The Health and Economic Burden of Smoking in Missouri, 2000-2004

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Smoking harms nearly every organ of the body, causing many diseases and reducing quality of life and life expectancy.

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Abstract

This study used the Smoking-Attributable Mortality, Morbidity and Economic Cost (SAMMEC) software developed by the Centers for Disease Control and Prevention to assess the health consequences and economic burden due to smoking in Missouri. During 2000-2004, cigarette smoking resulted in 9,600 deaths (17.5% of all deaths), 132,103 Years of Potential Life Lost, and $2.4 billion in productivity loss annually in Missouri. These data show that Missouri suffers enormous human and financial losses from smoking.

Introduction

Cigarette smoking is the chief preventable cause of premature death in the United States.[1] Smoking harms nearly every organ of the body, causing many diseases and reducing quality of life and life expectancy.[2] According to the Centers for Disease Control and Prevention (CDC), during 1995-99, smoking caused 442,398 deaths annually in the United States, including 10,303 deaths annually in Missouri;[3] during 1997-2001, smoking resulted in approximately 438,000 premature deaths, 5.5 million years of potential life lost (YPLL), and $92 billion in productivity lost annually in the United States.[4] Worldwide, an estimated 4.83 million people died of diseases attributable to smoking.[5] These deaths and financial losses are preventable.

The objectives of this study are to describe the health consequences and financial burden imposed by cigarette smoking in the State of Missouri during 2000-2004, and to provide scientific evidence for policy makers, health professionals, and the general public who are engaged in actions to contain the tobacco epidemic in the State of Missouri.

Methods

Data Sources

The 2000-2004 Missouri Behavioral Risk Factor Surveillance System (BRFSS) data were used to estimate the age- and gender-specific yearly prevalence of current and former smokers in Missouri.[6] The 2000-2004 Missouri Death Records data were used to calculate the age-, gender- and disease-specific numbers of deaths in each year, and the yearly gender-specific life expectancy.[7] The 2000-2004 Missouri Birth Records data were used to estimate the yearly maternal smoking prevalence.[7] The 2005 Missouri Medicaid expenditure data were used to calculate smoking-attributable Medicaid expenditure in Missouri.[8]

Data Analysis

The adult, and maternal and child health Smoking-Attributable Mortality, Morbidity and Economic Cost (SAMMEC) software was used to calculate the smoking attributable mortality (SAM) and YPLL for adults and infants, and productivity losses for adults.[9] The SAMMEC software was developed by the Centers for Disease Control and

Prevention (CDC) in 1987 and was revised in 2004 based on findings from the 2004 Surgeon General's Report.[9] The list of smoking-attributable diseases now includes stomach cancer and acute myeloid leukemia and excludes hypertension.[9]

Age-adjusted SAM and YPLL rates were calculated directly using SAMMEC, and standardized to the 2000 U.S. population. These estimates cover only adults aged 35 years and older, and do not include deaths due to burn caused by smoking-induced fire, or second-hand smoking. The data elements used in computation of these rates were smoking prevalence by corresponding age groups and years[6]; number of deaths in Missouri for corresponding age groups[7]; Missouri's resident population by different age groups; for the respective year, U.S. 2000 standard population by different age groups[10]; and the built-in age-adjusted relative risks in SAMMEC.[11] To estimate YPLL, life expectancies in Missouri were also used.[7] The maternal and child health (MCH) reports were also generated using SAMMEC, in which different relative risk for short gestation/low birth weight, Sudden Infant Death Syndrome, Respiratory Distress Syndrome - newborn, other conditions among newborns,[12] as well as maternal smoking prevalence and infant mortality for Missouri.[7] Productivity losses were also generated using the 2001 Present Value of Future Earnings for the United States.[13] The data elements for estimating the total and Medicaid-specific expenditure attributable to smoking were generated using the total expenditure and smoking-attributable fractions by different medical expenditure categories (i.e., ambulatory, hospital, prescription drugs, nursing home, and other).[14 & 15]

Sex- and age-specific smoking-attributable deaths were calculated by multiplying the total number of deaths in each sex and age category for 19 adult and four infant diseases. The smoking-attributable fractions (SAFs) were calculated for each disease by different sex and age categories. The SAFs provide estimates of the public health burden for each risk factor and the relative importance of risk factors for multi-factorial diseases. The formula for calculating SAF is: [9] $SAF = [p_1(RR_1-1) + p_2(RR_2-1)]/[p_1(RR_1-1) + p_2(RR_2-1) + 1]$, where p_1 is the prevalence of current smokers (i.e., persons who have smoked $\geq$100 cigarettes and now smoke every day or some days) in the study population, p_2 is the prevalence of former smokers (i.e., persons who have smoked $\geq$100 cigarettes and do not currently smoke), RR_1 is the relative risk for current smokers vs. never smokers, and RR_2 is the relative risk for former smokers vs. never smokers.

For adults, sex-specific RR_1 and RR_2 for each cause of death were estimated from the American Cancer Society's Cancer Prevention Study-II (CPS-II) for the period 1982-1988.[11] For ischemic heart disease and cerebrovascular disease deaths, RR_1 and RR_2 estimates were also stratified by age (35-64 years and $\geq$65 years). Yearly sex-and age-specific p_1 and p_2 were estimated from the Missouri BRFSS.[6] For infants, SAFs were calculated by using pediatric RR_1 and RR_2 estimates and maternal smoking prevalence estimates (p_1 and p_2) from the birth certificates.[12] Smoking-attributable YPLL and productivity losses were estimated by multiplying sex- and age-specific SAM by remaining life expectancy and lifetime earning data, respectively.

Since only secondary data analysis was used and there was no direct contact with human subjects, the Institutional Review Board at the Missouri Department of Health and Senior Services reviewed the study protocol and determined it to be exempt.

Results

Adult Smoking-Attributable Mortality

During 2000-2004, smoking resulted in an estimated annual average of 9,578 adult deaths (17.5% of total deaths), including 5,800 deaths (22.1% of all deaths) in men and 3,778 deaths (13.3% of all deaths) in women. SAM in men accounted for 61% of the total SAM. Among adults, 3,870 (40.4%) of these deaths were attributed to cancer, 3,256 (34.0%) to cardiovascular diseases, and 2,453 (25.6%) to respiratory diseases. The three leading specific causes of smoking-attributable death were cancer of the lung, trachea, and bronchus (3,117); ischemic heart disease (2,000); and chronic airway obstruction (1,884). See Table 1.

Infant Smoking-Attributable Mortality

Smoking during pregnancy resulted in an estimated 29 infant deaths (13.4% of total infant deaths) annually in Missouri during 2000-2004. The majority of smoking-attributable infant deaths were due to short gestation (51.7%) and Sudden Infant Death Syndrome (37.9%). Approximately 57% of these infant deaths were among boys and 43% were among girls. See Table 1.

Years of Potential Life Lost, Productivity Losses, and Medicaid Expenditures

During 2000-2004, on average, smoking accounted for an estimated 132,103 YPLL, including 78,686 for men and 53,417 for women annually, excluding burn deaths due to fire incited by smoking and adult deaths from secondhand smoke. The estimated average annual smoking-attributable productivity losses during this period were approximately $2.4 billion, including $1.6 billion for men and $0.8 billion for women. See Table 1. The estimated smoking-attributable Medicaid expenditure was $512 million in 2005, representing a 50% increase from $207 million in 1993, after adjusting for medical inflation. See Table 2.

Discussion

The findings of this study show that

Table 1. Annual Deaths and Estimates of Smoking-Attributable Mortality (SAM), Years of Potential Life Lost (YPLL), and Productivity Losses (PLoss), By Sex and Cause of Death, Missouri 2000-04

	Total				Male				Female			
Cause of Death (ICD-10* Code)	Deaths	SAM	YPLL	PLoss**	Deaths	SAM	YPLL	PLoss**	Deaths	SAM	YPLL	PLoss**
Malignant Neoplasms												
Lip, Oral Cavity, Pharynx (C00-C14)	144	95	1,611	$37,312	93	70	1,212	$29,677	51	24	400	$7,636
Esophagus (C15)	257	179	2,709	$58,044	198	145	2,216	$49,881	59	34	493	$8,163
Stomach (C16)	202	45	623	$12,467	120	35	504	$10,820	82	9	119	$1,648
Pancreas (C25)	636	153	2,300	$45,692	317	77	1,207	$28,014	319	77	1,093	$17,677
Larynx (C32)	77	62	974	$21,179	62	52	790	$17,738	15	11	183	$3,441
Trachea, Lung, Bronchus (C33-C34)	3803	3,117	46,197	$903,844	2238	1,987	27,517	$566,469	1565	1,130	18,680	$337,375
Cervix Uteri (C53)	77	11	272	$6,915	0	0	0	$0	77	11	272	$6,915
Kidney and Renal Pelvis (C64-C65)	286	77	1,168	$25,739	177	71	1,073	$24,150	109	6	94	$1,590
Urinary Bladder (C67)	241	102	1,181	$19,698	168	82	943	$16,691	73	20	238	$3,007
Acute Myeloid Leukemia (C92.0)	161	28	397	$7,905	87	21	294	$6,313	74	7	102	$1,592
Total	**5884**	**3,870**	**57,433**	**$1,138,797**	**3460**	**2,540**	**35,757**	**$749,753**	**2424**	**1,329**	**21,676**	**$389,044**
Cardiovascular Diseases												
Ischemic Heart Disease (I20-I25)	11397	2,000	29,094	$604,179	5651	1,242	19,113	$446,776	5746	758	9,981	$157,403
Other Heart Disease (I00-I09, I26-I51)	4371	588	7,010	$121,499	1845	364	4,479	$88,301	2526	225	2,531	$33,198
Cerebrovascular Disease (I00-I69)	3690	396	6,086	$127,219	1374	194	2,852	$64,928	2316	202	3,234	$62,291
Atherosclerosis (I70-I71)	292	44	365	$3,429	109	30	259	$3,037	183	14	107	$392
Aortic Aneurysm (I71)	319	190	2,215	$35,417	190	125	1,460	$25,897	129	65	754	$9,520
Other Arterial Disease (I72-I78)	245	37	455	$7,567	103	15	187	$3,624	142	22	268	$3,943
Total	**20314**	**3,256**	**45,225**	**$899,309**	**9272**	**1,969**	**28,350**	**$632,563**	**11042**	**1,286**	**16,875**	**$266,746**
Respiratory Diseases												
Pneumonia, Influenza (J10-J18)	1529	273	2,632	$32,943	639	150	1,440	$21,018	890	123	1,192	$11,925
Bronchitis, Emphysema (J40-J42, J43)	340	295	3,576	$55,884	175	160	1,841	$31,868	165	135	1,735	$24,017
Chronic Airway Obstruction (J44)	2395	1,884	21,046	$292,379	1192	980	10,088	$151,448	1203	905	10,958	$140,931
Total	**4264**	**2,453**	**27,254**	**$381,206**	**2006**	**1,290**	**13,369**	**$204,334**	**2258**	**1,163**	**13,885**	**$176,872**
Perinatal Conditions												
Short Gestation / Low Birth Weight (P07)	109	15	1,114		59	8	576		50	7	538	
Sudden Infant Death Syndrome (R95)	56	11	805		33	6	457		23	4	348	
Respiratory Distress (Syndrome) - newborn (P22)	15	1	45		8	0.4	29		7	0.2	16	
Other Respiratory Conditions - perinatal (P23-P28)	37	3	227		24	2	148		13	1	79	
Total	**217**	**29**	**2,191**		**124**	**16**	**1,210**		**93**	**12**	**981**	
Total	30,499	9,607	132,103	$2,419,312	14,762	5,816	78,686	$1,586,650	15,737	3,790	53,417	$832,662

* International Classification of Diseases, Tenth Revision. **Productivity loss estimates are in thousands of dollars

*Smoking-Attributable Medicaid Expenditures were estimated by using Smoking-Attributable Fractions (SAFs).

Table 2. Smoking-Attributable Expenditures in Missouri (in millions)

	Ambulatory	Hospital	Prescription Drugs	Nursing Home	Other**	Total
Medicaid 2005*	$48	$109	$157	$109	89	$512
Medicaid 1993*	$34	$19	$102	$1	$52	$207

Medicaid SAFs were estimated using a national model that describes the relationship between smoking and medical expenditures, controlling for a variety of socio-demographic, economic, and behavioral factors.

*** Categorized as 'home health care'. This excludes dental and mental care, and expenditures on durable medical equipment. Included are physician related expenditures, in-home services, rehab and specialty services.*

smoking caused 9,607 deaths annually during 2000-2004, or more than one death per hour in Missouri. This death toll is more than twice the annual total number of deaths from accidents, AIDS, homicide, and suicide combined.[16] More people died annually in Missouri during 2000-2004 than the population of counties such as St. Clair County, Monroe County, or Ozark County. Additionally, cigarette smoking continues to impose enormous financial costs in Missouri. In 1998, smoking-attributable healthcare expenditures were estimated at $1.7 billion in Missouri.[9] These expenditures rose to $2.2 billion when adjusted to 2004 dollars, plus the productivity losses ($2.4 billion), for a total of $4.6 billion dollars in 2004. In 2005, the estimated smoking-attributable Medicaid expenditure was $512 million, or approximately $91 paid for by each Missouri resident.

According to CDC [17], the national SAM was 398,000 during 1997-2001. Therefore, the expected SAM in Missouri proportional to the state's population would be 7,875. The actual SAM of 9,800 is higher than the expected SAM because adult smoking prevalence (25.9% - 28.6%) in Missouri was higher than the national prevalence (22.6% - 23.2%) during 1997-2001. In fact, during 2004, adult smoking prevalence in Missouri was higher than the national level among all socio-economic subpopulations examined (i.e., race, education, income, and age group). [17] Missouri's youths (grades 9-12) also had a substantially higher smoking prevalence (24.8%) than the national level (21.7%).[17] Additionally, fewer Missourians are protected by the smoke-free policy at work or at home than nationally. [17]

Although the estimates of the adverse impact of smoking are based on extensive epidemiologic research, the findings of this study are subject to inherent limitations (such as death certificate data are subject to error in the certification of underlying causes of death) common to this type of studies. Additionally, smoking-attributable deaths, YPLL, productivity losses, and expenditures are likely to have been underestimated due to the fact this study did not include deaths attributable to exposure to secondhand smoke, smoking-related fire, and deaths attributable to the use of other tobacco products (e.g., cigar, bidi, kretik, pipe, and smokeless tobacco). Overall, these limitations combined likely have underestimated the tobacco-related burden in Missouri.

Effective intervention strategies are available to prevent smoking initiation and promote smoking cessation among adults and youth.[18] CDC recommends that states establish and implement a comprehensive tobacco control program.[19] Experiences from California and Massachusetts, which have been funding comprehensive tobacco prevention and control programs using state tobacco excise taxes, showed that comprehensive tobacco control programs, when faithfully implemented, can produce dramatic declines in per capita cigarette consumption and in the prevalence of smoking among adults and youth.[20] CDC recommends that Missouri spend between $32.77 and $91.36 million annually in order to implement an effective comprehensive tobacco control program.[19] However, the actual budget for the tobacco control program in Missouri in the fiscal year 2006 is approximately $1.25 million (including $1.2 million from the federal government and $48,000 from private contributions), representing only about 7% of the minimum budget recommended by CDC.

Insufficient funding and lack of intervention in Missouri may partially explain the high smoking prevalence in the state. The smoking prevalence among Missouri adults was estimated to be between 24% and 27% during 1990-2004, which is consistently higher than the national average.[21] In contrast, with effective interventions, smoking prevalence among adults in California decreased dramatically from 24.9% in 1984 to 14.6% in 2004.[22] Smoking prevalence among high school students in Missouri has decreased significantly from 39.0% in 1999 to 27.0% in 2005; nationally, the prevalence in 2005 was 28.4%. [23] However, the Missouri prevalence was significantly higher than that in California (13.5% in Los Angeles,

17.3% in San Diego, 18.3% in San Bernardino). [23]

The excise tax rate on cigarettes in Missouri is second lowest in the nation with 17 cents per pack compared to national median of $1.04cents per pack in 2007.[24] Increasing the excise tax on cigarettes is one of the most cost-effective strategies to reduce tobacco consumption among adults and to prevent youth initiation of tobacco use.[24] That effect can be further enhanced by using the increased excise tax funds to support effective community, media, and school programs to prevent and control tobacco use. [20 & 24]

In summary, this study has convincingly demonstrated that smoking is imposing a great human health and financial burden in the State of Missouri. More funding and efforts are needed to reduce this human and financial loss in the state. Policymakers, health professionals, and the general public should take more actions in containing the tobacco epidemic in the State of Missouri.

Acknowledgment

This document was supported by Cooperative Agreement Number U58/CCU722795-04 between the Centers for Disease Control and Prevention (CDC) and the Missouri Department of Health and Senior Services. The contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC. Authors also acknowledge the technical support from Wayne Schramm, mortality data from Margaret Tyler, Sheila Murphy for neonatal data, Brian Tordoff for proof reading, and Andrew Hunter for the population estimates.

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Disclosures

None reported.

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