Burden of coronary heart disease attributable to current exposure to passive smoking

James Lightwood*, Pamela Coxson†, Kirsten Bibbins-Domingo†, Larry Williams‡, Lee Goldman§

*Dept. of Pharmacy, University of California, San Francisco, CA; †Dept. of Medicine, University of California, San Francisco, CA; ‡Brigham and Women’s Hospital, Boston, MA; §School of Medicine, Columbia University

Funding by the Flight Attendants Medical Research Institute

Background

Observational studies, and recent natural policy experiments, which suddenly changed the prevalence of passive smoking in isolated cities, indicate that passive smoking is a significant risk factor for coronary heart disease (CHD).

Objective

Provide estimates of clinical burden of CHD due to remaining exposure to passive smoking, by estimating average annual events in two alternative scenarios of current prevalence of exposure to passive smoking. Estimate burden of passive smoking includes exposure due to unknown, home, work, or both work and home, exposures.

Outcomes

Average annual CHD events attributable to passive smoking for 25 years following elimination of exposure, starting in 2007:
- New onset CHD cases, and resulting CHD deaths and MIs
- Total CHD deaths (due to CHD and sequelae)
- Total CHD events (MI, cardiac arrest, angina pectoris attacks, revascularizations, hospitalizations for CHD and sequelae)
- Total MI
- MI due to new onset CHD
- Distribution of exposure, total death and MIs by age group (< 65, >= 65 years) sex, and source of exposure for Status Quo estimate.

Methods (cont.) Smoking and Coronary Heart Disease

- Relative Risk (RR) for new onset CHD is a function of age and average daily consumption (Figure) based on estimates in observational studies, and recent natural policy experiments, which suddenly changed the prevalence of passive smoking in isolated cities, indicate that passive smoking is a significant risk factor for coronary heart disease (CHD).
- RR for passive smoking is approximately equal to that of direct smoking one cigarette/day (1.26), averaged over age and sex, adjusted for possible confounding by diet (Figure).
- Passive smoking exposure based on measured serum cotinine in the National Health and Nutrition Examination Survey, using thresholds of 0.05 ng/mL and 0.10 ng/mL for clinically significant exposure.

Figure. RR of MI and cardiac arrest attributable to direct and passive smoking

Methods (cont.) Distribution of CHD Events

Distribution of clinical events caused by passive and direct smoking:
- Higher proportion of CHD caused by passive smoking exposure presents as MI and arrest, than CHD caused by direct smoking
- Lower proportion presents as angina pectoris

Proportion of hard events is estimated by calibrating increases in overall CHD as predicted by Framingham risk model and estimated RR for hard events in clinical literature to observed events

Consistent with existing evidence that etiology of CHD due to passive smoking strongly associated with MI and arrest (Source: Law and Wald, Progress in Cardiovascular Disease, 2003)

Scenario for Estimates

- Simulation begins in 2000, passive smoking exposure assumed to end at beginning of year 2007
- US population modeled with and without passive smoking exposure for 30 years, until end of year 2036
- Total, and average annual statistics calculated
- Estimates calculated for 0.05 and 0.10 ng/mL thresholds for exposure to passive smoking reported in 2002 NHANES
- Status Quo estimate: levels remain at those measured in 2002

Results: Burden of Passive Smoking

Annual events (Table 1)
- New Onset CHD
  - 5,400 – 25,000 cases
  - 4,500 – 20,100 MI
  - 1,400 – 6,600 deaths
- Total (new-onset and existing CHD cases)
  - 7,600 – 36,000 CHD events
  - 6,400 – 29,800 MI
  - 2,700 – 14,700 deaths
- Distribution of events (Table 2)
  - Approximately 60% of exposure and burden falls on men
  - 80% of exposure among those aged 35-64
  - Approximately 60% - 75% of burden falls on those age 65 – 84
  - Approximately 2/3 of exposure and 3/4 of burden due to exposure from unknown sources of passive smoking

Model calibration: to reproduce, in its baseline year of 2000, all key outcomes in the U.S. to within 1% as well as the results of relevant clinical trials.

Discussion

- CHD burden of passive smoking still significant regardless of cut-off for exposure used.
- Ending passive smoking would reduce CHD events substantially
- Largest source of variation is due to undertainty in best cut-off level for clinically significant exposure to passive smoking. But significant effect seen even at the higher threshold level. Significant effects probably exist at low levels of exposure. 
- Most exposure among working age and those under 65, but burden falls mostly on elderly
- Most exposure and burden of disease due to unknown exposure
- Further work:
  - More precise measure of clinically significant exposure
  - Addition of uncertainty analysis to model