Hardening and the hard-core smoker: concepts, evidence, and implications

Kenneth E. Warner \( ^a \); David M. Burns \( ^b \)

\( ^a \) School of Public Health, University of Michigan, Ann Arbor, Michigan

\( ^b \) School of Medicine, University of California at San Diego, La Jolla, California, USA

Online Publication Date: 01 January 2003


To link to this article: DOI: 10.1080/1462220021000060428

URL: http://dx.doi.org/10.1080/1462220021000060428
Hardening and the hard-core smoker: concepts, evidence, and implications

Kenneth E. Warner, David M. Burns

[Received 20 November 2001; accepted 23 April 2002]

A nascent debate pits researchers who believe that hard-core smokers are coming to dominate the remaining population of smokers against others who perceive the hardening of the target as a far more distant concern. At stake is the future emphasis of tobacco control: should we alter the current allocation of resources between treatment of individual smokers and modification of the psychosocial environment through public education and policy measures? We review the evidence and conclude that: (1) hardening is probably occurring in the sense that, compared with earlier generations, many of today’s smokers possibly do have greater difficulty quitting, or are inherently less willing to do so. (2) Hardening may be most usefully construed in the context of specific groups of smokers, such as the mentally ill, who may constitute a growing fraction of the remaining smoking population. (3) Using conventional measures, however, we find little evidence that the population of smokers as a whole is hardening. Cessation rates have not decreased. (4) Truly hard-core smokers necessarily constitute a very small fraction of the population. Quitting-susceptible smokers continue to dominate the smoking population. (5) Hardening and the potential existence of true hard-core smokers recommend creative thinking about, and devotion of resources to, finding new ways to help the most dependent smokers to quit. (6) Sound research recommends the expansion of comprehensive tobacco-control programs in both the public and private sectors, and does not support reallocation of resources from such programs toward more intensive individualized treatment. We can afford both.

Introduction

A nascent debate pits researchers who believe that hard-core smokers are coming to dominate the remaining population of smokers against others who perceive the hardening of the target (remaining smokers targeted for cessation) as a far more distant concern (National Cancer Institute, in press). In part a matter of semantics — What constitutes a hard-core smoker? How does the notion of hardening relate to the definition of hard-core smoker? — the debate poses more than just an intellectual quandary. At stake is the future emphasis of tobacco control: should we alter the current allocation of resources between treatment of individual smokers and modification of the psychosocial environment through public education and policy measures? The resolution of this issue is extraordinarily complex, itself requiring answers to two questions: first, do remaining smokers have a harder time quitting than did earlier generations of smokers? Second, do the interventions we are currently using fail to reach or influence hardened smokers? If the answer to the first question is in the affirmative, the second question becomes the critical one for purposes of contemplating tobacco-control resource allocation.

We examine whether hardening is occurring in the US, whether the US is rapidly approaching an irreducible hard core of remaining smokers, and what our conclusions mean for tobacco-control resource allocation. We begin by examining the concepts. We then describe the evidence supporting the idea that hardening is occurring, evidence opposing it, and other evidence indicating that the size of the ultimate pool of true hard-core smokers is necessarily very limited. Next, we contemplate why so many smokers destined to quit in the future have not done so yet, despite four decades of publicity on
the dangers of smoking and despite a social environment increasingly hostile to smoking. We conclude with a few general observations on the implications of this assessment for tobacco-control strategy and its associated resource allocation. Although the analysis considers the situation in the US only, we believe it has implications for other countries as well.

**Concepts of hardening and hard-core smokers**

In common usage, *hard-core smokers* generally refers to the number (or proportion) of smokers, at a single point in time, completely unwilling or unable to quit and likely to remain so (Emery, Gilpin, Ake, Farkas, & Pierce, 2000). In contrast, the concept of *hardening* assesses whether or not the smoking population as a whole is becoming more resistant to quitting over time, due to unwillingness or inability to quit, or both. Note that the population of smokers could be hardening without the existence of any hard-core smokers. *Hardening* simply means that the average ability or desire of smokers to quit is falling. Similarly, one could identify a sizable group of hard-core smokers but not find the target hardening.

In practice, many proponents of the hardening hypothesis link the two concepts: Smokers are becoming more resistant to cessation in part because a growing proportion of smokers is truly hard core. Illustrative is Hughes’ (in press) implicit characterization of hard-core smokers as those ‘left behind’, given that smokers who found it comparatively easy to quit have already done so. Such smokers persist in the face of four decades of health warnings, increasing restrictions on smoking in public places, and the growing stigmatization of smoking.

We derive conceptual definitions of hardening and hard-core smokers from two possible explanations for continued smoking. We admit that we find it difficult, though, to define these populations clearly and comprehensively in a way that would permit quantitative empirical assessments of their magnitude. The first explanation for continued smoking is substantial physical dependence on nicotine and/or psychological and behavioral dependence on smoking. Such smokers might be characterized by multiple failed attempts to quit, with characteristics of their smoking behavior consistent with high levels of addiction. The second is a lack of interest or unwillingness to quit. The absence of cessation attempts and self-reported absence of any interest in quitting would characterize this group of smokers. Some, but not all, also would be highly dependent. Each of these groups could account for a significant portion of the remaining population of smokers. If, indeed, smokers fairly characterized by these conditions account for a growing proportion of the smoking population, and if this translates into a truly, and importantly, greater collective difficulty in achieving and maintaining abstinence, as measured by lower rates of cessation, then it seems reasonable to characterize the smoking population as hardening.

By themselves, however, these conditions do not define a set of smokers who will never quit. Uncounted former smokers who were characterized by each of these conditions have quit, some with ease. Besides, each condition is subject to change. Both can be altered by the circumstances in which smokers find themselves — the inability to smoke at work, for example. Thus, although this definition does not lend itself to easy measurement, we define the hard-core smoker as a daily, long-term smoker who is unable or unwilling to quit and who is likely to remain so even when possessing extensive knowledge about the hazards of smoking and when confronting substantial social disapproval of smoking. By this definition, for example, older physicians who still smoke are clearly hard-core smokers.

Emery and colleagues (2000) have produced an empirical measure that comes close to this conceptual definition. They define hard-core smokers as current daily smokers of ≥15 cigarettes, ≥25 years old, who had not attempted to quit during the preceding year, and who never expected to quit. The problem with this measure, relative to our conception, is that while it assesses current intentions, it cannot effectively evaluate smokers’ future quitting behavior. Nor does it assess such smokers’ knowledge about smoking, nor the social disapproval they confront. Indeed, the authors report that the prototypical hard-core smoker is an older, retired, single white male, exposed to fewer non-smoking stimuli such as workplace policies and spouses who urge their loved ones to quit. Nevertheless, the study is useful in contemplating the potential magnitude of the hard-core population of smokers, as we do later.

**Evidence that the target is hardening**

Both logic and empirical evidence lead to the almost inescapable conclusion that the remaining population of smokers contains groups of smokers for whom quitting is innately more difficult than it was for smokers in earlier decades. As noted above, today’s older smokers have persisted as smokers in the face of decades of increasing stigmatization of smoking, education about the disease risks, and the availability of an array of cessation assistance. Despite restrictions on smoking in public places and the psychological burden smokers bear (e.g., the glares of non-smokers), these smokers persist in what has become an increasingly disparaged behavior; thus today’s model smoker may be more dependent on smoking or may have fewer personal resources to break that dependence than was the case for smokers in previous years.
The prevalence of adult smoking exhibited a distinctive and consistent downward trend throughout the 1970s and 1980s. Through the first two-thirds of the 1990s, however, prevalence appeared to have reached a plateau at just under a quarter of adult Americans, suggestive of hardening (although Mendez, Warner, and Courant (1998) argue that the leveling off of prevalence was more apparent than real, a function of a change in the National Health Interview Survey’s definition of smoker in a manner that increased prevalence estimates by about 1 percentage point). Data on quitting from this period, from the Current Population Survey (CPS), are similarly suggestive of hardening. Table 1 presents the current smoking status of those who were daily cigarette smokers 1 year prior to the survey, for each of the CPSs during the 1990s (1992–1993, 1995–1996, 1998–1999). Smoking initiation rates rose through much of the decade, and the 1992–1993 and 1995–1996 data indicate that cessation rates declined between the two surveys.

Many knowledgeable observers perceived the initiation and cessation data as strong evidence that the tobacco-control target had hardened, i.e., that we were now observing a much more quitting-resistant group of smokers (Hughes, in press; Irvin & Brandon, 2000). The apparent leveling-out of prevalence was interpreted as a reflection of success in having weeded out less-dependent smokers from the smoking population. To proponents of this view, the prevalence pattern augured an especially vexing problem for the future of tobacco control: Short of the development of a true ‘magic bullet’ for treating tobacco addiction, further attempts to reduce the smoking population would be unusually demanding and perhaps uniquely frustrating. Note that the decade of the 1990s confronted smokers with more anti-smoking news and publicity than any earlier period, highlighted by coverage of unprecedented developments in the legal arena, Congressional hearings and debates, and the first presidential campaign in which tobacco control surfaced as a prominent, popular, issue. Yet the rate of decline in prevalence from earlier decades had clearly subsided. This alone would appear to constitute a prima facie case for hardening.

Hughes (in press) supports this view with a more technical explanation that seems to lead, inevitably, to the conclusion that hardening is occurring. He observes that high dependence on smoking predicts a low probability of quitting. As such, he argues, over a period of time during which much of the smoking population quit, individuals who continued to smoke must be more highly dependent on average. This increasing level of average dependency would not occur only if new (replacement) smokers were destined to become smokers with the same low-dependence level as those who have quit. That seems highly improbable. More realistically, new smokers should reflect a mix of levels of dependence comparable with those of earlier generations of beginners.

Lower socioeconomic status (SES) smokers, an increasing proportion of the smoking population in many countries, may be more nicotine dependent than are higher-SES smokers, and historically have had lower rates of cessation (US Department of Health and Human Services [USDHHS], 1990; Burns et al., 2000a). This shift in characteristics may result in a hardening of the smoking population. For example, Bobak, Jarvis, Skodova, and Marmot (2000) found a statistically significant inverse relationship between education and serum thiocyanate among male smokers in the Czech Republic. In part, the association was explained by the lower-education smokers’ greater number of cigarettes per day (CPD); however, the inverse relationship persisted, albeit not at a level of statistical significance, when the authors controlled for CPD. The authors concluded that lower-education smokers may be smoking more intensively, puffing more frequently, inhaling more deeply, or smoking more of each cigarette. As smoking continues to shift toward lower-education smokers, dependence levels — and, hence, resistance to quitting — may increase. Data from the 1992–1993 and 1995–1996 CPS and

<table>
<thead>
<tr>
<th>Survey years</th>
<th>Daily smokers</th>
<th>Non-daily smokers</th>
<th>Former smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No quit attempts</td>
<td>Failed quit attempts</td>
<td>Quit &lt;3 months</td>
</tr>
<tr>
<td>1992–1993</td>
<td>63.6 (0.6)</td>
<td>25.9 0.6</td>
<td>3.0 0.2</td>
</tr>
<tr>
<td>1995–1996</td>
<td>67.9 (0.6)</td>
<td>23.5 0.6</td>
<td>2.9 0.2</td>
</tr>
<tr>
<td>1998–1999</td>
<td>63.2 (0.6)</td>
<td>25.6 0.6</td>
<td>3.4 0.2</td>
</tr>
<tr>
<td>Sep 98</td>
<td>63.7 (1.1)</td>
<td>26.7 1.0</td>
<td>2.9 0.4</td>
</tr>
<tr>
<td>Jan 99</td>
<td>62.8 (1.1)</td>
<td>24.1 1.0</td>
<td>4.2 0.4</td>
</tr>
<tr>
<td>May 99</td>
<td>63.2 (1.1)</td>
<td>26.0 1.0</td>
<td>3.2 0.4</td>
</tr>
</tbody>
</table>

*aSelf respondents, age 25 or older.

*bNon-daily smokers were not asked whether they had made a cessation attempt in the past year and are therefore reported as a separate category.

from surveys in California show disadvantages in cessation activity and success among lower-educated and lower-income groups (Burns et al., 2000a).

Three empirical analyses provide additional support for the hardening hypothesis. The first compared smoking prevalence and degree of dependence among smokers in six countries, with dependence measured by the Fagerström Test for Nicotine Dependence (FTND; Fagerström et al., 1996). The countries with a lower prevalence of smoking, presumed to be the result of more active and successful tobacco-control efforts (e.g., the US), had higher average dependence scores. The implication drawn was that tobacco-control success is achieved by encouraging the least dependent smokers to quit, leaving the more dependent smokers as a greater proportion of the remaining population of smokers.

In the second study, the authors evaluated changes in treatment success rates over time (1977–1996) in published studies of cognitive-behavioral coping skills training (Irvin & Brandon, 2000). They chose this treatment method because it remained relatively constant over the period studied. The authors found that quit rates declined over time, as measured by abstinence immediately post-treatment and at 3 and 6 months. They concluded that contemporary smokers are more dependent, and hence less able to quit, than those participating in similar programs in earlier years. The authors noted a number of possible confounders, however, including differences in the demographic characteristics of participants over time. They observed, too, that their trend of declining quit rates lost statistical significance beyond the 6-month follow-up.

A great deal of evidence has suggested that substance abusers and persons suffering from mental illness have higher rates of smoking than do people neither abusing drugs nor experiencing mental illness. In particular, both alcoholics and schizophrenics have remarkably high smoking prevalence, often estimated in the vicinity of 80% or more (Goldsmith & Knapp, 1993; Marks, Hill, Pomerleau, Mudd, & Blow, 1997). Lasser, Boyd, Woolhandler, Himmelstein, McCormick, and Bor (2000) employed a nationally representative survey conducted in 1991–1992 (the National Comorbidity Survey) to examine the association between smoking, quitting, and mental illness (including alcohol and drug dependence). They found substantial differences in current smoking, ever smoking, and quitting according to whether respondents had no mental illness, any lifetime mental illness, or past-month mental illness. Current smoking prevalence rates for the three groups were 22.5%, 34.8%, and 41.0%, respectively. Lifetime smoking rates were 39.1%, 55.3%, and 59.0%. Quit rates were 42.5%, 37.1%, and 30.5%. For respondents with past-month mental illness, the statistically significant odds ratios of both current and ever smoking were 2.7, compared with respondents with no history of mental illness. The authors concluded that persons with a diagnosable past-month mental illness consumed close to half of all cigarettes smoked.

This study clearly indicated that persons suffering from mental illness constituted a disproportionately large share of the smoking population. With their lower quit rates, this group of smokers with more resistance to quitting should constitute a growing proportion of the smoking population. Given the absence of comparable data from earlier years, this probable trend remains an inference rather than an empirically supported conclusion.

Although the time trend of smokers with mental illness is unknown, other trends in smoking are well documented and highly germane to evaluating the hardening hypothesis. Table 2 presents the changing sociodemographic composition of the smoking population. Perhaps the most profound shift since the mid-1960s has been the change in the educational background of smokers. In 1966, differences in smoking prevalence by education class were modest. Among those in the US who did not graduate from high school, smoking prevalence was 42.3%. Among high school graduates, the rate was 44.9%. Among those with some college 43.9% smoked, while 36.5% of college graduates smoked, as did a third of people with postgraduate degrees. In 1999, smoking prevalence was clearly inversely related to education. The percentage decline in prevalence over this interval among non-high school graduates was 30%, and 36% among those who completed high school. In contrast, smoking prevalence declined 64% among college graduates and 74% among those with educational attainment beyond college. By 1999, the smoking prevalence of people with postgraduate studies was less than 30% of that of people lacking a high school diploma.

Educational status has important socioeconomic correlates, occupational class among them. From 1978–1980 to 1997, National Health Interview Survey data show that smoking among white-collar employees declined by 34%, vs. 16.7% among blue-collar employees. At the end of this period, the blue-collar prevalence rate exceeded the white-collar rate by fully 75% (36.4% vs. 20.8%, respectively). Within specific groups of professionals, smoking prevalence had declined even more dramatically. For example, among physicians, self-reported smoking prevalence stood at 3.3% in 1990–1991, having fallen from 19% in the mid-1970s (Nelson et al., 1994). Recently, Gilpin, Emery, and Berry (2000) found that in California in 1999 the prevalence of daily smoking among college graduates had declined to 6.4%.

Data such as these provide powerful evidence on both sides of the hardening debate. The dramatic decline in smoking among the highly educated and among professionals suggests that the remaining...
smokers from these groups may qualify as significantly hardened, with many possibly reasonably categorized as true hard core. The social pressure against smoking in such groups must be immense. In contrast, the far more modest decline in smoking among the less educated, blue-collar population raises the prospect that many smokers in this group remain susceptible to quitting and simply have not been reached yet. The hardened segment of this group may represent a far smaller proportion than it does among the highly educated. We revisit this notion below.

Evidence against hardening

Opponents of the hardening hypothesis observe that if a hard-core smoker is being left behind, or if those who can quit with relative ease have done so, then there should be significant evidence of this hardening in the remaining smoking population, yet conventional measures do not reflect this. For example, data from the 1998–1999 CSP challenge the pro-hardening interpretation of CPS data from the early and mid-1990s presented above. Cessation rates, which had declined from 1992–1993 to 1995–1996, increased at the end of the decade, returning to the level measured in 1992–1993. Prevalence declines also occurred when cigarette prices rose at the end of the decade (CDC, 2001), following the Master Settlement Agreement between the states and the tobacco industry (National Association of Attorneys General, 1998).

The number of cigarettes smoked per day (CPD) by continuing smokers has fallen over time as well (Burns, Major, & Shanks, in press-b). Consumption by smokers over age 20 declined over the past decade, from 18.8 CPD in 1991 to 17.2 CPD in 1998. This followed a decline of slightly more than 2 CPD from the preceding decade, for a total drop of 20%. Notably, whereas 28.4% of smokers said that they smoked 25 or more CPD in 1980, that figure had fallen to 18.5% by 1998. Correspondingly, the percentage reporting smoking fewer than 15 CPD rose from 30.8% to 42% during the same period.

There are multiple possible explanations for the decline in mean number of cigarettes smoked per day that offset its value as an argument against hardening, however. For one, as noted above, the definition of current smoking has changed, drawing into the pool of smokers more who smoke on a non-daily basis, a group growing as a proportion of smokers (Burns et al., in press-b). The lower number of cigarettes smoked per day by these occasional smokers decreases estimates of daily consumption. The decline also may have been influenced by the dramatic changes in levels of workplace and social restrictions on smoking that have occurred over the last two decades (Gilpin, Emery, Farkas, Distefan, White, & Pierce, 2001). As these restrictions become pervasive, they may encroach on smokers’ opportunities to smoke, thereby reducing daily consumption. Finally, some of the decline may be an artifact of an increasing tendency by smokers to under-report their daily consumption, a reflection of the growing stigma associated with smoking. This phenomenon was documented in an earlier era (Warner, 1978; but see Hatzianandreou, Pierce, Fiore, Grise, Novotny, & Davis, 1989) and has been described for pregnant smokers more recently (Boyd, Windsor, Perkins, & Lowe, 1998; Owen & McNeil, 2001). Even allowing for these corrections, mean CPD for all current smokers has probably declined in recent

Table 2. Smoking status of the US population by demographic characteristics, 1966 and 1999

<table>
<thead>
<tr>
<th>Gender</th>
<th>NHIS 1966</th>
<th></th>
<th></th>
<th>NHIS 1999</th>
<th></th>
<th>Percentage decline in the prevalence of current smoking, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current, %</td>
<td>Former, %</td>
<td>Never, %</td>
<td>Current, %</td>
<td>Former, %</td>
<td>Never, %</td>
</tr>
<tr>
<td>Male</td>
<td>52.4</td>
<td>21.3</td>
<td>26.3</td>
<td>25.7</td>
<td>28.2</td>
<td>46.1</td>
</tr>
<tr>
<td>Female</td>
<td>34.1</td>
<td>8.2</td>
<td>57.7</td>
<td>21.4</td>
<td>19.7</td>
<td>59.0</td>
</tr>
<tr>
<td>Age (Years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20–24</td>
<td>49.4</td>
<td>7.4</td>
<td>43.2</td>
<td>29.2</td>
<td>8.3</td>
<td>62.5</td>
</tr>
<tr>
<td>25–44</td>
<td>51.1</td>
<td>13.6</td>
<td>35.3</td>
<td>27.3</td>
<td>15.4</td>
<td>57.3</td>
</tr>
<tr>
<td>45–64</td>
<td>42.0</td>
<td>16.6</td>
<td>41.4</td>
<td>23.3</td>
<td>31.0</td>
<td>45.7</td>
</tr>
<tr>
<td>65+</td>
<td>17.5</td>
<td>16.1</td>
<td>66.4</td>
<td>10.6</td>
<td>40.6</td>
<td>48.8</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>42.4</td>
<td>15.0</td>
<td>42.6</td>
<td>23.5</td>
<td>25.5</td>
<td>51.0</td>
</tr>
<tr>
<td>African-American</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>38.2</td>
<td>9.6</td>
<td>52.2</td>
<td>19.9</td>
<td>13.9</td>
<td>56.3</td>
</tr>
<tr>
<td>Education (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; HS graduate</td>
<td>42.3</td>
<td>13.7</td>
<td>44.0</td>
<td>29.4</td>
<td>23.5</td>
<td>47.1</td>
</tr>
<tr>
<td>HS graduatea</td>
<td>44.9</td>
<td>13.3</td>
<td>41.8</td>
<td>28.6</td>
<td>23.8</td>
<td>47.6</td>
</tr>
<tr>
<td>Some college</td>
<td>43.9</td>
<td>15.1</td>
<td>41.0</td>
<td>24.4</td>
<td>23.2</td>
<td>52.4</td>
</tr>
<tr>
<td>College graduate</td>
<td>36.5</td>
<td>19.1</td>
<td>44.4</td>
<td>13.2</td>
<td>23.4</td>
<td>63.3</td>
</tr>
<tr>
<td>Post-graduate</td>
<td>33.0</td>
<td>23.0</td>
<td>44.0</td>
<td>8.5</td>
<td>26.2</td>
<td>65.3</td>
</tr>
</tbody>
</table>

*aHigh school graduate’ includes those with 12 years completed but no diploma and those with a GED or equivalent for 1999. Source: 1966 and 1999 National Health Interview Surveys.
years. CPD has long been deemed an important indication of dependence, and smokers of higher numbers of CPD have lower rates of successful cessation compared to light smokers (Burns et al., 2000a; Hymowitz, Cummings, Hyland, Lynn, Pechacek, & Hartwell, 1997). In assessing the degree of nicotine dependence, the FTND places special emphasis on CPD, as well as time to first cigarette of the day (Fagerström & Schneider, 1989; Heatherton, Kozlowski, Frecker, & Fagerström, 1991); thus, detractors of the hardening hypothesis ask, how could we have more hard-core smokers when average daily consumption has declined by one-fifth? Similar data are also available on the time to first cigarette. There was a substantial decline in smoking prevalence in California from 1990 to 1999, but the fraction of smokers who reported having their first cigarette within 30 min of waking did not increase. Indeed, no change was observed in any of the CPD categories when smokers were stratified by cigarettes smoked per day (Burns, Major, Anderson, & Vaughn, in press-a; see Figure 1).

There is a clear positive relationship between CPD and blood cotinine levels (Benowitz, Hall, Herning, Jacob, Jones, & Osman, 1983), and lower rates of cessation among smokers who smoke higher numbers of CPD are used as part of the demonstration that heavily dependent smokers have more difficulty quitting. If more-dependent smokers consume more CPD on average and they also quit less on average, then those smokers left behind ought to smoke higher numbers of CPD on average. The fact that CPD has declined over time supports the aforementioned notion that some third factor may be at work reducing CPD, such as restrictions on where smoking is allowed, increasing cost, or under-reporting. However, unless one dismisses the decline in CPD as an artifact, it is difficult to argue that a reduced frequency of use on average and a reduced fraction of smokers who smoke 25 or more CPD are consistent with the hypothesis that the residual smokers are more heavily addicted.

Hughes (in press) argues that CPD is, and always has been, a poor measure of dependence. He observes that the amount of drug consumption is not part of the definition of drug dependence in the standard definitions produced by the American Psychiatric Association and the World Health Organization. Further, he notes that differences in the manner in which cigarettes are smoked — depth or frequency of inhalation, for example — affect nicotine intake in significant ways, leading to a correlation between CPD and nicotine levels generally less than \( r = 0.5 \). Hughes (personal communication) also concludes that recent changes in social norms and policies concerning smoking may have uncoupled high dependence from high CPD consumption, reducing the correlation that existed previously.

One of the more fascinating aspects of contemporary smoking behavior lends a new twist to analyzing the reduction in daily consumption. Almost one-fifth of today’s cigarette smokers are non-daily smokers (Burns et al., in press-b; Hassmiller, Warner, Mendez, Levy, & Romano, 2002); in California and Massachusetts, the figure is close to 30% (Gilpin et al., 2000). These occasional smokers are a mix of smokers struggling with quitting, young adults experimenting with smoking, and older adults with confirmed non-daily smoking. Collectively they constitute the largest group of non-daily smokers ever documented (Hassmiller et al., 2002). Clearly, non-daily smokers do not qualify as hardened smokers. Equally clearly, their historically aberrantly low consumption of cigarettes affects the overall data on daily consumption. Arguments favoring hardening may need to adjust CPD estimates to account for this perplexing new population of smokers, but even when they are eliminated from the smoking population used to calculate mean CPD, the number of cigarettes smoked by daily smokers has not increased over time (Burns et al., in press-b). Accounting for trends in occasional smoking, however, proponents of the hardening hypothesis must acknowledge a sizable group, with what was previously thought to be a rare smoking pattern, who clearly do not fall within the risk group of interest.

An additional and compelling anti-hardening argument relies on the fact that in states with substantial tobacco-control programs, especially California and Massachusetts, prevalence has fallen more rapidly than in other states (Biener, Harris, & Hamilton, 2000; Burns et al., 2000a; Gilpin et al., 2001; Hamilton, Norton, & Weintraub, 2001). One can turn this argument into a pro-hardening argument,
noting that declines in prevalence are occurring only where there is an aggressive and well-funded tobacco-control program, in contrast with earlier years' experience, when declining smoking occurred without comprehensive programs. Even so, the bottom line message is that, with adequate resources, existing tobacco-control approaches can lower smoking prevalence whether or not the smoking population is innately more quitting-resistant than before.

Opponents of the hardening hypothesis challenge the evidence supporting it through critiques of the pro-hardening studies, some offered by the studies' authors themselves. For example, as observed above, Irvin and Brandon (2000) concluded that the declining efficacy over time of group-coping-skills cessation programs owed to participants' increasing resistance toward quitting; yet, the authors noted, significant declines in end-of-treatment quit rates were not sustained on 1-year follow-up. In addition, the more quitting-susceptible smokers of earlier years now may gravitate toward self-treatment with over-the-counter nicotine replacement products. If true, formal cessation programs might well be enrolling a harder-core smoker without the smoking population as a whole having hardened.

Similarly, the case made by Fagerström et al. (1996) that countries with lower smoking prevalence have higher average dependence scores rests in part on a comparison of smoking prevalence vs. average FTND scores in six countries. As the authors themselves note, however, the strong inverse relationship weakens considerably when one includes both male and female smokers in the data for Finland, where females exhibit both a low prevalence of smoking and a low FTND score. In fact, when one examines the data for both sexes combined, the middle four countries of the six studied show no obvious relationship between prevalence and dependence score.

**Potential resolution of the apparent logical paradox**

Logic dictates that, when the factor of age is controlled, research would indicate that those who have not quit smoking have more difficulty quitting than those who have. Logic also argues, however, that if the population is hardening, we should see increases in measures correlated with difficulty quitting among remaining smokers. In particular, quit rates should be declining, and prevalence should be tending to level off. However, quit rates rose between 1995–1996 and 1998–1999, and prevalence has fallen in recent years. One potential resolution of this paradox is that although the smokers who remain have more innate difficulty quitting, they also have more motivation to quit and access to more and better cessation assistance. Cessation techniques have improved efficacy; social disapprobation of smoking has grown over time; and policy measures such as smoking bans in workplaces and higher cigarette taxes combine to make smoking inconvenient and more costly. As such, quit rates could be comparable to those of prior years, despite contemporary smokers' greater inherent degree of difficulty in quitting. In essence, the two forces — hardened smokers and an environment that increasingly encourages and supports cessation — may cancel each other out. Changes in daily consumption can be explained similarly. Smokers who are more addicted and hence would have smoked more CPD in prior decades may be more heavily impacted by restrictions on where smoking is allowed and by increases in cost and social disapproval. The result would be a hardened target without increasing CPD among remaining smokers.

This is more than semantics. In terms of the innate difficulty of encouraging smokers to quit, the target probably has been hardening. Commensurate with the increased degree of difficulty in reaching smokers, however, has been progress in doing so. Thus far, tobacco control has proven itself up to the challenge.

**How low can we go?** Empirical evidence that the number of true hard-core smokers must be very small

Empirical evidence abounds that, in the right set of circumstances, including strong social pressure and public policies, no more than 10% of adults — less than half of current prevalence in the US — will smoke. Indeed, Mendez and colleagues (1998) have demonstrated that if smoking initiation can be brought down from the current rate of 30% to 20% (it is falling at present; see Johnston, O’Malley, & Bachman, 2002), overall prevalence inevitably will fall over time to one-eighth of the US population, even if cessation rates do not increase.

Other evidence lends weight to the notion that the number of true hard-core smokers must necessarily be very small. Consider, for example, the experience of physicians. Highly educated and having a professional stake in good health, physicians have decreased their rate of smoking from something close to 50% in the immediate post-World War II period (US Department of Health, Education, and Welfare, 1979) to 3% or less today (Nelson et al., 1994). A similar if slightly less dramatic phenomenon is seen in all high-SES occupations. As noted above, smoking prevalence among people with postgraduate study, including both daily and occasional smokers, stood at 8.5% in 1999, down from 33% in 1966 (Table 2). Relatively speaking, therefore, only one-fourth as many of the most highly educated Americans smoke today as did in the mid-1960s. In states with significant tobacco-control programs, the change may be even more dramatic. Recent data indicate that the self-reported daily
smoking prevalence of college graduates in California has fallen to a remarkably low 6.4%, with an additional 3.85% smoking occasionally (Gilpin et al., 2000).

Consider, too, that in 1999, approximately one-fourth of women of childbearing age were smokers (USDHHS, 2001). For pregnant women, the rate was 11.8%, ranging from 29% among non-graduates of high school to 2.1% for women with college education (Mathews, 2001). Consistent results have been reported in Finland: while one-fourth of working-class women smoke during pregnancy, the figure is only 4% for women with university degrees (Jaakkola, Jaakkola, Gissler, & Jaakkola, 2001). Allowing for the possibility of under-reporting by women with higher education (Boyd et al., 1998; Kendrick et al., 1995; Owen & McNeill, 2001), and given the strong social stigma against smoking during pregnancy, the rate is probably no higher than 5% among these most educated women. These data suggest that when knowledge and motivation are at their highest, the fraction of the population that persists in smoking is vanishingly low.

Temporary quitting is not synonymous with permanently avoiding smoking. Relapse to smoking following pregnancy is common (McBride, Pirie, & Curry, 1992). So too is relapse by men who have quit smoking following myocardial infarctions (Havik & Maeland, 1988). Nevertheless, quitting sustained for several months indicates the possibility of long-term quitting.

In striking contrast with experience at the upper end of the educational and occupational spectra, smoking rates among the nation’s low-education, blue-collar population remain very high (Bang & Kim, 2001; Burns et al., 2000a). Class-differentiated smoking rates suggest strongly that we are far from the irreducible hard core of smokers. Indeed, short of a genetic difference in quitting ability between college graduates and non-graduates of high school, a large pool of contemporary smokers must be able and eventually should be willing to stop smoking. Past differences in rates of successful cessation may in part reflect differences between these two groups in personal resources that enable behavioral change or in access to cessation messages or assistance. They do not necessarily imply that these smokers are unwilling or unable to quit if provided appropriate support. Thus, whether the hard core is best represented by the 2.1% of pregnant college graduates who continue to smoke, 3% of physicians, 6.4% of college-educated Californians, or 8.5% of Americans with postgraduate degrees, the majority of the 36.4% of blue-collar workers who smoke cannot reasonably be categorized as hard core. Probably two-thirds or more of them are, rather, quitters-in-waiting: smokers who will quit in the future, given the appropriate circumstances and opportunities.

A second small but noteworthy group of quitters-in-waiting exists, namely, new smokers. Especially through much of the 1990s, when the smoking initiation rate among teenagers was increasing, the influx of new young adult smokers included a large proportion who, like their parents’ and grandparents’ generations before them, are likely to find quitting desirable and, in relative terms, easy.

**Why the quitters-in-waiting haven’t quit yet**

With the relatively stable number of new entrants into the adult smoking population, itverges on inconceivable that these new smokers are somehow inherently more resistant to quitting than were previous generations. More likely, a social trend is at play here, including some later initiation, with the implication being that, as they mature, this cohort may exhibit increasing cessation rates. In any consideration of hardening, it is crucial to recognize that, to date at least, there is little reason to believe that the inflow of new smokers is any more hard core than were prior generations. Thus, with the myopia of youth, the adult smoking population gets replenished annually with relatively typical smokers, rather than an especially quitting-resistant population.

The larger group of quitters-in-waiting consists of the poorly educated and blue-collar workers. Some of the needs that smoking addresses, from stress reduction to ego definition, may be more prevalent within this population. Also, the social stigma associated with smoking is not as great in lower SES groups as it is in higher SES groups. Opportunities to smoke are probably greater for some lower SES groups than for others, and these in turn may influence the likelihood of continued smoking. In many automobile-manufacturing plants in the US, for example, workers are still permitted to smoke while on the factory floor. In contrast, white-collar employees of the same firms typically are precluded from smoking in their workplaces. Being employed in a non-smoking workplace increases the probability of successful quitting (Brownson, Erikson, Davis, & Warner, 1997; Burns et al., 2000b).

Higher rates of smoking among the less educated population also may reflect less frequent exposure to information on the health hazards of smoking. Even with frequent exposure, this group may not process the information as effectively as do more educated people. Linking smoking to adverse outcomes involves a degree of abstraction, given the lag between exposure and disease. The tobacco industry effectively has blunted concern about smoking per se by convincing many members of the public that smoking is merely one more risk factor in an environmental soup of hazards to which we are all exposed every day (Advocacy Institute, 1998). Additionally, lower SES...
smokers may have fewer personal resources to support a cessation effort, higher rates of comorbidity, and less environmental support for cessation.

Related to the suggested educational gradient in the effectiveness of health education is the orientation of the message itself. For years, it has been argued, public education on the dangers of smoking was developed by white, college-educated health educators for an audience of similar background, albeit not consciously. More recently, in some states and, at the national level, through efforts like those of the American Legacy Foundation’s ‘truth campaign,’ the health education community has begun to tailor messages to the specific interests, educational backgrounds, and cultures of groups with high smoking prevalence. Preliminary evidence indicates that such campaigns are reaching their targets effectively (Farrelly, Healton, Davis, Messeri, Hersey, & Haviland, 2002). Some groups of smokers may be especially hard to reach, however. Illustrative is Emery and colleagues’ (2000) prototypical hard-core smoker, described above: the older, retired, single white male, exposed to fewer personal and public non-smoking stimuli.

Yet another explanation for why many lower SES smokers have not yet been reached with the anti-smoking message is rarely considered. Quite accurately, lower SES smokers may view their future as bleaker than do members of the higher SES population, especially regarding their ability to fund and enjoy retirement. Consequently, in the highly personalized cost-benefit calculus of the merits of smoking, the lower-SES smoker may determine, logically, that the pleasure derived from smoking and the stress reduction it affords outweigh the prospect of a longer life. This makes the lower SES smoker rationally less immediately susceptible to a public health message on smoking, but it does not necessarily warrant the label hard-core smoker.

In a similar manner, the finding that lower SES smokers may be more dependent (Bobak et al., 2000) might reflect economic circumstances and social norms rather than inherent differences among the individuals. Having developed greater dependency, they may indeed find quitting more difficult than did less dependent higher SES smokers in past years, but the apparent differences in dependency are modest. The implications for ability to quit probably are modest as well. There is, however, a substantial difference in their reported quitting behaviors and success, both of which may be contributing to a hardening of the residual population of smokers that would not be reflected in increasing measures of dependence in the population of residual smokers.

Recent research finding a disproportionate number of the mentally ill within the smoking population (Lasser et al., 2000) suggests that another group of contemporary smokers have a lower propensity to quit than the typical smoker of bygone years. For selected mental illnesses and drug-dependency conditions, including schizophrenia and alcoholism, quitting appears to be especially hard (Goldsmith & Knapp, 1993; Marks et al., 1997). The good news is that in the broader category of smokers with mental illness, quit rates are still substantial, even if they are lower than for the non-affected (Lasser et al., 2000). Like blue-collar workers or lower SES smokers, most mentally ill smokers may be fairly characterized as among the quitters-in-waiting too.

Implications for the future of tobacco control

The target for tobacco control appears to be hardening, but the target is not yet very hard. There is plenty of room for application of tried-and-true tobacco-control measures, ranging from tax increases to indoor-smoking restrictions, from social-marketing media campaigns to promotion of cessation programs, with the assurance that success will follow. The experiences of California and Massachusetts offer encouraging evidence in this regard (Gilpin et al., 2001; Hamilton et al., 2001). Using conventional tobacco-control interventions, with some innovative twists, both states have shaved several more points off their smoking-prevalence figures than have other states. Sizable price increases implemented nationwide at the end of the 1990s, associated with the Master Settlement Agreement, have demonstrated that few interventions decrease cigarette consumption as quickly or effectively as raising prices (Chaloupka & Warner, 2000). In short, there is no reason to abandon the tried-and-true methods and every reason to intensify their use.

At the same time, the emergence of sizable groups of harder-to-reach smokers implies the need to tailor interventions to such smokers. Some of these interventions may be treatment oriented, while others may entail adaptation of existing public health measures. For example, it is plausible that lower SES smokers will respond to a different set of messages in media campaigns than have middle-class smokers.

A priori, there are no obvious implications for the mix of public health and individual treatment interventions. What is obvious, however, is the need for a more focused research agenda. The tobacco-control research community must begin to study how smokers differentiated by education, occupation, or mental health respond to different public health and treatment interventions. Commercial firms have applied their knowledge of market research in designing successful new tobacco-control media campaigns in several states and, nationally, through the American Legacy Foundation. There has been too little scholarly research on the subject, however. Less-targeted research has paid large dividends in directing
tobacco-control resources to date. To continue to yield comparable contributions in the future, research will have to notch up its specificity and sophistication, focusing on the predominant groups of remaining smokers.

Fortunately, we live in the first era with abundant potential resources for tobacco control-research and intervention. Strong commitments of research funds have been directed specifically toward tobacco control from, among others, the Robert Wood Johnson Foundation, the National Cancer Institute, the American Legacy Foundation, and several pharmaceutical companies. The states’ monies from the Master Settlement Agreement allow the possibility that resources for applied interventions could be widely available, although, thus far, few states have committed significant shares of their revenues to the fight against tobacco (Campaign for Tobacco-Free Kids, 2001). Getting more of that money directed to tobacco control must be a top priority. A mere 17% of the state Master Settlement Agreement monies would permit states to mount comprehensive programs of a size that the CDC believes would be effective (CDC, 1999). Other sources should be sought as well. For example, once convinced of the financial worthiness of the endeavor (Warner, Smith, Smith, & Fries, 1996), businesses can afford to invest a lot in smoking cessation for their employees.

The expanded resource base offers the potential to continue to employ demonstrably effective techniques while simultaneously testing out novel interventions, oriented toward the contemporary high-risk groups. If governmental and private sector authorities could be made to appreciate the monumental importance of the task, the tobacco-control community could have both an effective programmatic effort and a robust research enterprise.

Short of a substantial expansion of the resource base, a sensible strategy might call for application of tried-and-true interventions at present, while research is redirected toward both policy analysis and treatment research that target the high-risk populations. Within these two research domains, resources must be marshaled wisely. If ample funding is available for treatment research, through pharmaceutical companies, for example, public funds might be directed toward policy research. Both areas count, and both need to be supported effectively.

Conclusion

Examining the composition of the contemporary smoking population, one is struck by a number of important opposites. There are signs of hardening, documented in this paper. At the same time, we see a persistent influx of about 30% of young adults into the smoking population, probably no more dependent than were smokers in their parents’ generation. We also see daily consumption falling, a function no doubt of the changing social environment in which smoking is permitted to occur, legally or by social convention. Other measures of addiction in the population, such as time to first cigarette, do not appear to have increased even with a substantial fall in smoking prevalence in California. Finally, a fifth of cigarette smokers are non-daily smokers, and this fraction is even larger in states such as California and Massachusetts where tobacco-control programs have been particularly effective (Beiner et al., 2000; Burns et al., in press-a; Gilpin et al., 2000). In no way can this large and apparently growing group of smokers be construed as hardened smokers.

Where does this leave us? It suggests to us that we confront two distinct segments of the smoking population. One is the hardening group who, through attrition of less- dependent smokers, has become an increasingly important factor in the future of tobacco control. They almost certainly require help to achieve cessation, but whether in the form of targeted and more resource-intensive help or an expansion of existing tobacco-control approaches remains an open and important issue. Although harder to reach, the vast majority of such smokers should be reachable in principle. Assisting them effectively may well depend on our creativity and diligence in approaching the task.

The people in the second segment of the smoking population are surprisingly similar to smokers of past decades. They are young, in many instances, and perhaps proportionately more blue collar than their predecessors. They too may require some reengineered interventions reflecting their unique characteristics and the unique character of the era. Nevertheless, they represent a group that should be reached with relative ease, if with creativity. The resources available for tobacco control nationally lend reason for optimism with regard to this group that, in terms of dependency, consists of more traditional smokers.

The bottom-line assessment is that, regardless of the hardening of some smokers, the tobacco-control community should have confidence that smoking prevalence can continue to be brought down, eventually to levels at least half those of today, conceivably much lower. The speed with which this occurs will depend on the commitment of talent, resources, and imagination dedicated to the task. It will occur through greater support of cessation treatment and through further changes in the social environment (e.g., more smoke-free environments, large and persistent social-marketing campaigns, and higher tobacco product prices).

Seen through this lens, ascertaining the precise magnitude of hard-core smoking appears to be more a matter of puzzle solving than an essential ingredient in tobacco-control progress. Indeed, a measure of
ultimate success in tobacco control will involve reaching the point at which the size of the irreducible hard core looms large in future strategy. Both the good news and the bad is that we are far away from facing that challenge.

Acknowledgments

We thank John Hughes and two anonymous reviewers for helpful comments on earlier drafts of this paper, and Jacqueline Major and Christy Anderson for assistance in preparing the tables and figure.

References


Kendrick, J. S., Zahniser, S. C., Miller, N., Salas, N., Stine, J.,
Gargiullo, P. M., Floyd, R. L., Sparto, F. W., Sexton, M., &
routine public prenatal care: The smoking cessation in pregnancy
Lasser, K., Boyd, J. W., Woolhandler, S., Himmelstein, D. U.,
McCormick, D., & Bor, D. H. (2000). Smoking and mental illness:
A population-based prevalence study. *Journal of the American
Medical Association, 284*, 2606–2610.
(1997). Nicotine dependence and withdrawal in alcoholic and
nonalcoholic ever-smokers. *Journal of Substance Abuse Treatment,
14*, 521–527.
smoking: A prospective study. *Health Education Research, 7*, 381–
390.
ceased? Expected trends in the prevalence of smoking in the United
National Association of Attorneys General. Master Settlement
www.naag.org/tobaccopublic/Detail.cfm?ID = 15&Lib = 33&Cat =
NULL&Sub = NULL.
National Cancer Institute (In press). *Those who continue to smoke: Is
achieving abstinence harder and do we need to change our interven-
tions?* (Smoking and Tobacco Control Monograph No. 15). U.S.
Department of Health and Human Services, Public Health Service,
National Institutes of Health, National Cancer Institute.
Nelson, D. E., Giovino, G. A., Emont, S. L., Brackbill, R., Cameron,
smoking among US physicians and nurses. *Journal of the American
Medical Association, 271*, 1273–1275.
Owen, L., & McNeill, A. (2001). Saliva cotinine as indicator of
and health: A report of the Surgeon General* (pp. 22.9–22.12). Public
Health Service, Office of the Assistant Secretary for Health, Office
on Smoking and Health. (DHEW Publication No. (PHS) 79–
benefits of smoking cessation* (DHHS Publication No. (CDC) 90–
8416). Public Health Service, Centers for Disease Control, National
Center for Chronic Disease Prevention and Health Promotion,
Office on Smoking and Health.
United States, 2001*. Hyattsville, MD: National Center for Health
Statistics.
Warner, K. E. (1978). Possible increases in the underreporting of
cigarette consumption. *Journal of the American Statistical Associa-
tion, 73*, 314–318.
and economic implications of a work-site smoking-cessation
program: A simulation analysis. *Journal of Occupational &
Environmental Medicine, 38*, 981–992.

48 HARDENING AND THE HARD-CORE SMOKER