).

Increasing the cost of cigarettes, restricting where smoking is allowed, changing social norms about smoking, and encouraging the provision of physician advice to quit are all components of tobacco control programs intended to influence the environment around the smoker in ways that provide motivation to quit and support abstinence.

One potential explanation for the paradox of heavier smokers finding it more difficult to quit without the residual population of smokers containing an increasing fraction of heavy smokers is that there is a differential effect of these environmental interventions on cessation success among heavy smokers. An example is the price increase experienced by a two-pack-per-day smoker when the cost of cigarettes is raised to twice that of a one-pack-per-day smoker. It is not unreasonable to expect that the impact of that price increase on motivation to change smoking behavior might also be greater in the two-pack-per-day smoker. At a constant price, heavier smokers would have more difficulty quitting than light smokers, but when a price increase is implemented, the change in price may have a more powerful effect on heavy smokers than on light smokers. During periods when the cost of cigarettes is changing rapidly, the differences in successful cessation among smokers of different numbers of cigarettes per day might diminish or even invert for a period of time, with heavy smokers being more likely to quit than light smokers.

Over long periods of time, the relationship between intensity of smoking or level of addiction and difficulty quitting may not be constant. Rapid changes in environmental factors might alter the gradient of successful abstinence across number of cigarettes smoked per day, might eliminate the gradient altogether, or might even invert the gradient for short periods of time. If the relationship of number of cigarettes smoked per day with successful abstinence varies substantially over time, this variation might reduce the impact of CPD-related differences in cessation success on the mean number of cigarettes smoked by the residual smokers.

A similar differential effect can be postulated for restrictions on where smokers are allowed to smoke. Bans on smoking in the workplace are likely to inconvenience heavy smokers and disrupt their pattern of smoking more than for lighter smokers. It is unclear whether the effect of a smokefree workplace on smoking cessation is more powerful on heavier smokers than on lighter smokers, but the possibility of a differential effect is not unreasonable.

Another area of differential impact on heavy smokers may be the likelihood of receiving an intervention to promote cessation. Heavy smokers are more likely than lighter smokers to report having received physician advice to stop smoking in the last 12 months (Hollis 2000), and they are more likely to participate in or utilize cessation assistance as well. The differential provision of proven cessation assistance to heavy smokers may

offer a gain in achieving long-term abstinence that partially offsets their increased difficulty in quitting.

It is also possible that, as the fraction of smokers and particularly heavy smokers decline, the negative social pressures on heavy smokers may increase disproportionately compared with those experienced by lighter smokers. Pressure to quit from family and friends, plus the frequency of requests to put out a cigarette or other negative messages from strangers, may be life experiences that are more intense or more frequent for heavy smokers.

Not all changes in the environment influence heavy smokers more than light smokers, as evidenced by the response to the intervention in the COMMIT study. Light and moderate smokers had increased abstinence rates in response to the intervention, but heavy smokers did not (COMMIT 1995a,b).

Consideration of hardening of the target must, therefore, involve an examination of changes in both the population of individuals smoking and the environment within which smokers smoke. Removal of those individual smokers who can easily quit from the smoking population may well leave behind a group of smokers who require more motivation to make a quit attempt, need more assistance for that attempt to be successful, or find achieving cessation a greater challenge. If the meaning of hardening is simply an abstract concept of the difficulty a smoker has in achieving cessation, then little more than a logical imperative is needed to conclude that the current population of smokers is hardening. However, if hardening is intended to mean that the population of smokers is less likely to achieve cessation, or that existing tobacco control strategies are becoming ineffective, then evidence of these effects actually occurring over time is needed before reaching a conclusion that the population of smokers is hardening.

Careful consideration of the changing environment around the smoker and its potential to differentially affect heavier and more-addicted smokers is needed before the conclusion that the population of smokers must be hardening can be converted into a judgment both that the population of smokers has actually hardened and that we need to adjust our tobacco control approaches to recognize that hardening.

**SUMMARY** Smoking cessation is influenced both by individual characteristics of the smoker and by environmental forces that make smoking more expensive, more difficult, or less rewarding. These external environmental forces may not influence all smokers equally. Heavy smokers and those who are more strongly addicted may be more influenced by these environmental changes than lighter smokers. An increased intensity of environmental motivation to quit may counterbalance a greater personal difficulty in quitting among the residual population of smokers. The probability that it is harder for the residual population of smokers to quit than it was for their former smoking colleagues does not translate into a probability that they are less likely to achieve cessation with existing tobacco control approaches until the level of environmental support for cessation is also considered. If

difficulty in achieving cessation on an individual level results in a reduced likelihood of successful cessation over time, then, over time, we should see an increase in the mean number of cigarettes smoked per day, an increase in measures of addiction (e.g., time to first cigarette), and a fall in rates of successful cessation. The absence of convincing trends in these measures suggests that the population of residual smokers is not “measurably” harder.

## REFERENCES

- Brownson, R. C., Eriksen, M. P., Davis, R. M. et al. Environmental tobacco smoke: Health effects and policies to reduce exposure. *Annual Review of Public Health* 1997;18:163–85.
- Burns, D. M., Anderson, C., Johnson, M. et al. Cessation and cessation measures among adult daily smokers: National and state-specific data. In *Population-Based Smoking Cessation: What Works. Smoking and Tobacco Control Monograph No. 12*, edited by D. Burns, D. Shopland, 25–97. NIH Pub. No. 00-4892. Bethesda, MD: U.S. Department of Health and Human Services, National Cancer Institute, 2000a.
- Burns, D. M., Shanks, T., Major, J. et al. Restrictions on smoking in the workplace. In *Population-Based Smoking Cessation: What Works. Smoking and Tobacco Control Monograph No. 12*, edited by D. Burns, D. Shopland, 99–126. NIH Pub. No. 00-4892. Bethesda, MD: U.S. Department of Health and Human Services, National Cancer Institute, 2000b.
- Community Intervention Trial for Smoking Cessation (COMMIT) Research Group. I. Cohort results from a four-year community intervention. *American Journal of Public Health* 1995a;85:183–92.
- Community Intervention Trial for Smoking Cessation (COMMIT) Research Group. II. Changes in adult smoking prevalence. *American Journal of Public Health* 1995b;85:193–200.
- Fiore, M. C., Bailey, W. C., Cohen, S. J. et al. *Treating Tobacco Use and Dependence. Clinical Practice Guideline*. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research, 2000.
- Gilpin, E. A., Emery, S. L., Farkas, A. J. et al. *The California Tobacco Control Program: A Decade of Progress, 1989–1999*. La Jolla, CA: University of California at San Diego, 2001.
- Hollis, J. F. Population impact of clinician efforts to reduce tobacco use. In *Population-Based Smoking Cessation: What Works. Smoking and Tobacco Control Monograph No. 12*, edited by D. Burns, D. Shopland, 129–53. NIH Pub. No. 00-4892. Bethesda, MD: U.S. Department of Health and Human Services, National Cancer Institute, 2000.
- Hymowitz, N., Cummings, K. M., Hyland, A. et al. Predictors of smoking cessation in a cohort of adult smokers followed for five years. *Tobacco Control* 1997;6(Suppl 2):S57–S62.
- U.S. Department of Health and Human Services. *The Health Benefits of Smoking Cessation*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 1990.
- U.S. Department of Health and Human Services. *Reducing Tobacco Use: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2000.
- U.S. Department of Health and Human Services. *Women and Smoking: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2001.