Individual, Social-Normative, and Policy Predictors of Smoking Cessation: A Multilevel Longitudinal Analysis

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Objectives. We assessed the prospective impact of individual, social-normative, and policy predictors of quit attempts and smoking cessation among Massachusetts adults.

Methods. We interviewed a representative sample of current and recent smokers in Massachusetts by telephone in 2001 through 2002 and then again twice at 2-year intervals. The unit of analysis was the 2-year transition from wave 1 to wave 2 and from wave 2 to wave 3. Predictors of quit attempts and abstinence of longer than 3 months were analyzed using multilevel analysis. Predictors included individual, social-normative, and policy factors.

Results. Multivariate analyses of 2-year transitions showed that perceptions of strong antismoking town norms were predictive of abstinence (odds ratio = 2.06; $P < .01$). Household smoking bans were the only policy associated with abstinence, but smoking bans at one's worksite were significant predictors of quit attempts.

Conclusions. Although previous research showed a strong relation between local policy and norms, we found no observable, prospective impact of local policy on smoking cessation over 2 years. Our findings provide clear support for the importance of strong antismoking social norms as a facilitator of smoking cessation. (*Am J Public Health.* 2010;100:547–554. doi:10.2105/AJPH.2008.150078)

Increasing the rate of successful smoking cessation is one of the most effective public health strategies for improving the health of the population.[1] To provide guidance for future intervention efforts, it is vital that we understand the factors that contribute to successful cessation at the population level. Longitudinal studies of population-based samples are one of the best ways to examine the process of change in smoking behaviors.

The UMass Tobacco Study was a 3-wave longitudinal investigation examining personal, social-normative, and policy factors that contribute to favorable change in smoking behavior among residents of a state that had a comprehensive tobacco control program in place for almost 10 years.[2] The study hypothesized that local clean indoor air policies and those that reduced youths' access to tobacco would have a beneficial effect on adult smoking primarily by increasing antismoking norms. Local tobacco control regulations, such as restaurant smoking bans, may influence the way individuals perceive the community norm because they can no longer smoke in restaurants, because they observe fewer people smoking in restaurants, or because they see the restaurant's "No Smoking" sign as indicating community disapproval. Regulations may influence individual's perceptions even when their own behavior is not regulated. An adult who sees a store clerk check the identification of a young person attempting to buy cigarettes may infer that the community disapproves of tobacco use, at least by young people.

Support for the hypothesis that strong local policies affect social norms about smoking was obtained in an analysis of the baseline data from the UMass Tobacco Study, which showed that adults living in towns with higher numbers of strong tobacco control policies were more likely than those living in towns with fewer policies to report that town residents disapproved of smoking and that fewer people smoked.[3] This relationship remained significant even after preexisting antitobacco sentiment in the town and other demographic characteristics of the town and its residents were controlled. The connection between policy and norms was also shown in cross-sectional analyses of the impact of local restaurant smoking bans on youths' perceptions of norms.[4]

SOCIAL-NORMATIVE PREDICTORS OF CESSATION

In addition to perceived norms, the immediate social environment of the smoker is expected to play an important role. Several longitudinal studies have shown that living with smokers has a negative impact on cessation.[5,6] Having children in the home might be expected to increase motivation to quit, but there is no evidence that parental status predicts cessation, and at least 1 study showed a negative impact.[7] Although it seems an important sociocultural factor, there is surprisingly little information about the role of smoking among one's friends as a factor in adult cessation. There is evidence from cross-sectional studies that perceived antismoking norms promote smoking cessation among adults.[8,9]

POLICY PREDICTORS OF CESSATION

We examined policy at 3 levels of proximity to the individual smoker: household policy, respondents' workplace policy, and tobacco control policy in one's community. One of the relatively few longitudinal studies of the impact of household smoking policies on cessation showed that the prospective effect of a household smoking ban is limited to smokers with high levels of motivation to quit.[10] More recent evidence, however, indicates that it has a beneficial impact on cessation even when motivation, level of dependence, and household composition are held constant.[7]

The impact of workplace policies on smoking cessation is difficult to study prospectively because of changes in both individual employment and worksite policies over time. Longitudinal studies that have limited the

predictor to the worksite policy at baseline tend not to show a significant association with cessation.[7,11] If change to a smoke-free policy in the interval between baseline and follow-up is considered, however, there does seem to be a favorable impact on cessation.[12,13]

The most distal tobacco policies examined are regulations existing in one's city or town. Cross-sectional econometric or ecological studies show that strong state and local restrictions on tobacco smoking increase cessation and reduce smoking prevalence among adults.[14,15] One longitudinal study provided evidence that statewide clean indoor air laws influence adult smoking behavior.[16] Unfortunately, these studies did not control for town-level factors that may confound the relationship between the adoption of smoking regulations and smoking behavior, thus making it impossible to determine whether the regulations caused the reduced smoking or whether states and towns that are more likely to adopt stronger laws are also more likely to have social, political, economic, and demographic characteristics that are themselves the cause of enhanced smoking cessation and lower smoking rates.

As mentioned earlier, cross-sectional analyses of the baseline data from the UMass Tobacco Study demonstrated a significant relation between strength of local tobacco control policy and antitobacco norms. For our study, we took advantage of 2 additional waves of data collection in the UMass Tobacco Study that allowed for more detailed analyses of the contribution of individual and policy factors to smoking behavior change. We examined the role of perceived social norms as a mechanism for smoking cessation. We also took account of preexisting antitobacco sentiment as well as town demographics in examining the impact of policy on adult smoking behavior.

METHODS

Between January 2001 and June 2002, the Center for Survey Research, University of Massachusetts, Boston, obtained a probability sample of 6739 Massachusetts adults, with an over-sampling of adult smokers, young adults (between the ages of 18 and 30 years), and recent quitters (those who had quit in the past 2 years). At baseline, 66% of residential households were successfully screened, and 70% of eligible adults were interviewed, for an overall response rate of 46%. Between January 2003 and July 2004, we attempted to reinterview all adults in the baseline sample who were current smokers, recent quitters, or young adults (n=4991). Interviews were completed with 2805 respondents, for a follow-up rate of 56%. Between January 2005 and July 2006, we attempted to reinterview all 2805 respondents to the wave 2 interview plus eligible respondents at wave 1 who were not successfully interviewed at wave 2 but were traceable. Of the former group, 1916 adults were successfully reinterviewed; of the latter group, 233 adults were successfully reinterviewed. The total wave 3 sample size was 2149 (43.0% of the baseline sample). The analytic sample included all respondents who were smokers at either wave 1 or wave 2 and responded to 1 or more subsequent surveys. Respondents who were interviewed only at waves 1 and 3 had a 4-year rather than a 2-year interval between interviews and were not included in the analyses.

The unit of analysis was the transition period of approximately 2 years between the interviews. An individual who responded to all 3 waves of interviews had 2 transitions: one from wave 1 to wave 2 and one from wave 2 to wave 3. The analyses included only those transitions in which the respondent was a smoker at the beginning of the period, the transition baseline, and resided in the state at both the beginning and the end of the transition. Town of residence at each wave was obtained by using the reported zip code. The analyses thus include 2635 transitions: 1650 between waves 1 and 2 and 985 between waves 2 and 3.

Outcomes

The 2 primary outcomes were (1) cessation, which was defined as abstinence from cigarettes for more than 3 months, and (2) quit attempt, which was defined as having made a quit attempt lasting at least 24 hours at any point between the transition baseline and the transition ending. The choice of more than 3 months as an indication of successful cessation followed the recommendation of Gilpin et al.,[17] who found that abstinence of that duration was a good predictor of continuous abstinence for the following 2 years. At each wave, a current smoker was defined as a respondent reporting a lifetime consumption of at least 100 cigarettes who currently smoked some days or every day. Former smokers were categorized as short-term quitters if they reported having been abstinent for 3 months or less and long-term quitters if they reported being abstinent for more than 3 months.

Individual Predictors

Individual predictors included the following demographic variables: (1) age (18–30, 31–59, and ≥60 years), (2) gender, (3) race/ethnicity (non-Hispanic White vs other), (4) living with a spouse or partner, (5) presence of 1 or more children younger than 18 years in the household, (6) education level (college graduate or not), and (7) household income (≤$50 000 vs >$50 000). The following aspects of individuals' smoking patterns were hypothesized to be associated with cessation: (1) not being a dependent smoker (defined as smoking ≥20 cigarettes daily and smoking within the first 30 minutes of waking), (2) having made a quit attempt in the past year, and (3) planning to quit within the next 30 days.

Social-Normative Predictors

Cessation was predicted to be more likely among those who (1) had a nonsmoking spouse or partner, (2) reported that fewer than half of their friends smoke, and (3) perceived a strong antismoking norm in the community. The perceived community norm was measured by 2 questions about perceived smoking prevalence among adults and adolescents ("About how many of the adults (teenagers) in [RESPONDENT'S TOWN] smoke cigarettes?—very few, less than half, about half, more than half, or almost all?") and 1 question about approval of restaurant smoking ("How do most [TOWN] adults that you know feel about smoking in restaurants?—the majority would prefer that smoking be allowed throughout the restaurant, only in special smoking areas, or not at all?"). A respondent who gave the most antismoking response possible to all 3 questions was categorized as perceiving a "strong" antismoking norm. Those giving the most antismoking response to 2 questions were categorized as perceiving a "medium" antismoking norm, and the rest were categorized as perceiving "weak" antismoking norms.

Policy Predictors

We considered 3 types of policy that might influence smoking cessation: (1) household smoking bans, i.e., whether smoking was banned for both residents and visitors in the respondent's home; (2) workplace smoking bans, i.e., whether the individual reported that his or her workplace banned indoor smoking; and (3) 4 types of local tobacco control regulations. Data on regulations came from the Massachusetts Tobacco Control Program and other sources, as described elsewhere.[4,18] The 2 measures of clean air regulations were the presence or absence of (1) a town ordinance or regulation that prohibited smoking in restaurants and allowed no variances[4] (i.e., no exceptions) and (2) regulations that prohibited smoking in all private and public indoor workplaces located in the town.

The measures of youth access regulation dealt with (1) enforcement of age of sales laws and (2) merchandising restrictions. Towns were characterized as having strong enforcement if they required tobacco vendors to be licensed or prescribed fines or other penalties for sales to underage youth *and* if they conducted at least 3 annual compliance checks per vendor, on average, for the 2 years before the interview. Towns were characterized as have strong merchandising restrictions if they had regulations banning retailers' use of freestanding cigarette displays and vending machines, limited them to adult-only establishments, or required lockout devices.

Because smokers' quitting behavior might be influenced either by the policy existing at baseline or by the adoption of new policies during the transition, we included 2 binary indicators of change in town policy: whether an increase occurred between the 2 interviews in (1) clean indoor air policy and (2) either of the youth access policies. Changes in the prevalence of strong policies over the study period are shown in Table 1. Similarly, an indicator of policy change at the individual's workplace was included. Although household smoking rules might also have changed in the interval between interviews, a change might either precede or follow a change in smoking behavior, thus making the direction of causality indeterminate. We therefore included only the baseline measure of home smoking rules.

Town Demographics and Prior Support for Tobacco Control

We examined the effect of the following town-level variables (which were included as continuous variables except where noted): (1) the percentage of the town's voters who voted "yes" on Question 1, a 1992 ballot initiative that increased the cigarette tax; (2) the percentage of White residents in each town; (3) the percentage of youths (younger than 18 years) in each town; and (4) town population (<20 000, 20 000–50 000, and >50 000). Of a large number of town-level factors examined, the aforementioned were most strongly related to the strength of local restaurant smoking regulations in Massachusetts towns.[18] The percentage of the "yes" vote on Question 1 reflected the level of antismoking sentiment in each town before the proliferation of local restaurant smoking regulations in the state. Because this measure has been shown to correlate extremely strongly with the level of education in the town, town education level was not included in the model.[19] All town-level variables were obtained from the 2000 US Census, except for the Question 1 vote, which was obtained from the Division of Elections within the Massachusetts office of the Secretary of State.

Analysis

The data were weighted in all analyses both to account for the oversampling and to adjust for attrition from wave to wave. Because transitions were clustered within individual respondents, we used a multilevel (hierarchical) logistic regression model. This procedure accounted for correlation of data within individuals, thus reducing the probability of a type 1 error that could be introduced if this correlation were ignored.[20,21]

Two-level models were estimated, with time-varying predictors at level 1 and unchanging individual characteristics (gender, race, and education) at level 2. Town-level variables, including town policy variables, were entered at level 1 because individuals could change towns and towns could change policies between interviews. Policies reported by respondents (smoking bans at their workplace or in their home) were likewise entered at level 1. Weights were included at level 1. All analyses were conducted using HLM 6.04 (Scientific Software International, Inc., Lincolnwood, IL) and 2-sided tests with a significance level of 0.05.

RESULTS

Of the 2635 observations of individuals who were smoking at the beginning of a transition, 68.3% made at least 1 quit attempt lasting 1 day or more during the subsequent 2-year period, and 13.5% were abstinent for at least 3 months at the end of the period (Table 2). These rates varied only moderately across population subgroups. The subgroups with the highest rate of quit attempts were those who planned at the transition baseline to quit in the next 30 days (86.3%), those who had made an attempt in the preceding year (84.2%), and those who perceived their community to have strong antismoking norms (84.0%). The lowest rates were for smokers who had not attempted to quit in the past year (54.8%) and for dependent smokers (57.5%). The smoking cessation rate was highest for the group

TABLE 1—Percentage of Respondents in Massachusetts Towns With Strong Tobacco Control Policies, 2001–2006

	Clean Indoor Air Policies[a]		Youth-Oriented Policies[b]	
	Restaurant, %	Workplace, %	Enforcement, %	Marketing, %
Wave 1	11.3	6.4	26.3	80.2
Wave 2	28.4	15.2	7.8	81.7
Wave 3	100.0	100.0	15.3	82.0

Note. Data were limited to those who responded to all 3 waves and who lived in Massachusetts towns at each wave (n = 1430).
[a]Between wave 2 and wave 3, a statewide smoke-free workplace law (including restaurants and bars) was implemented.
[b]The changes in enforcement from wave to wave were because of a loss of program funding for local boards of health between wave 1 and wave 2 and then a gain of some funding by wave 3.

TABLE 2—Distribution of Transitions Across Population Categories, Percentage of Respondents Making Quit Attempts Between Interviews, and Percentage of Respondents Who Quit for 3 or More Months at Transition End: 2003–2006

Characteristics at Transition Baseline	Weighted Percentage of Transitions, % (Unweighted No.)	Quit Attempts, %	Quit for ≥3 Months, %
Full population (all transitions)	100.0 (2635)	68.3	13.5
Sociodemographic characteristics			
Gender			
Men	45.5 (1117)	69.9	12.9
Women	54.5 (1518)	67.0	13.9
Age, y			
18–30	25.1 (609)	76.1*	17.3*
31–59	64.7 (1699)	66.1	11.3
≥60	10.3 (327)	63.9	18.0
Race/Ethnicity			
White/non-Hispanic	82.1 (2321)	67.5	11.4
Minority	17.9 (314)	72.3	13.9
Education			
Less than college graduate	77.7 (1987)	67.7	11.7*
College graduate	22.3 (648)	70.4	19.7
Income			
<$50 000	55.9 (1467)	65.2*	11.7*
≥$50 000	44.1 (1178)	72.3	15.8
Marital status			
No spouse or partner	45.0 (1405)	66.2	12.9
Has spouse or partner	55.0 (1230)	70.1	13.9
Children in household			
No children	71.3 (1859)	68.8	14.4
1 or more children	28.7 (776)	67.2	11.3
Smoking characteristics			
Smoking dependence			
Not dependent	65.5 (1729)	74.0*	15.8*
Dependent	34.6 (906)	57.5	9.0
Quit attempts in past y			
No attempts	53.9 (1405)	54.8*	12.3
1 or more quit attempts of ≥24 h	46.1 (1230)	84.2	14.9
Quitting plans in next 30 d			
No plan to quit	74.2 (1936)	62.1*	11.9*
Plan to quit	25.8 (697)	86.3	17.9
Smoking environment			
Spouse smoking status			
Spouse or partner does not smoke	77.3 (2193)	68.6	13.9
Spouse or partner smokes	22.7 (442)	67.5	12.1
Friends smoking status			
Less than half	49.0 (1366)	71.8*	15.6*
Half or more	51.0 (1269)	65.0	11.4
Perceived town smoking norm[a]			
Low antismoking norm	82.2 (2159)	66.0*	12.6*

Continued

perceiving strong antismoking norms (28.0%), which was followed at some distance by persons living in houses with a smoking ban (18.2%), those 60 years and older (18.0%), and those planning to quit in 30 days (17.9%). The lowest cessation rates were for dependent smokers (9.0%), those without a household smoking ban (10.4%), and those working in a location without a smoking ban (10.9%).

The multivariate analyses (Table 3) showed that only 1 sociodemographic factor—being aged 18 to 30 years—was significantly associated with both quit attempts and cessation. Compared with smokers aged 31 to 59 years, the younger group had nearly 70% better odds of quitting by either measure. Smokers who were at least 60 years old and those who were college graduates were significantly more likely to have abstained for more than 3 months at the end of the period, but these factors did not predict the likelihood of making a quit attempt during the 2 years. Gender, race, having a spouse or partner, and the presence of children in the household did not significantly predict either outcome.

Smokers who said at the transition baseline that they planned to quit in the next 30 days were about 1.5 times as likely as others to have abstained for 3 or more months 2 years later, and they were more than twice as likely to have made a quit attempt during the period. Nondependent smokers had 44% to 47% greater odds of attempting to quit and abstaining for 3 or more months than dependent smokers. Having quit for 1 day or more in the year before the baseline interview was significantly associated with quit attempts during the next 2 years but not with abstaining for more than 3 months at the end of the period.

Smokers who perceived a strong antismoking norm in their town at baseline were more than twice as likely to make a quit attempt and to succeed for more than 3 months than were those perceiving weak norms. Perceiving medium-strength norms was significantly associated with 24-hour quit attempts but not with cessation at the end of the period. Neither of the other measures of the social-normative factors—having a smoking spouse or partner and having half or more of friends smoking—were significant predictors.

Among the smoking policies considered, the presence of a household ban on smoking

TABLE 2—*Continued*

Medium antismoking norm	13.5 (330)	77.4	14.2
High antismoking norm	4.3 (146)	84.0	28.0
Smoking policies			
Household smoking policy			
Smoking allowed	60.6 (1602)	63.6*	10.4*
Smoking ban for residents and visitors	39.4 (1033)	75.6	18.2
Workplace smoking policy			
Does not work at indoor job	44.8 (1562)	66.7	13.5
Workplace does not have smoking ban	14.0 (264)	63.6	10.9
Workplace has smoking ban	41.2 (809)	71.7	14.3
Town tobacco control policies			
Restaurant regulations at transition baseline			
No ban	82.2 (2162)	67.5	13.5
Ban	17.8 (473)	72.0	13.3
Workplace regulations at transition baseline			
No ban	90.2 (2362)	68.4	13.3
Ban	9.8 (273)	67.9	15.3
Change in clean indoor air regulations			
No increment	56.8 (1473)	67.5	13.8
Additional strong policy at transition end	43.2 (1162)	69.4	13.1
Youth sales enforcement at transition baseline			
Not strong	79.3 (2083)	68.4	13.3
Strong	20.7 (552)	68.0	14.3
Marketing restrictions at transition baseline			
Not strong	19.5 (515)	70.9	12.2
Strong	80.5 (2120)	67.7	13.8
Change in youth-oriented regulations			
No increment	89.3 (2331)	68.6	13.1
Additional strong policy at transition end	10.7 (304)	66.4	16.5
Town population characteristics			
Percentage voting for Question 1[b]			
< 50%	66.2 (1725)	67.9	12.6
≥ 50%	33.8 (910)	69.2	15.2
Population size			
Under 20 000	29.8 (842)	65.8*	15.0
20 000–50 000	31.1 (850)	65.0	12.6
> 50 000	39.2 (943)	72.9	13.1
Percentage non-Hispanic White[b]			
< 90%	54.7 (1359)	70.9*	11.7
≥ 90%	45.3 (1276)	65.2	15.6
Percentage < 18 y[c]			
< 25%	62.7 (1608)	67.8	14.2
≥ 25%	37.3 (1027)	69.2	12.3

Note. The unit of analysis was the transition, i.e., an individual observed for 2 consecutive interviews. N = 2635 transitions, which included 902 individuals with 2 transitions and 831 with 1 transition. Weighted percentages are shown.
[a]"High" antismoking norm was defined as giving the most antismoking possible response on 3 items (perceived adult prevalence, perceived youth prevalence, and perceived adult opinions about restaurant smoking). Respondents giving the most antismoking response on 2 out of 3 items were classified as "medium," and 0 or 1 antismoking responses were classified as "low."
[b]Entered in multivariate analysis as a continuous variable.
*$P < 0.05$, in bivariate test.

was a significant predictor of both quit attempts and cessation. Smokers who had a household smoking ban at the transition baseline had 30% greater odds of reporting a quit attempt during the period and 63% greater odds of abstaining for more than 3 months at the transition ending.

Respondents who worked at a job with a workplace smoking ban at the transition baseline had 64% better odds of making a quit attempt relative to those whose workplace had no ban. Although the estimated odds ratio for abstention for 3 or more months was similar, it was not statistically significant ($P = .12$). Having a workplace ban introduced after baseline did not significantly predict either outcome, but the association with making a quit attempt approached statistical significance ($P = .08$). Town-level policies did not significantly predict either quit attempts or cessation.

We undertook 2 supplementary analyses to determine whether policies might have significant effects that were masked in our particular specification. First, because we hypothesized that policies affect smoking behavior indirectly by influencing social norms, we reestimated the models first without the measures of perceived norms and then without any individual or family variables that might plausibly mediate the effect of town policies (spouse and friends' smoking, smoking dependence, plans to quit, previous quit attempts, and household smoking bans). In addition, because the multiple policy measures might be intercorrelated, we repeated the modeling with each measure taken individually as well as with a composite measure indicative of the number of strong policies in the town, which had been used in previous analyses.[3] No measure of town policy in any of these analyses significantly predicted cessation. Finally, none of the town characteristics, including prior town support for tobacco taxes, proved to be significant predictors of either outcome.

DISCUSSION

To our knowledge, our study is the first longitudinal examination of the impact of norms and local policies on smoking behavior. The aim of these analyses was to uncover factors that could contribute to an increase in the rate of cessation among adult smokers. Of

TABLE 3—Multivariate Analysis of Cessastion Behaviors Over 2 Years: 2003–2006

	Any Quit Attempts		Quit for ≥3 Months at Transition End	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Sociodemographic characteristics				
Gender				
Men (Ref)	1.00		1.00	
Women	0.898 (0.710, 1.135)	0.367	1.085 (0.808, 1.455)	0.588
Age, y				
18–30	1.696 (1.265, 2.273)	0.001	1.672 (1.154, 2.424)	0.007
31–59 (Ref)	1.00		1.00	
≥60	1.149 (0.811, 1.628)	0.436	1.996 (1.261, 3.161)	0.004
Race/Ethnicity				
Non-Hispanic White	1.104 (0.788, 1.547)	0.566	1.361 (0.797, 2.326)	0.260
Minority (Ref)	1.00		1.00	
Education				
Less than college graduate (Ref)	1.00		1.00	
College graduate	0.858 (0.640, 1.149)	0.303	1.449 (1.028, 2.042)	0.034
Income				
<$50 000 (Ref)	1.00		1.00	
≥$50 000	1.260 (0.978, 1.622)	0.073	1.159 (0.833, 1.613)	0.381
Children in household				
No children (Ref)	1.00		1.00	
One or more children	0.840 (0.658, 1.072)	0.161	0.760 (0.545, 1.060)	0.105
Smoking characteristics at transition baseline				
Smoking dependence				
Not dependent	1.440 (1.128, 1.837)	0.004	1.470 (1.064, 2.030)	0.019
Dependent (Ref)	1.00		1.00	
Quitting plans				
No plan to quit (Ref)	1.00		1.00	
Plan to quit in next 30 d	2.715 (2.042, 3.609)	0.000	1.503 (1.098, 2.058)	0.011
Quit attempts in past y				
No attempts (Ref)	1.00		1.00	
1 or more quits of ≥24 h	3.191 (2.531, 4.024)	0.000	1.007 (0.738, 1.373)	0.966
Social-normative factors at transition baseline				
Spouse smoking status				
Nonsmoking spouse or partner (Ref)	1.00		1.00	
Smoking spouse or partner	0.933 (0.688, 1.265)	0.655	0.922 (0.605, 1.405)	0.707
No spouse or partner	0.863 (0.660, 1.127)	0.279	0.865 (0.603, 1.241)	0.432
Friends smoking status				
Less than half (Ref)	1.00		1.00	
Half or more	0.858 (0.678, 1.084)	0.199	0.861 (0.647, 1.146)	0.307
Perceived town smoking norm				
Low antismoking norm (Ref)	1.00		1.00	
Medium antismoking norm	1.694 (1.146, 2.502)	0.009	1.020 (0.655, 1.590)	0.929
High antismoking norm	2.307 (1.364, 3.902)	0.002	2.059 (1.247, 3.402)	0.005
Smoking policies at transition baseline				
Household smoking policy				
Smoking allowed (Ref)	1.00		1.00	
Smoking ban for residents and visitors	1.297 (1.015, 1.656)	0.037	1.633 (1.185, 2.251)	0.003

Continued

all the predictors we examined, the one most strongly predictive of cessation after 2 years was the perception of strong antismoking norms in one's town. Our results are consistent with the hypothesis that policies of various types can promote quit attempts, although the results for longer-term abstention are mixed. Self-imposed household policy, i.e., prohibiting smoking in the house by either residents or visitors, significantly predicted both quit attempts and cessation. Although a household ban may often stem from the smoker's intention to quit, the effect is observed even when controlling for an individual's stated plans to quit and previous quit attempts. Policies established by external entities, however, showed no significant association with quitting.

Our earlier research found that the greater the number of strong tobacco control policies in effect in one's town, the more likely that one was to report antitobacco norms among the residents.[3] This relationship persisted in the data we analyzed. We found that perceptions of strong antismoking norms in one's town predicted both quit attempts and cessation. Thus, it is puzzling that we did not find a direct relation between town policies and smoking behavior in this longitudinal analysis. Several explanations are possible for this lack of relation between town policies and individual behavior. First, it is clear that more proximal factors dealing with the individual and the household are important determinants of changes in smoking behavior. Highly addicted smokers and those who had no plans to quit in the near future were less likely to be abstinent 2 years later.

Second, intrahousehold dynamics seemed important in that those who had established a prohibition on smoking in the home were more likely to quit than those who had not. The household policy may be a proxy for motivation to quit and family concerns about environmental tobacco smoke. In comparison with these intra- and interpersonal factors, the policies in effect in one's town may be too remote to demonstrate a significant impact on behavior. If town policy is one among many factors influencing perceived norms, and perceived norms are among many factors influencing cessation, larger samples may be required to clearly distinguish the effect of town policy on quitting behaviors, especially for relatively low-frequency outcomes such as lengthy abstention.

TABLE 3—*Continued*

Employer's workplace smoking policy				
No indoor job at 1 or both waves	1.622 (1.055, 2.493)	0.027	1.407 (0.762, 2.599)	0.275
Workplace has no ban, both waves (Ref)	1.00		1.00	
Workplace has smoking ban at transition baseline	1.644 (1.012, 2.670)	0.044	1.662 (0.875, 3.160)	0.121
Workplace gets smoking ban by transition ending	1.722 (0.939, 3.159)	0.079	1.327 (0.583, 3.019)	0.499
Town tobacco control policies				
Restaurant regulations at transition baseline				
No ban (Ref)	1.00		1.00	
Ban	1.283 (0.908, 1.814)	0.159	0.798 (0.478, 1.334)	0.390
Workplace regulations at transition baseline				
No ban (Ref)	1.00		1.00	
Ban	0.874 (0.536, 1.426)	0.590	1.107 (0.502, 2.443)	0.801
Change in clean indoor air regulations				
No increment (Ref)	1.00		1.00	
Additional strong policy at transition ending	1.083 (0.862, 1.361)	0.493	0.949 (0.685, 1.314)	0.753
Youth sales enforcement at transition baseline				
Not strong (Ref)	1.00		1.00	
Strong	0.920 (0.707, 1.197)	0.536	1.066 (0.744, 1.528)	0.727
Marketing restrictions at transition baseline				
Not strong (Ref)	1.00		1.00	
Strong	0.849 (0.636, 1.132)	0.265	1.261 (0.879, 1.811)	0.208
Change in youth-oriented regulations				
No increment (Ref)	1.00		1.00	
Additional strong policy at transition ending	0.744 (0.523, 1.058)	0.099	1.286 (0.818, 2.023)	0.277
Town population characteristics				
Percentage voting for Question 1 (continuous)	1.001 (0.985, 1.018)	0.877	0.993 (0.971, 1.016)	0.559
Population size				
<20 000 (Ref)	1.00		1.00	
20 000–50 000	0.966 (0.714, 1.306)	0.823	0.875 (0.611, 1.254)	0.468
>50 000	1.375 (0.930, 2.033)	0.111	1.157 (0.702, 1.907)	0.566
Percentage non-Hispanic White (continuous)	0.999 (0.989, 1.008)	0.789	1.009 (0.997, 1.022)	0.156
Percentage <18 y (continuous)	0.995 (0.964, 1.027)	0.773	0.994 (0.952, 1.038)	0.783

The primary potential threat to the validity of our findings is the relatively high rate of loss to follow-up in the study. Although not unusual for a telephone survey in which respondents are followed for 4 years, the follow-up rates of 57% at wave 2 and 38% at wave 3 do introduce the possibility of a differential loss to follow-up bias. Analyses of the baseline differences between adult respondents to either wave 2 or wave 3 and those who failed to respond indicated that responders were significantly more likely to be older, to be female, to be non-Hispanic White, and to have higher levels of education. To correct for this biased attrition, we used these variables in an iterative raking procedure. We created adjustments to the baseline weights that yielded distributions on these demographic variables that were either identical to those at baseline or differed by at most four tenths of a percentage point. Hence, we believe that we minimized this threat to validity. ■

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Contributors

L. Biener, W.L. Hamilton, and M. Siegel designed the study. L. Biener oversaw the development of the survey instrument, the data collection, and the construction of the person-level data files. W.L. Hamilton, M. Siegel, and E. Sullivan developed the town-level data files. W.L. Hamilton carried out the multi-level modeling. L. Biener, W.L. Hamilton, and M. Siegel drafted the article, and E. Sullivan made critical comments on the drafts. All authors read and approved the final version.

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Human Participant Protection

The data collection protocol was reviewed and approved by the institutional review boards of both the University of Massachusetts, Boston, and the Boston University School of Public Health.

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