Burden of Tobacco Report: Technical Notes

This report estimates the burden of cigarette smoking using the most current version of the Centers for Disease Control and Prevention's Smoking Attributable Mortality, Morbidity and Economic Costs (SAMMEC) software program.[6] The software program estimates the number of deaths directly caused by cigarette smoking for 19 specific diseases and the number of years of life lost due to premature death from cigarette smoking. The program also estimates the economic costs associated with cigarette smoking, in terms of direct health care costs and costs due to lost productivity.

Mortality Data

The number of deaths for 19 smoking-related diseases that occurred between 2000 and 2004 in Wisconsin, the 72 counties, and the City of Milwaukee, were obtained from the Division of Public Health within the Wisconsin Department of Health and Family Services.[7] The data were grouped by sex and five-year age groups starting with age 35. For the list of diseases included in SAMMEC and their corresponding International Classification of Diagnoses, 10th revision (ICD-10) codes see Table A following these technical notes.[6]

Smoking Prevalence

Smoking prevalence estimates are based on data from several sources. State, county, and city adult prevalence estimates are from 2000-2004 Behavioral Risk Factor Surveillance System data.[1] Smoking prevalence is based on two questions measuring whether a respondent is a current smoker. A current smoker is defined as an individual who smoked 100 cigarettes in his or her lifetime and currently smokes cigarettes on some days or every day. A former smoker is defined as an individual who smoked 100 cigarettes in his or her lifetime, but does not currently smoke. Sample sizes were large enough to publish county-specific prevalence data for 19 Wisconsin counties and the City of Milwaukee. For 52 smaller counties, clusters consisting of 2 to 6 counties were constructed to approximate county prevalence estimates. (See Table B) Every county within a given cluster uses the same combined prevalence estimate. In the case of Menominee County, Wisconsin prevalence for Whites and Native Americans were used to obtain a prevalence estimate for Menominee. The smoking prevalence for Whites in the state (22%) was multiplied by the percent of Menominee residents that are white (12%).[1,2] The Native American smoking estimate for the state (39%) was multiplied by the percent of Menominee residents that are Native American (88%).[1,2] The white and Native American percentages were then added together to obtain the county estimate (37%).

Data on youth smoking are from the 2004 Wisconsin Youth Tobacco Survey.[3] Prevalence data are only available as statewide estimates. Youth are considered current smokers if they reported having smoked cigarettes at least once in the past 30 days.

Maternal smoking data are from 2004 birth certificates.[5] Wisconsin's birth certificates include a question on whether the mother smoked cigarettes during her pregnancy. The percentage of 'Smoking during Pregnancy' is the number of women who indicated that they

smoked during their pregnancy divided by the number of women who had a live birth in 2004.

The SAMMEC software program requires that prevalence rates be stratified into age and gender subgroups to account for associated differences in the risk of developing a smoking-related illness.[6] However, due to small sample sizes, county level rates could not be split into the required age and gender subgroups. State prevalence data stratified by age and sex subgroups were used to approximate county prevalence estimates for these subgroups. To account for differences in smoking rates between the county and the state, the overall county smoking prevalence was divided by the state smoking prevalence to obtain a county to state prevalence ratio. This ratio was then multiplied by the state prevalence for each sex/age subgroup to obtain a county-adjusted prevalence estimate. For example, the overall current smoker prevalence estimate for Brown County (2000-2004) is 24.2%, and the current smoker prevalence estimate for the state is 22.9% (2000-2004). The ratio of the Brown County prevalence to the Wisconsin prevalence is calculated to be 1.06 for current smokers (24.2% ÷ 22.9% = 1.06). This ratio is then multiplied by each sex/age prevalence subgroup for the state. For example, 1.06 is multiplied by 24.8%, which is the Wisconsin estimate of current smoking prevalence among males, aged 35-64 years, to obtain the adjusted county estimate. The new adjusted county estimate for this group is 26.2% (see Table 1). These adjusted prevalence estimates are then entered into the SAMMEC model for each sex/age subgroup.

Table 1. Example calculation of adjusted county prevalence estimates, Brown County

Sex/Age Subgroup	% Current Smokers in Wisconsin	County:State Ratio	Adjusted Brown County Prevalence
Male, 35-64 years	24.8%	1.06	26.2%
Male, 65 years or older	8.1%	1.06	8.6%
Female, 35-64 years	22.5%	1.06	23.8%
Female, 65 years or older	8.2%	1.06	8.7%

Smokers in Wisconsin

Overall adult smoking prevalence estimates were multiplied by the number of adults over 18 years old to estimate the number of adult smokers in Wisconsin, each county, and the City of Milwaukee.[1,2] Estimates for the number of adults came from the Census Bureau's population estimates for 2004.[2] For youth, the state prevalence estimates were multiplied by the number of youth in Wisconsin, each county, and the City of Milwaukee to estimate the respective number of youth smokers.[3,4] Both public and private school enrollment data for the 2004 school year were obtained from the Department of Public Instruction in order to estimate the number of youth in each area.[4] The number of maternal smokers was obtained from the Wisconsin Interactive Statistics on Health (WISH) query system for 2004.[5]

Relative Risks

SAMMEC software uses relative risk estimates in several of the calculations. A relative risk is the measure of how much a particular risk factor (i.e., cigarette smoking) influences the

risk of a specified outcome (i.e., death due to lung cancer). The relative risks in SAMMEC are unpublished age-adjusted estimates from the second wave of the American Cancer Society's Cancer Prevention Study.[6] These relative risks cannot be altered by the user.

Smoking-Attributable Fractions

Before the smoking attributable mortality can be calculated, SAMMEC first calculates the Smoking-Attributable Fraction (SAF), which gives the percent of deaths for each disease category that can be attributed to smoking.[6] The SAF calculations use the adult smoking prevalence data and the relative risks. The equation that is used in SAMMEC to calculate the SAF's is provided below, where p0 is the percent of the study population that are never smokers, p1 is the percent that are current smokers, and p2 are former smokers.[6] RR1 is the relative risk of death for current smokers compared to never smokers, and RR2 is the relative risk of death for former smokers compared to never smokers.[6]

$$SAF = [(p0 + p1(RR1) + p2(RR2)) - 1] / [p0 + p1(RR1) + p2(RR2)]$$

Smoking-Attributable Mortality

The smoking-attributable mortality (SAM) is calculated by multiplying the SAF's by the number of deaths for each disease in 2000-2004.[6] We divided the smoking-attributable mortality number by five to obtain an annual average number of smoking-related deaths. If there was less than one death for a specific disease in a county, smoking-attributable deaths were not reported. The percent of deaths due to smoking were calculated by dividing the annual average of smoking-attributable deaths by the annual average number of deaths and multiplying by 100.

Deaths Indirectly Related to Smoking

The number of deaths due to secondhand smoke and maternal smoking were estimated by multiplying the number of SIDS, ischemic heart disease and lung cancer deaths in Wisconsin by national estimates of population attributable risk (proportion of these deaths caused by secondhand smoke). The population attributable risks were estimated by dividing national estimates of the number of SIDS, ischemic heart disease and lung cancer deaths associated with secondhand smoke, by the 4-year national average of total deaths for those conditions between 1999-2002.[8,10] (see Table 2) (A 4-year average was used for this estimate because 2002 is the latest data available via CDC Wonder, and because coding changed from ICD-9 to ICD-10 beginning in 1999.) This calculation yielded the percentage of deaths related to secondhand smoke (PAR) for each category nationwide. This percentage was multiplied by the average number of SIDS, ischemic heart disease and lung cancer deaths in Wisconsin (2000-2004).[5,7] This resulted in our estimate of the annual number of deaths statewide from these three categories that were caused by secondhand smoke or maternal smoking.

Table 2. Calculation of National Population Attributable Risks

	Number of national deaths (4-year average)[10]	Number of national deaths associated with secondhand smoke annually[8]	Population Attributable Risk (PAR)
Ischemic heart disease	510,359	46,000	9%
Lung cancer	155,362	3,400	2%
SIDS	2,425	430	18%

Deaths due to fires which started as a result of improper disposal of a lit cigarette, cigar, or pipe were determined by taking an available estimate of the percentage of fire deaths due to smoking nationwide (PAR). This percentage was multiplied by the average annual number of fire deaths in Wisconsin between 2000-2004.[5,9]

Years of Potential Life Lost (YPLL)

The SAMMEC model calculates years of potential life lost based on the potential life expectancy of those who died.[6] The YPLL estimates are calculated in SAMMEC by multiplying the smoking attributable mortality by the remaining life expectancy (using the midpoint of each five-year age group).[6] For each Wisconsin county and the City of Milwaukee, the YPLL estimate is based on county or city specific mortality data from 2000-2004. The SAMMEC-produced years of potential life lost were divided by five to obtain an annual average estimate of years of potential lives lost for Wisconsin, each county, and the City of Milwaukee.

Smoking-Attributable Expenditures

The SAMMEC software provides precalculated estimates of smoking-attributable expenditures for the National and state level for 1998.[6] The current report updated the 1998 data using the most recently available state data from the Center for Medicaid and Medicare Services for the year 2000.[11] The 2000 data were further updated using the most recently available national data for the year 2003.[11] The annual percent change observed for the United States from 2000 to 2003 was applied to the 2000 data for Wisconsin in order to estimate the 2003 state health expenditures for Wisconsin.[11] The health expenditure data are then multiplied by the annual expenditure smoking-attributable fractions, which represent the percent of expenditures that could be avoided if smoking was eliminated from the population.[6] Direct cost estimates include hospital care, ambulatory care, prescription drugs, nursing home care, and other care (home health, durable and non-durable medical equipment, and other personal health care).[6] County and City of Milwaukee estimates were obtained by multiplying the state estimates by the ratio of the county or city population to the state population. To estimate the health care costs per person in the state, the total smoking attributable expenditures for the state were divided by the total population for Wisconsin. Per capita health care costs for the counties and the City of Milwaukee were based on state level expenditure estimates.

Smoking-Attributable Productivity Lost

Mortality-related productivity costs are the estimated costs of lost future earnings from paid market and unpaid household labor resulting from premature death due to smoking-related

diseases.[6] The productivity loss calculations use the present value of future earnings for 2001, available in SAMMEC, along with the mortality data, smoking prevalence, and relative risks.[6] The estimates are weighted by sex to eliminate the effect of gender bias associated with income and occupation.[6] County and City of Milwaukee estimates were obtained by multiplying the state estimates by the ratio of the county or city population to the state population.

Cigarette Packs Sold and Cost

The estimate for the number of packs of cigarettes sold and average price per pack in Wisconsin in 2004 came from the *Tax Burden on Tobacco*, Volume 39. The total number of packs sold was multiplied by the average price per pack to estimate the amount of money Wisconsin residents spent on cigarettes in 2004.[12] The county and city estimates for number of packs sold and cost came from multiplying the state estimates by the ratio of the county or city population to the state population, and the ratio of the county or city smoking prevalence to the state smoking prevalence.

Limitations

There are several limitations associated with the SAMMEC software and the methods that we used for county estimates. For a full discussion of the limitations of SAMMEC go to http://apps.nccd.cdc.gov/sammec/methodology.asp#Limitations. A limitation associated with the software that may cause the number of deaths related to smoking to be underestimated is the use of current smoking prevalence in the calculations. Due to the latency period associated with many smoking related diseases, people are dying today due to their smoking behavior in previous decades when the prevalence was much higher.

A second limitation of the current report is that estimates for YPLL and the economic costs of smoking do not take into consideration deaths due to secondhand smoke, maternal smoking, and fires. Accordingly, the YPLL and estimates of the economic impact associated with smoking may be underestimated.

A further limitation is inherent in the use of mortality data. There is the potential for cause of death to be misclassified on the death certificate.

Some of the limitations encountered are associated with the use of the BRFSS. Because it is a phone based survey, low income individuals without a phone may be missed as well as individuals who only use cell phones. As a result, these subgroups of the population may be under-represented. In addition, BRFSS sample sizes were too small to be reliable for many of the counties. Smaller counties were grouped to improve sample sizes for estimating adult smoking prevalence.

Due to recent updates in the SAMMEC software program, and changes in some of the county groupings, data presented in this report should be compared to those presented in the previous report with caution.

Despite the limitations associated with SAMMEC, it is able to provide adequate estimates for the health and economic burden of tobacco in Wisconsin.