Changes in Measures of Nicotine Dependence Using Cross-Sectional and Longitudinal Data from COMMIT

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INTRODUCTION   This chapter uses cross-sectional and longitudinal survey data from the Community Intervention Trial for Smoking Cessation (COMMIT) to assess changes in measures of nicotine dependence between 1988 and 1993. We examine rates of successful smoking cessation in relation to different smoking behaviors, specifically the number of cigarettes smoked per day and the time to first cigarette in the morning (a measure commonly used to assess addiction).

METHODS   The COMMIT study was initiated in 1986 and involved testing a comprehensive community-based smoking control
The COMMIT Study   intervention in 11 matched pairs of communities throughout the United States and Canada (COMMIT 1991). Table 5-1 shows the names of the communities that participated in the study along with their demographic characteristics and smoking prevalence rates. For the purposes of the trial, a community was broadly defined to include an individual city, multiple smaller geographically linked cities, and portions of well-defined metropolitan areas. Within each community pair, one community was randomly assigned to comprehensive intervention and the other served as a comparison community. The intervention phase of the trial was completed in December 1992. Details on the COMMIT intervention and findings from the trial are published elsewhere (U.S. DHHS 1995; COMMIT 1995a,b).

COMMIT Surveys   The first cross-sectional survey was conducted during a telephone interview implemented between January and May
Cross-Sectional Surveys   1988. Details of the survey are published elsewhere (COMMIT 1991). In addition to the cross-sectional component of the survey, current smokers aged 25 to 64 years were eligible for inclusion in a cohort of smokers to be followed until 1993. A current smoker was defined as someone who reported having smoked at least 100 cigarettes in his or her lifetime and who also reported smoking at the time of interview.

The 1988 survey was administered in two stages. The first stage involved identifying representative samples averaging 5,400 households within each community and gathering information on the age, gender, and smoking behaviors of all adults within selected households. In the second stage, a sample of current smokers aged 25 to 64 years was selected for an extended cross-sectional interview that included questions about current and past smoking behaviors, brand and type of cigarette usually smoked, interest in

Table 5-1
Characteristics of the 22 Communities Participating in COMMIT

						% Adult Smoking	
Community Pairs (I/C)*	State/ Country	Population (*N*)	High School Graduates (%)	Low Income (%)	White (%)	1988	1993
Yonkers (I)	NY/USA	63,278	67	40	76	25	22
New Rochelle (C)	NY/USA	57,493	68	44	75	25	20
Bellingham (I)	WA/USA	65,632	79	49	95	20	18
Longview/Kelso (C)	WA/USA	60,424	72	41	96	26	24
Vallejo (I)	CA/USA	89,046	73	42	66	26	19
Hayward (C)	CA/USA	121,134	69	37	77	25	19
Santa Fe (I)	NM/USA	57,572	77	47	80	22	19
Las Cruces (C)	NM/USA	53,757	73	55	80	20	17
Paterson (I)	NJ/USA	138,317	42	59	52	27	21
Trenton (C)	NJ/USA	91,726	49	60	47	29	26
Medford/Ashland (I)	OR/USA	58,929	78	51	97	21	20
Albany/Corvallis (C)	OR/USA	73,452	83	50	95	18	16
Raleigh (I)	NC/USA	163,036	77	40	73	23	20
Greensboro (C)	NC/USA	166,824	66	47	64	26	26
Utica (I)	NY/USA	85,490	58	58	93	27	24
Binghamton/Johnson City (C)	NY/USA	76,418	63	57	96	26	23
Cedar Rapids (I)	IA/USA	144,835	78	35	97	22	22
Davenport (C)	IA/USA	136,408	75	35	93	26	24
Fitchburg/Leominster (I)	MA/USA	75,805	61	49	97	26	23
Lowell (C)	MA/USA	92,418	58	52	96	29	26
Brantford (I)	Ont/Canada	86,985	46	34	NA	32	30
Peterborough (C)	Ont/Canada	84,800	54	36	NA	28	25

*I/C: Within each community pair, one community was randomly assigned to comprehensive intervention (I), and the other served as a comparison (C) community.

quitting smoking, alcohol consumption, the presence of other smokers in the household, and sociodemographic characteristics. The mean response rate for the household rostering portion of the survey was 84%. Of the eligible smokers identified from the household rostering, 92% completed the extended interview. There were 34,443 respondents to the 1988 cross-sectional survey with complete smoking status, amount smoked, demographic categories, and other tobacco-related variables indicated.

From August 1993 to January 1994, a similar random-digit–dialed telephone survey was conducted to identify approximately 2,300 households in each COMMIT community. A disproportionate sample of smokers, ex-smokers, and never-smokers aged 25 to 64 years was selected to participate in an extended interview to gather information on current and past smoking status, other tobacco-use patterns, and demographic variables.

The response rate for the survey was 80%. Data used for this analysis are for the sample of 13,146 respondents with complete data on tobacco-related variables.

Longitudinal Survey   A sample of approximately 500 light-to-moderate (<25 cigarettes per day) and 500 heavy smokers (>25 cigarettes per day) in each community was taken from the 1988 cross-sectional survey. These individuals comprise the smoker cohort for COMMIT, were followed until 1993, and reinterviewed using an instrument comparable to the baseline survey. In 1988, the cohort consisted of 20,417 smokers (10,328 light-to-moderate and 10,019 heavy smokers). By 1993, 13,415 smokers remained, including 3,214 (24%) former smokers. Persons who were younger, single, and less educated were more likely to be lost to follow-up over the five-year study period.

Measures of Smoking Status   A current smoker is defined as someone who reports he or she has smoked 100 cigarettes in his or her lifetime and answers "yes" to the question: "Do you smoke cigarettes now?"

A person is classified as a successful quitter if he or she was previously defined as a current smoker and also reported not smoking any cigarettes in the 6 months prior to the interview.

Measures of Nicotine Dependence   Number of cigarettes smoked per day is defined as the weighted average of amount smoked per weekday and weekend. For these analyses, this continuous measure is categorized into the following groups: <5 cigarettes per day, 5 to 14 cigarettes per day, 15 to 24 cigarettes per day, 25-plus cigarettes per day.

The time to the first cigarette in the morning is based on responses to the following question: "How soon after you wake up do you have your first cigarettes?" Response categories were "less than 10 minutes," "from 10 to 30 minutes," "from 31 minutes to 1 hour," "from 61 minutes to 1.5 hours," "from 91 minutes to 3 hours," and "more than 3 hours." The latter three categories were collapsed for these analyses to comprise a category of "more than 60 minutes."

Tar yields of cigarettes were determined by linking self-reported UPC code and brand descriptor information provided in the surveys to the 1993 Federal Trade Commission (FTC) report (FTC 1995) on the tar, nicotine, and carbon monoxide content of varieties of cigarettes for sale in the United States. These tar yields were used to assign subjects to one of three categories: ultra-light (0 to 6 mg tar), light (7 to 15 mg tar), and regular (16-plus mg tar). Self-reported generic brands typically were not able to be matched to the FTC data; therefore, there is a disproportionate percentage of missing data in the 1993 survey (28% missing) compared with the 1988 survey (14% missing) because generic use was much more prevalent in 1993 (Cummings et al. 1997).

Other Predictor Variables: The following predictor variables were used for these analyses:

- Gender (male or female)
- Age (25 to 34 years, 35 to 44 years, 45 to 54 years, 55 to 64 years)
- Race/ethnicity (white non-Hispanic, black non-Hispanic, Hispanic, Asian, American Indian, Canadian, other)
- Gross household income (<$10,000/year, $10,000 to $25,000/year, $25,001 to $40,000/year, >$40,000/year)
- Education (<12 years, 12 years, 13 to 15 years, 16-plus years)
- Alcohol consumption (daily, 3 to 4 times/week, 1 to 2 times/week, 1 to 3 times/month, <1 time/month)
- Age started smoking daily (<16 years, 16 to 19 years, >19 years)
- Use of a noncigarette tobacco product (yes or no)
- Price category of cigarette smoked (generics, discount, premium)
- Desire to quit (none, a little, somewhat, a lot)
- Presence of another smoker in the household (yes or no)

ANALYSIS   Analyses focus on the association between quitting, measures of dependence, and other factors. Some of these findings have been previously reported (Hymowitz et al. 1997). Briefly, a logistic regression model was constructed with successful cessation in 1993 as the outcome, and the baseline measures of tobacco dependence and other variables outlined above included as predictors.

Change in the number of cigarettes smoked per day, time to first cigarette in the morning, and tar level of cigarettes smoked between 1988 and 1993 from the cross-sectional surveys are also reported. Independent samples t-tests are used to assess the statistical significance of change in these measures over time.

RESULTS   Figures 5-1 and 5-2 show the association between amount smoked or time to first cigarette and future cessation, controlling for a variety of other potential confounding factors. Lower levels of consumption and longer duration before smoking in the morning were both significantly predictive of an increased likelihood of success in stopping smoking.

The percentage of respondents at each level of the measures of dependence from the two cross-sectional surveys is reported in Figures 5-3 to 5-5. The average amount smoked per day decreased from 20.4 cigarettes per day in 1988 to 18.7 cigarettes per day in 1993 (p = <0.01), and fewer smokers fell into the 25-plus cigarettes category (29% in 1988 versus 25% in 1993) (Figure 5-3). Time to first cigarette in the morning remained virtually unchanged between 1988 and 1993 (Figure 5-4). The reported tar level, per the FTC method, decreased from 1988 to 1993; in 1988, 52% of subjects reported smoking a light or ultra-light cigarette, whereas 69% reported the same in 1993 (p = <0.01) (Figure 5-5).

Figure 5-1
Average Daily Amount Smoked as a Predictor of Future Cessation, 1988 to 1993*
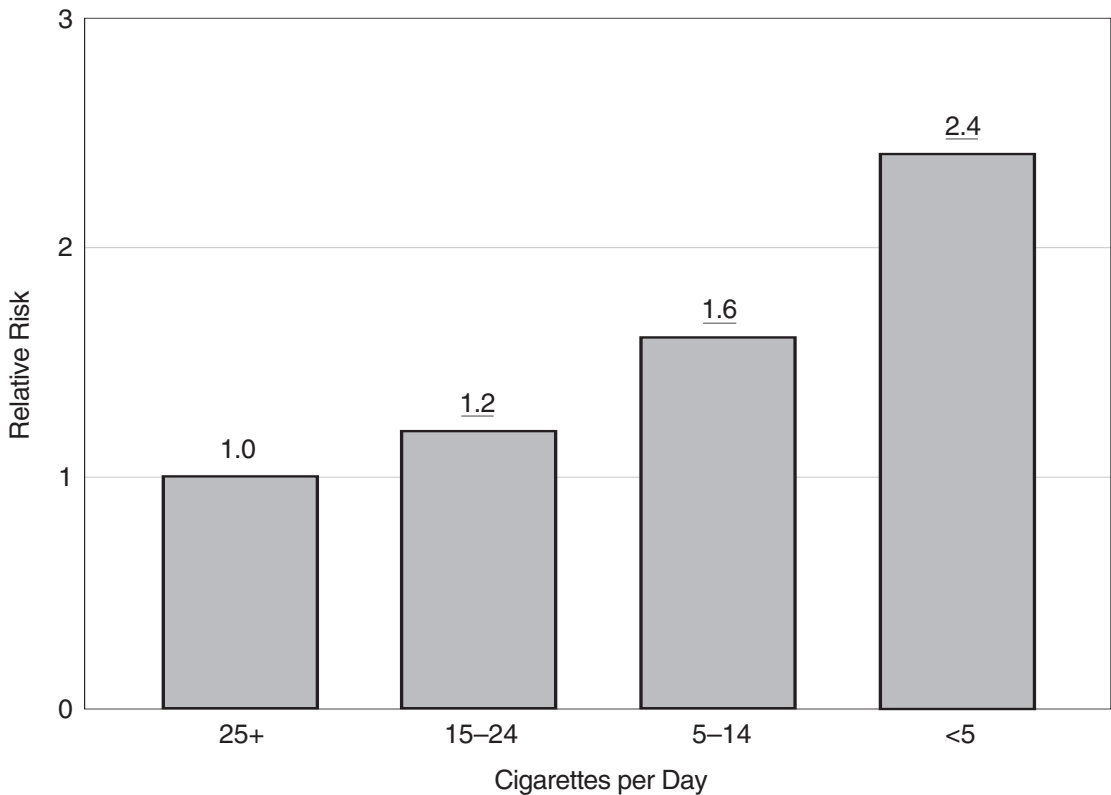
*Data from the COMMIT Endpoint Cohort, *N* = 13,415. Adjusted for sex, age, race/ethnicity, income, education, alcohol consumption, age started smoking, time to first cigarette, use of a noncigarette tobacco product, price category of cigarette smoked, past quit attempts, desire to quit, and number of other smokers in the household.

NOTE: Underlined relative risks are statistically significant at the 5% level.

SUMMARY   Data collected from COMMIT between 1988 and 1993 indicate the following: (1) smokers who are less dependent (as measured by amount smoked and time to first cigarette) are more likely to stop smoking in the future, and (2) population-based surveys in 22 North American communities indicate that the number of cigarettes smoked per day and the tar level of cigarettes smoked have decreased, and that the time to first cigarette has remained constant over this relatively short interval.

There are many ways to measure tobacco dependence. Three measures are highlighted in this study: (1) cigarettes smoked per day, (2) time to first cigarette in the morning, and (3) tar level of cigarettes smoked.

Although it is recognized that the measures used in this study are crude measures that are only moderately correlated with a more standard measure of dependence (i.e., Fagerström Tolerance Questionnaire) (Riggs and Hughes

Figure 5-2
Time to First Cigarette as a Predictor of Future Cessation, 1988 to 1993*


Time to First Cigarette (Minutes)
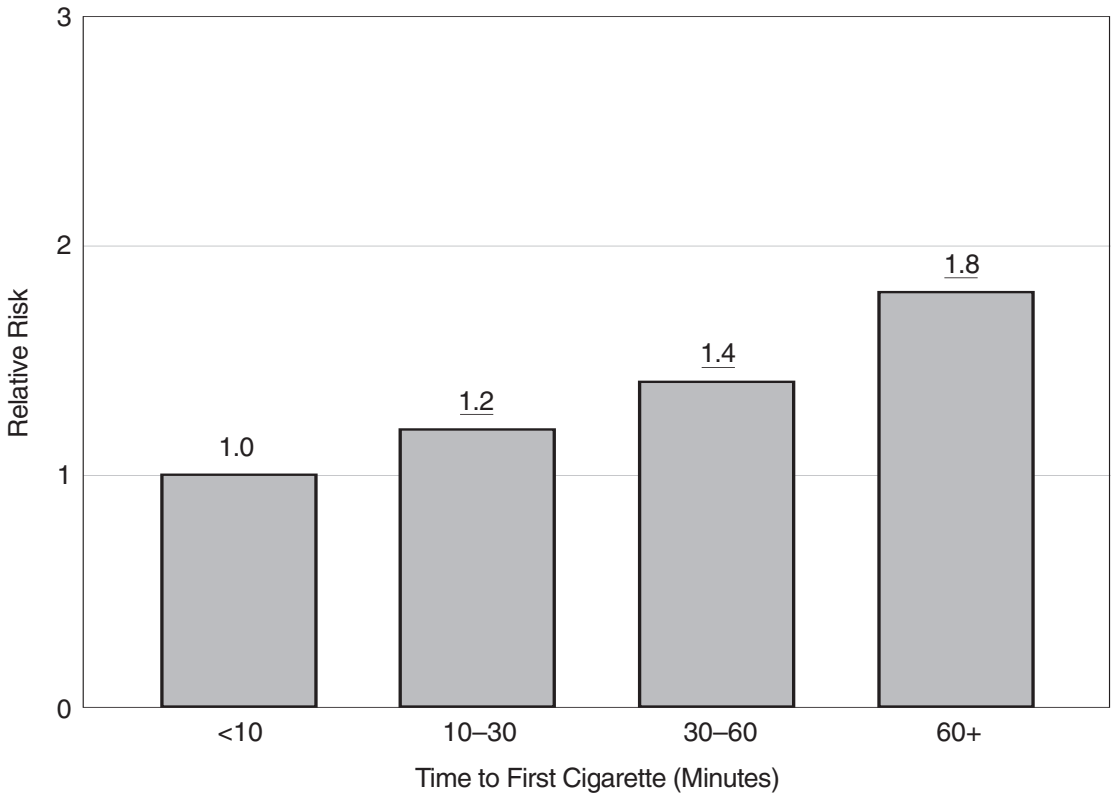
*Data from the COMMIT Endpoint Cohort, N = 13,415. Adjusted for the following baseline factors: sex, age, race/ethnicity, income, education, alcohol consumption, age started smoking, amount smoked, use of a noncigarette tobacco product, price category of cigarette smoked, past quit attempts, desire to quit, and number of other smokers in the household.

NOTE: Underlined relative risks are statistically significant at the 5% level.

1998), studies clearly show that some of these measures of dependence are among the strongest predictors of who makes a cessation attempt and who succeeds in quitting (Hymowitz et al. 1997; Farkas et al. 1996).

Time to first cigarette in the morning does have predictive validity for tobacco dependence (Kozlowski, Pillitteri, and Sweeney 1994). The finding that this measure remained virtually unchanged between 1988 and 1993 in this study provides little support for the hardening hypothesis. The average number of cigarettes smoked per day decreased by nearly 10% in this study. This is likely due to increased restrictions about smoking in the workplace and public places during the course of the COMMIT study (Glasgow, Cummings, and Hyland 1997); however, population levels of dependence have probably remained unchanged as smokers tend to compensate for their smoking behavior (Evans and Farrelly 1998; Kozlowski et al. 1989, 1994) and still exhibit behaviors consistent with dependence.

Figure 5-3
**Average Daily Amount Smoked From the 1988 and 1993 Cross-Sectional COMMIT Surveys***
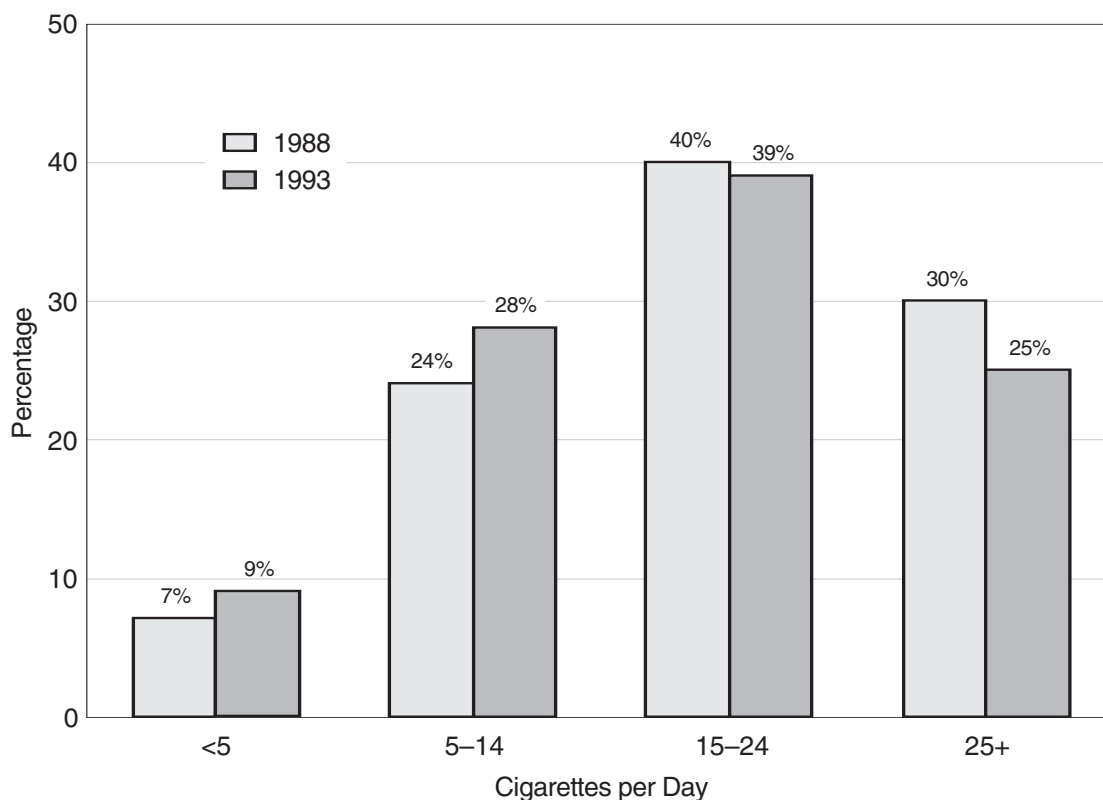
The average daily amount smoked among smokers was 20.4 in 1988 and 18.7 in 1993.

*Among smokers age 25–64. N = 34,443 in 1988 and N = 13,146 in 1993.

Three possible alternative explanations are offered that reconcile the findings from this study and the hardening hypothesis. They are:

- The population of smokers is dynamic and the characteristics of smokers have changed over time; however, on balance, the dependence level of the population has remained constant. For example, older smokers are more likely to quit than younger smokers, but younger smokers are less dependent than older smokers and smoking initiation rates have been increasing until recently. A dynamic smoking population with a greater percentage of younger smokers who are less likely to quit and are less addicted may explain why population cessation rates have not continued to increase and time to first cigarette has not changed.

Figure 5-4
Time to First Cigarette in the Morning From the 1988 and 1993 Cross-Sectional COMMIT Surveys*
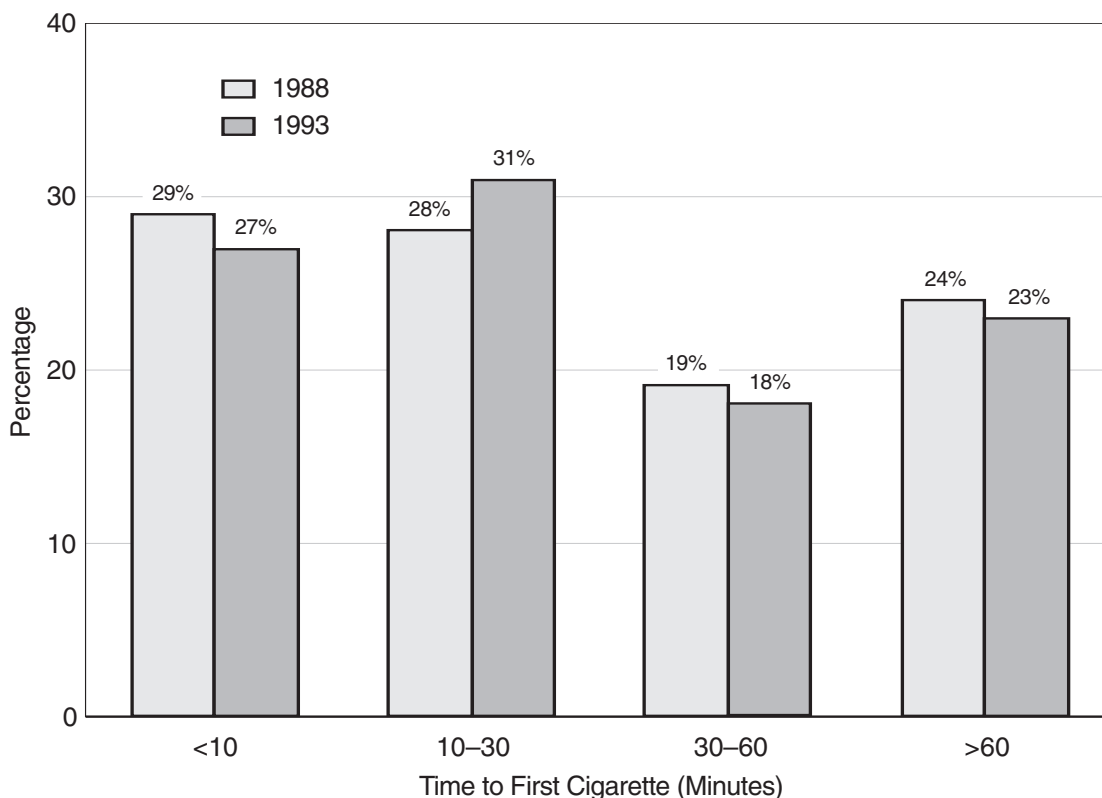
*Among smokers age 25–64. *N* = 34,443 in 1988 and *N* = 13,146 in 1993.

- The population has changed with respect to other factors that are associated with decreased smoking cessation rates, such as lower incomes, younger age, alcohol consumption, and other factors. Data from the 1988 and 1993 COMMIT cross-sectional surveys indicates that the mean age and the frequency of alcohol consumption remained constant and annual income increased (data not shown), disputing this explanation. However, a more detailed study of changes in population-based predictors of smoking cessation over time is warranted to better address this issue.

- The introduction of readily available treatments for tobacco use, including the sale of nicotine gum and patches over the counter, may have shifted the primary source of treatment for tobacco dependence from the physician to the individual smoker. Persons who enter clinics today for smoking cessation may be more likely to be smokers who tried a variety of unsuccessful measures to quit on their own and are inherently less likely to quit smoking, thus potentially explaining the observation of decreased clinical cessation rates.

Figure 5-5
Average Tar Level of Cigarettes Smoked From the 1988 and 1993 Cross-Sectional COMMIT Surveys*
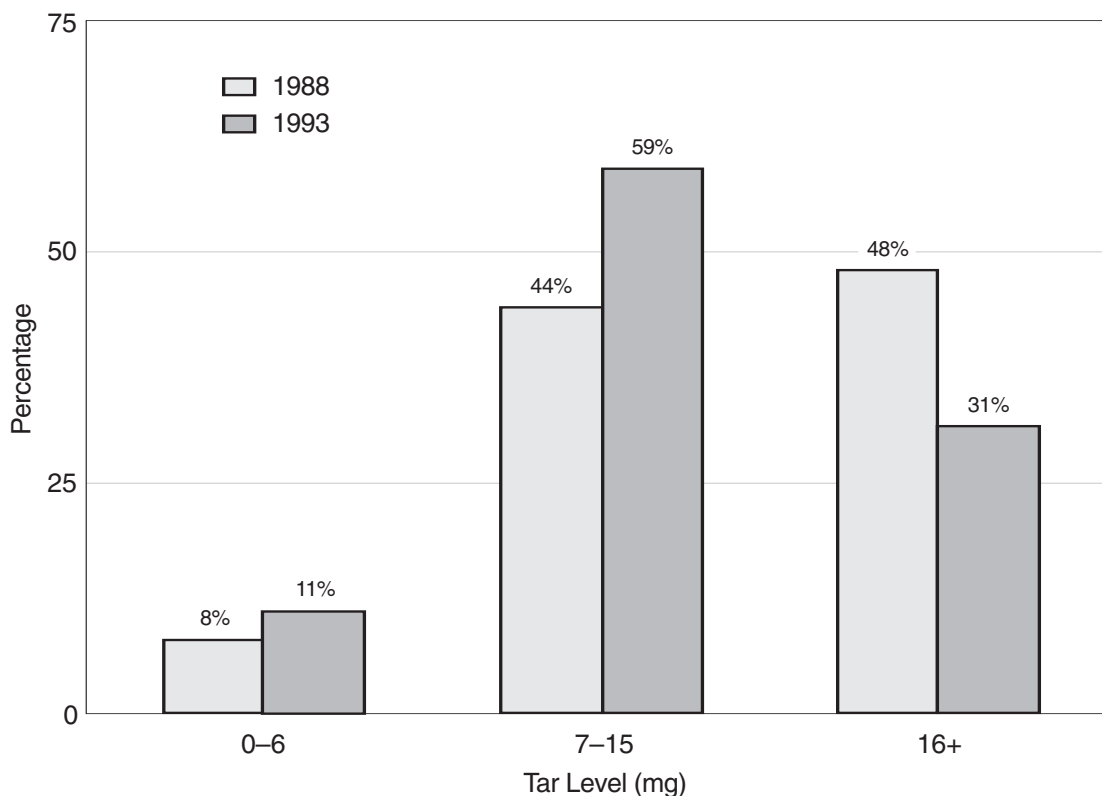
*Among smokers age 25–64. *N* = 34,443 in 1988 and *N* = 13,146 in 1993.

In summary, data from COMMIT do not indicate that the number of cigarettes smoked per day or time to first cigarette has changed as population-level measures of tobacco dependence between 1988 and 1993. The short time period available to measure changes consistent with hardening may limit the opportunity to observe these changes, and the measures of dependence used have their limitations; however, the data available from the COMMIT study do not demonstrate a clear hardening in the population.

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