

# Tobacco use by Massachusetts public college students: long term effect of the Massachusetts Tobacco Control Program

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**Objective:** To assess tobacco use among Massachusetts public college students and compare students who attended high school in Massachusetts and were exposed to the Massachusetts Tobacco Control Program (MTCP) with students who attended high school outside Massachusetts and were unexposed to the programme.

**Design:** Analysis of the 1999 Massachusetts College Alcohol Survey.

**Setting:** Four year public colleges and universities in Massachusetts (n = 11).

**Subjects:** 1252 randomly selected students (response rate 56%).

**Main outcome measures:** Self report of current (past 30 day), past year, and lifetime use of cigarettes, cigars, and smokeless tobacco.

**Results:** One third of students had used a tobacco product in the past month and 46.4% had used tobacco in the past year. Cigarettes accounted for most of this tobacco use. Total tobacco use was higher among males than females but cigarette smoking did not differ by sex. Tobacco use was lower among athletes and higher among students who used alcohol or marijuana. Current tobacco use was lower among public college students who had attended high school in Massachusetts compared with those who attended high school in another state (31.5% v 42.6%, p = 0.006). This difference persisted after adjustment for age, sex, race, parental education, and students' college residence (adjusted odds ratio [OR] 0.67, 95% confidence interval [CI] 0.46 to 0.97, p = 0.034).

**Conclusion:** Tobacco use is common among Massachusetts public college students. Students who were exposed to the MTCP during high school are less likely to use tobacco than their peers who were not exposed to this programme. The MTCP may have reduced tobacco use among this group of young adults.

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Tobacco use is rising among young adults (aged 18–24 years) in the USA, reflecting the aging of a cohort of adolescents whose smoking rates increased by 32% between 1991 and 1997.<sup>1–3</sup> Young adults are also the youngest legal targets of tobacco industry marketing and may consequently be initiating tobacco use in larger numbers. US colleges and universities offer a channel for interventions to discourage young adult tobacco use. More than one third of US adults attend college, and one quarter attend a four year college.<sup>4</sup> Previous work showed that cigarette smoking prevalence rose 28% among a nationally representative sample of US college students between 1993 and 1997 and did not change in 1999.<sup>5,6</sup> Total tobacco use rates were even higher because college students use all forms of tobacco.<sup>6</sup>

This paper reports the prevalence and patterns of use of all tobacco products among a random sample of students attending 11 Massachusetts four year public colleges and universities.<sup>7</sup> It provides an opportunity to explore a potential impact of Massachusetts' comprehensive Tobacco Control Program (MTCP) on smoking by young adults. MTCP's goals are to reduce tobacco uptake by youths, increase cessation among adults, and protect non-smokers from secondhand smoke.<sup>8,9</sup> Activities relevant to youth include an aggressive statewide mass media counter-advertising campaign, support to local health departments to enact and enforce youth access and clean indoor air regulations, and programmes such as school based tobacco education and outreach to at-risk youths.<sup>9</sup> Approximately \$39 million are spent per year.<sup>8</sup> Activities began in 1993, funded by a 1992 increase in the state tobacco excise tax.

The MTCP has reduced per capita cigarette consumption and adult tobacco prevalence in Massachusetts.<sup>8,9</sup> A delayed fall in adolescent tobacco prevalence appeared after 1996.<sup>10</sup> Whether this decline will persist into young adulthood is

unknown. Massachusetts youth who were teenagers in 1993 when the MTCP began are now young adults, and many of them attend college. If the programme has had long term effects, college students who attended high school in Massachusetts and were exposed to the MTCP should have lower tobacco use rates than college students who attended high school outside the state and were not exposed to the programme.

## METHODS

### Sample of colleges

The sample of colleges was drawn from the 13 four year public colleges and universities accredited by the Massachusetts Board of Higher Education. The sample was limited to colleges that provided on-campus housing for at least 20% of undergraduates. This was done to permit an analysis of the relation between residential smoking policies and student tobacco use. All 11 institutions meeting these criteria agreed to participate. The sample included one school with > 10 000 students, three schools with 5001–10 000 students, and seven schools with ≤ 5000 students. Six schools were located in urban or suburban areas. Five were in small town or rural areas.

### Sample of students

Data were collected as part of the 1999 Massachusetts College Alcohol Study, which surveyed a randomly selected sample of 225 students enrolled at each of the 11 participating colleges. The Center for Survey Research at the University of Massachusetts, Boston, conducted the survey and supervised the drawing of the sample. College registrars were sent guidelines for drawing a random sample of undergraduates from their total enrolment of full time students. For quality control,

**Table 1** Prevalence of tobacco use by sex and race in 11 Massachusetts public colleges, 1999\*

	All n=1248	Male n=511	Female n=737	p Value	White n=1063	Black n=34	Asian n=34	Hispanic n=62	p Value†
Total tobacco									
Current use	33.2	37.6	30.1	0.006	34.7	14.7	15.1	29.0	0.009
Past year use	46.4	53.3	41.6	<0.001	49.0	26.5	21.2	32.3	<0.001
Lifetime use	64.5	68.8	61.5	0.009	67.0	38.2	36.4	56.5	<0.001
Cigarettes									
Current use	29.3	29.0	29.4	0.872	30.9	8.8	14.7	25.8	0.005
Past year use	38.7	37.2	39.7	0.366	40.9	17.7	20.6	27.4	0.001
Lifetime use	56.2	52.3	58.9	0.021	58.6	29.4	29.4	51.6	<0.001
Cigars									
Current use	6.0	10.9	2.6	<0.001	6.2	5.9	0	3.3	0.486
Past year use	19.4	33.2	9.8	<0.001	20.8	8.8	2.9	9.8	0.002
Lifetime use	35.3	56.7	20.5	<0.001	37.5	11.8	20.6	21.3	<0.001
Smokeless tobacco									
Current use	2.6	6.4	0		2.8	0	0	1.6	0.412
Past year use	5.7	12.5	1.0	<0.001	6.2	0	3.0	3.2	0.452
Lifetime use	15.6	30.8	5.2	<0.001	16.6	0	6.1	11.3	0.007

\*Results on race exclude data on students reporting Native American or other race.

†p Values for  $\chi^2$  or Fisher's exact test.

demographic characteristics of students in each sample were compared with the known distribution of these factors in that school's enrolment data. If the distributions were dissimilar, a statistician contacted the school to review the sampling procedure and, if necessary, supervise a redrawing of the sample.

Three separate mailings were sent: a questionnaire with a cover letter, a reminder postcard, and a second questionnaire. Questionnaires were mailed to 2475 students during the first two weeks of April 1999. A reminder postcard was mailed four days later. A second survey was mailed to non-responders during the first two weeks of May 1999. A total of 230 surveys were undeliverable because of incorrect or missing student addresses; 1256 questionnaires were returned (56% response rate). Four questionnaires were excluded from analysis because the source school could not be identified. Response rates varied between 49–65% among the 11 colleges. The correlation between individual schools' enrolment and response rate was  $-0.24$  ( $p = 0.46$ ).

### Questionnaire

The questionnaire, an abbreviated version of that used in the 1999 Harvard School of Public Health's College Alcohol Study,<sup>6</sup> was anonymous but included an individual school code number. Demographic factors assessed were age, sex, race, year in school, marital status, and highest level of parental education attained (a proxy for socioeconomic status). To assess tobacco use, respondents were asked if they had smoked a cigarette or cigar or used smokeless tobacco. Response options were "never used", "used, but not in the past 12 months", "used, but not in the past 30 days", or "used in the past 30 days." Students were asked about their place of residence and whether it was designated as smokefree. Other questions asked about current marijuana and alcohol use, and grade point average. One item assessed the importance a student placed on participation in eight activities (academic work, athletics, arts, fraternity or sorority life, parties, religion, community service, political activism). Response categories were collapsed for analysis (very important or important v somewhat or not at all important).

### Data analysis

For each tobacco product, students who reported any use were considered to be lifetime users. Past year users were those who reported having used the product in the past year. Current users were students who used the product in the past 30 days. Total tobacco use included any use of cigarettes, cigars, or smokeless tobacco.

Univariate analyses identified student characteristics associated with current cigarette smoking and total tobacco use. Factors that were significantly associated with these outcomes in the univariate analysis ( $p < 0.05$ ) were included in multiple logistic regression models. Models were built for two outcomes—current cigarette smoking and current total tobacco use. All multivariate models adjusted for sex, ethnicity, year in school, marital status, and highest parental educational attainment. SUDAAN software was used to adjust for the clustering of students within schools in the sample design and for the variability among schools in the sampling fraction. Adjusted odds ratios with 95% confidence limits are reported.

To examine the effect of prior exposure to the Massachusetts Tobacco Control Program (MTCP), tobacco use rates were compared between students who attended high school in Massachusetts and those who attended high school outside the state. This analysis was limited to respondents who were aged 17–23 in 1999. These individuals were exposed to the MTCP as adolescents because they were aged 11–17 when the MTCP started in 1993. Multivariate analysis using SUDAAN was used to adjust the relation for age, sex, race, and parental educational attainment, and student's college residence.

## RESULTS

### Characteristics of the sample

Fifty nine per cent of the 1252 respondents were female; 88% of respondents were white, 5% were Hispanic, 3% were African American, and 3% were Asian. Eighty eight per cent of respondents were 18–24 years old; 23% were freshmen, 25% were sophomores, 25% were juniors, 21% were seniors, and 7% were fifth year or postgraduate students. Ninety five per cent were unmarried. Forty seven per cent of respondents had one or more parent with a college degree. Half of the sample lived in college housing, while 30% lived with a parent or relative, and 9% lived with a spouse or significant other. Fewer than 1% of students lived in a fraternity or sorority. Eighty three per cent of respondents had attended high school (grades 9–12) in Massachusetts. Of 613 students who lived in college housing, 27% reported that their housing was designated as smokefree.

### Prevalence of tobacco use

One third of respondents had used a tobacco product in the past month, nearly half used tobacco in the past year, and nearly two thirds had ever used tobacco (table 1). Cigarettes accounted for most of the tobacco use. Over half of college students had smoked a cigarette, 39% had done so in the past year, and 29% were current (past 30 day) cigarette smokers.

**Table 2** Factors associated with current use of tobacco products: multivariate analysis

	Total tobacco use			Cigarette use		
	AOR	95% CI	p Value	AOR	95% CI	p Value
Sex						
Male	1			1		
Female	0.59	0.38, to 0.92	0.02	1.19	0.73 to 1.94	0.44
Race						
White	1			1		
African American	0.38	0.78 to 1.90	0.21	0.13	0.02 to 0.94	0.04
Asian	0.73	0.20 to 2.71	0.60	1.16	0.30 to 4.60	0.81
Hispanic	1.39	0.55 to 3.48	0.44	1.32	0.50 to 3.45	0.54
Year in school						
Freshman	1			1		
Sophomore	1.28	0.65 to 2.51	0.43	1.29	0.63 to 2.63	0.45
Junior	1.41	0.74 to 2.71	0.27	1.15	0.58 to 2.29	0.66
Senior	1.21	0.60 to 2.43	0.56	1.08	0.51 to 2.26	0.83
Marital status						
Single	1			1		
Married	0.92	0.29 to 2.90	0.87	1.19	0.37 to 3.85	0.74
Parental education						
Any college graduate	1.34	0.85 to 2.13	0.19	1.49	0.93 to 2.40	0.09
No college graduate	1			1		
Place of residence						
College housing	1.20	0.72 to 2.01	0.45	0.88	0.51 to 1.54	0.64
With parents	1			1		
Other off campus	1.06	0.53 to 2.11	0.86	1.07	0.53 to 2.19	0.83
Other tobacco use						
Cigars	NA			6.22	2.34 to 16.56	<0.01
Smokeless	NA			3.98	1.40 to 11.34	0.01
Other substance use						
Marijuana use	4.83	2.90 to 8.03	<0.01	5.12	3.09 to 8.50	<0.01
Binge drinking*	3.19	1.89 to 5.40	<0.01	3.62	2.07 to 6.36	<0.01
Education						
GPA (>B average)	1.23	0.77 to 1.97	0.35	1.03	0.62 to 1.69	0.91
Participation is important						
Athletics	0.36	0.21 to 0.63	<0.01	0.28	0.15 to 0.50	<0.01
Academics	1.71	0.60 to 4.82	0.28	1.57	0.47 to 5.21	0.43
Religion	1.10	0.66 to 1.82	0.69	0.93	0.54 to 1.60	0.77
Parties	1.29	0.78 to 2.13	0.28	1.23	0.74 to 2.06	0.39

AOR, adjusted odds ratio; 95% CI, 95% confidence interval; GPA, grade point average.

\*Binge drinking for males was defined as reporting  $\geq 5$  drinks on one or more occasions in the past two weeks; for females the limit was  $\geq 4$  drinks.

Cigar smoking accounted for the largest share of non-cigarette tobacco use. Over one third of college students had ever smoked a cigar, including more than half of males and one fifth of females (table 1). Nearly one in five college students had smoked a cigar in the past year, and 6% had smoked a cigar in the past month. Smokeless tobacco use was much less prevalent than cigarette or cigar smoking. Most current tobacco users used only one tobacco product; 14% of current tobacco users used more than one product.

Total tobacco use was higher among males than females (table 1). The sex difference was attributable to a higher prevalence of cigar and smokeless tobacco use among males. There was no sex difference in cigarette smoking rates. The prevalence of current, past year, and lifetime total tobacco use and cigarette smoking were significantly lower among African Americans, Asians, and Hispanics than among whites (table 1). Tobacco use rates did not differ significantly by grade in school. Among students living in college housing, current total tobacco use did not differ between students in smokefree housing and those in housing without this designation (35.0% v 35.8%,  $p = 0.85$ ).

### Correlates of tobacco use

Table 2 displays the factors independently associated with current use of any tobacco product and of cigarettes. Total tobacco use was significantly ( $p < 0.05$ ) higher among males, binge drinkers, and marijuana users. It was lower among students who rated participation in athletics as important to them. Total tobacco use was not related to race after adjustment for parental educational attainment, a marker of

socioeconomic status. In contrast, cigarette smoking was related to race, with less smoking by African Americans than by whites. Cigarette smoking did not differ by sex but, like total tobacco use, was higher among binge drinkers and marijuana users and lower among students who valued participation in athletics.

### Exposure to MTCP

Of the 1060 students in the Massachusetts public college sample who were under the age of 24 years in 1999, 85% had attended senior high school in the state. Compared to students who attended high school out of state, students who attended high school in Massachusetts were more likely to be female (61% v 49%,  $p = 0.004$ ) and white (91% v 85%,  $p = 0.010$ ), and less likely to have parents who were college graduates (48% v 65%,  $p < 0.0001$ ). They were more likely to live with parents (33% v 9%,  $p < 0.0001$ ) and less likely to live in university housing (53% v 74%,  $p < 0.0001$ ).

Public college students who had attended high school in Massachusetts had lower tobacco use rates than students who had attended high school outside the state (table 3). The 39% lower rate of current total tobacco use by students from Massachusetts high schools (unadjusted odds ratio (OR) 0.61, 95% confidence interval (CI) 0.43 to 0.87) remained significant after adjustment for demographic factors (age, sex, race, parental educational attainment) and students' college residence (adjusted OR 0.67, 95% CI 0.46 to 0.97,  $p = 0.03$ ). The lower rate of current cigarette smoking among students from Massachusetts high schools (unadjusted OR 0.62, 95% CI 0.44 to 0.87,  $p < 0.01$ ) also persisted after adjustment for

**Table 3** Tobacco use in Massachusetts public college students by state of high school attendance

	All n=1060	Massachusetts high school n=898	Out-of-state high school n=162	p Value
Total tobacco use				
Current use	33.2	31.5	42.6	0.006
Past year use	46.6	45.4	53.8	0.050
Cigarettes				
Current use	29.2	27.5	38.3	0.006
Past year use	39.0	37.5	46.9	0.024
Cigars				
Current use	6.2	6.3	5.6	0.732
Past year use	19.7	18.6	25.9	0.030
Smokeless tobacco				
Current use	2.8	2.5	4.9	0.079
Past year use	6.0	5.6	8.0	0.225

Analysis limited to students aged 17–23 years old in 1999.

demographic factors (adjusted OR 0.68, 95% CI 0.48 to 0.98,  $p = 0.04$ ), but not after adjustment for students' residence (adjusted OR 0.74, 95% CI 0.51 to 1.06,  $p = 0.10$ ).

Because nearly all students who lived with parents had attended high school in state, we repeated the analyses, excluding students who lived with parents. Among students who did not live with parents ( $n = 707$ ), those who attended high school in Massachusetts had a lower rate of current total tobacco use (34.9% *v* 46.9%,  $p = 0.009$ ) and current cigarette use (29.6% *v* 42.0%,  $p = 0.005$ ) than students who attended high school outside Massachusetts. For both end points, the effects remained significant after controlling for age, sex, race, parental educational attainment, and student's college residence (total tobacco use: adjusted OR 0.66, 95% CI 0.45 to 0.96,  $p = 0.03$ ; current cigarette smoking: adjusted OR 0.58, 95% CI 0.40 to 0.87,  $p < 0.01$ ).

## DISCUSSION

This work demonstrates that Massachusetts public college students use tobacco products at substantial rates. Current, past year, and lifetime tobacco use rates in this Massachusetts public college sample are similar to those reported for the same year (1999) by students in a nationally representative sample of 119 US public and private colleges.<sup>6</sup> The pattern of tobacco use in Massachusetts is also similar to the national sample. In both samples, total tobacco use rates were higher in males than females because of males' higher use of non-cigarette tobacco products, but there was no sex gap in cigarette smoking rates. The lower prevalence of tobacco use among non-whites as compared to whites reported in the national sample is also present in the Massachusetts sample. However, in Massachusetts only the lower rate of cigarette smoking among African Americans remains significant in multivariate models. As in the national sample, tobacco use was higher among users of other substances (alcohol and marijuana) and lower among students who valued participation in athletics.

Massachusetts has had a comprehensive tobacco control programme that aims to reduce youth tobacco use since 1993.<sup>8,9</sup> The college students in this study were adolescents (aged 11–17) in 1993 at the start of the MTCP. Those who lived in Massachusetts during these years were exposed to the MTCP, while those who lived outside Massachusetts were not exposed to a similar programme (California was the only other state with a comparable tobacco programme during those years). Living in Massachusetts during high school, a marker of exposure to the MTCP, was associated with a lower prevalence of tobacco use among Massachusetts public college students.

This finding suggests that the program may have had a long term effect on smoking prevalence among young adults. It is

consistent with recent Massachusetts school survey data that show a drop in adolescent tobacco use between 1996 and 1999.<sup>10</sup> However, our finding should be interpreted with caution. Students who attended high school in Massachusetts differ from students who attended high school out-of-state in ways that could potentially confound the relation with tobacco use. The lower rate of tobacco use by students from Massachusetts high schools persisted after adjustment for age, race, sex, socioeconomic status, and student's place of residence, which strengthens the case for attributing the difference in tobacco use to exposure to the MTCP. However, there are likely to be other differences between students who come to Massachusetts public colleges from in-state as opposed to out-of-state. It is possible that unmeasured factors may confound the relation we observed between tobacco use and state of residence during high school.

A smokefree policy for colleges has been advocated to discourage tobacco use and reinforce the message that non-smoking is the norm.<sup>11,12</sup> In the national sample of college students, there was less tobacco use among students living in smokefree residences.<sup>11</sup> This was not observed in Massachusetts public college students in the current study. A possible explanation is the limited variability in Massachusetts public colleges' smoking policies. All colleges in the sample restrict smoking in indoor public areas and designate some dormitory rooms as non-smoking, although only two schools prohibit smoking in all living quarters (NA Rigotti, unpublished data).

The results of this study must be viewed within the context of its limitations. Because the survey response rate was 56%, non-response bias is possible. The national College Alcohol Study, which developed the method for the current survey, found no correlation between response rate at a college and smoking rate.<sup>6</sup> Two other procedures to test for non-response bias in the larger national College Alcohol Survey sample found no evidence of this bias.<sup>6</sup> The two procedures could not be conducted in the current study because of the small number of colleges but do suggest that the chance of non-response bias is small. Another limitation is that self report was our measure of tobacco use. Biochemical measures have established the validity of relying on self reported smoking status in national surveys.<sup>13,14</sup> Under reporting of smoking status is probably even less likely in this survey, which focused on alcohol rather than tobacco.

This study suggests that MTCP, which targets adolescents, may have had a long term effect on college students who were exposed to the programme as adolescents. This is important because college students represent the largest single group of young adults aged 18–24 years, a group in whom tobacco use rates have risen.<sup>15</sup> Young adults are also the youngest age group that tobacco manufacturers can legally target for marketing efforts. The college years are a crucial period in the

### What this paper adds

Evidence from several US states shows that comprehensive tobacco control programmes are followed by reductions in adolescent and adult tobacco prevalence. However, the durability of these effects on young adults, in whom tobacco use prevalence is rising, is not known.

A cross sectional survey of 1252 randomly selected students enrolled in 11 Massachusetts public colleges in 1999 found that students who had attended high school in the state (and had thus been exposed to the Massachusetts Tobacco Control Program since 1993) had a lower smoking prevalence than students who had attended high school outside the state and were not exposed to a comprehensive tobacco control programme as adolescents. This finding suggests that the comprehensive tobacco control programme may have had a long term effect on smoking prevalence among young adults.

development or abandonment of smoking behaviour, and college students should be included in all tobacco control efforts.<sup>6</sup> Colleges offer a potential site for interventions to discourage tobacco use. Data from this study can help colleges to target interventions to the students at greatest risk of using specific tobacco products. One clear message is that college alcohol and substance use prevention and treatment programmes should include tobacco because use patterns are so highly correlated.

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