

# Coronary Heart Disease Deaths And Decreased Smoking Prevalence in Massachusetts, 1993–2003

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We used the previously validated IMPACT coronary heart disease (CHD) mortality model to estimate the CHD deaths attributable to reductions in smoking prevalence following the introduction of the Massachusetts Tobacco Control Program (MTCP) in 1993. A 29% and 31% decline in smoking prevalence and CHD mortality rates occurred, respectively (from 1993 to 2003). A total of 425 fewer CHD deaths, which generated approximately 3365 extra life-years, were attributable to decreased smoking prevalence. With these results in mind, a comprehensive tobacco control program should be sustained and supported. (*Am J Public Health*. 2008; 98:XXX–XXX. doi:10.2105/AJPH.

Monitoring and evaluating of comprehensive tobacco control programs such as the Massachusetts Tobacco Control Program (MTCP) can provide valuable data and evidence to support the health effects of reduced tobacco use on a population basis. The MTCP, funded by a 1992 ballot initiative that launched a statewide program through a special cigarette tax, has had a dramatic effect on adult smoking prevalence since the program's introduction in January 1993.<sup>1</sup> Therefore, the population health impact of the MTCP on reducing coronary heart disease (CHD) death rates is an important issue for which we provide new quantitative analysis.

## METHODS

We used a previously validated dynamic, comprehensive CHD mortality model, the IMPACT model, to determine how much of the CHD mortality decline in Massachusetts between 1993 and 2003 is attributable to reductions in smoking prevalence (for smokers aged 25–84 years). CHD mortality was defined using the *International Statistical Classification of Diseases, 9th Revision (ICD-9)* codes 410 to 414.<sup>2</sup> Details of the IMPACT model are published elsewhere.<sup>3,4</sup> This model, recently applied to the US population,<sup>5</sup> estimates the independent effect of each of the cardiovascular risk factors, including smoking prevalence on CHD death rates. We also determined the number of extra years gained from such fewer CHD deaths and the projected number of fewer CHD deaths by 2010.

The population-attributable risk (PAR) percentage was used to determine the independent effect of changes in the prevalence of smoking. PAR was calculated conventionally as

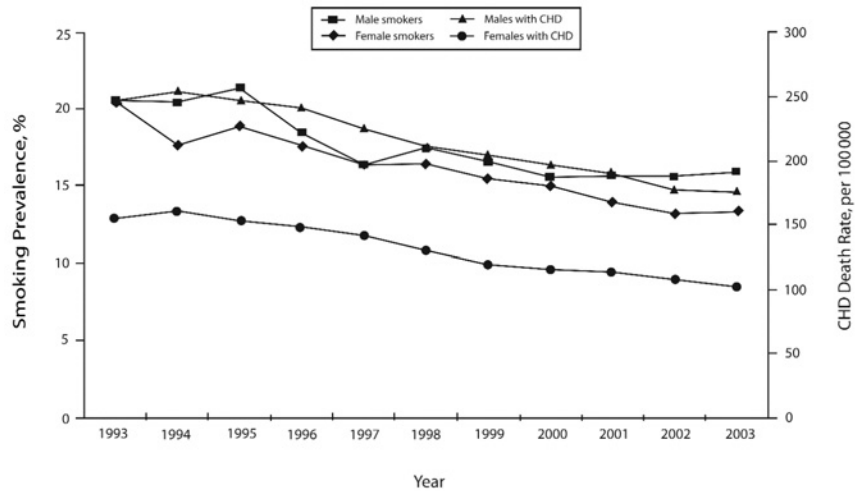
$$(1) \quad [P \times (RR - 1)] / [(1 + P) \times (RR - 1)],$$

where P is the prevalence of smoking and RR (obtained from the INTERHEART study<sup>6</sup>) is the relative risk of death from CHD associated with smoking, similar to the methods adopted in a recent US study.<sup>5</sup> The number of CHD deaths prevented because of reductions in smoking prevalence was then estimated as the number of CHD deaths in 1993 (the base year) multiplied by the difference between the PAR in 1993 and in 2003.

Annual age and gender-specific smoking prevalence data were abstracted from the Massachusetts Community Health Information Profile<sup>7</sup> using the Massachusetts Behavior Risk Factor Surveillance data, and were standardized to both age and population estimates using the year 2000 US standard population. Only regular smokers who smoked everyday were included in the analysis. CHD mortality data were obtained from the Surveillance, Epidemiology, and End Results database.<sup>8</sup>

## RESULTS

Between 1993 and 2003, CHD mortality rates declined 31% among persons aged 25



**FIGURE 1—Coronary heart disease (CHD) death rates and smoking prevalence, by gender: Massachusetts, 1993–2003.**

to 84 years, from 199 deaths to 137 deaths per 100 000 persons per year (total observed CHD deaths: 1993, 7710; 2003, 5789). Regular smoking prevalence for the same population declined by almost 29% overall (from 20.5% to 14.5%). Figure 1 shows CHD mortality rates and smoking prevalence in Massachusetts for both genders from 1993 to 2003, with women in general showing relatively low rates. Using the 1993 CHD mortality rates as our baseline, we found that approximately 3030 fewer CHD deaths occurred in 2003 (expected deaths, 8821; observed deaths, 5789). Based on the PAR calculation, approximately 425 (minimum=325; maximum=735) CHD deaths were prevented because of decreasing smoking prevalence; 14% (425 of 3030) of the fewer CHD deaths observed in 2003 were because of the decrease in smoking prevalence. Approximately 3365 (minimum=2695; maximum=5050) extra life-years were also saved in 2003 because of 425 fewer CHD deaths attributable to reductions in smoking prevalence.

If the current smoking decline from 1993 to 2003 continues, assuming the overall age- and population-standardized smoking prevalence (smokers aged 25–84 years) will fall from 14.5% in 2003 to 12% in 2010, then a total of 150 fewer CHD deaths are

projected in 2010. However, if smoking prevalence plateaus at 13%, then only 50 fewer CHD deaths is projected in 2010.

## DISCUSSION

A greater than 30% observed decline in CHD mortality rates in Massachusetts over a 10-year period is indeed a healthy trend. Studies have consistently indicated that more than half of such declines can be attributed to improvements in the 3 major cardiovascular risk factors: cholesterol, smoking, and blood pressure.<sup>3,5,9</sup>

Empirical evidence suggests that 15% to 45% of acute myocardial infarctions are associated with active smoking alone.<sup>6,10,11</sup> In addition, recent evidence suggests that comprehensive smoking bans reduce hospitalization rates for acute myocardial infarction.<sup>12–14</sup> Other contributors to declining CHD mortality includes improved case-fatality rates for acute myocardial infarction and overall survival rates for postmyocardial infarction patients over the years,<sup>15,16</sup> but contributions from such effects can be minimal at the population level.<sup>17</sup>

Our estimate of approximately 14% fewer CHD deaths in Massachusetts attributable to reductions in smoking prevalence is consistent with similar estimates done for the en-

tire US population.<sup>5,18</sup> Our results also showed that an excess of approximately 100 CHD deaths might occur over a 5-year period (2005–2010) if timely and urgent interventions in the form of more-aggressive antismoking campaigns are not enforced across the state of Massachusetts. This coincides with the gross budgetary cuts of the MTCP in 2002,<sup>19</sup> which stalled the program until recently.

In conclusion, smoking plays an important role in health outcomes, and thousands of extra life-years can be gained through prevention of major tobacco-related disease deaths such as CHD. A comprehensive tobacco control program similar to the Massachusetts Tobacco Control Program that was introduced in 1993 will prevent more CHD deaths if sustained and expanded to other US states and countries. ■

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### Contributors

Z. Kabir, G.N. Connolly, and L. Clancy conceptualized the study design. Z. Kabir did the analyses and drafted the first brief, with technical inputs from H.K. Koh and S. Capewell. S. Capewell developed the initial IMPACT Coronary Heart Disease Mortality Model. All the authors contributed to the final draft.

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### Human Participant Protection

No protocol approval was needed for this study.

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