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Healthcare Utilization and Expenditures Attributable to Cigar Smoking for US Adults

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ABSTRACT

Objectives: This paper estimated cigar smoking-attributable healthcare utilization and expenditures for US adults aged 35+.

Methods. We analyzed data on 89,638 adults aged 35+ using pooled 2000, 2005, 2010, and 2015 National Health Interview Surveys. Separate Zero-Inflated Poisson (ZIP) regression models on hospital nights, emergency room (ER) visits, doctor visits, and home care visits were estimated as a function of tobacco use status (current sole cigar smokers, current poly cigar smokers, former sole cigar smokers, former poly cigar smokers, other tobacco users, and never tobacco users) and other covariates. Utilization attributable to sole (current and former) cigar smoking was calculated based on the estimated ZIP models using an "excess utilization" approach. Excess utilization was multiplied by the unit cost per utilization from the 2014 Medical Expenditures Panel Survey to derive sole-cigar-smoking-attributable healthcare expenditures. Finally, healthcare expenditures per sole cigar smoker were applied to cigar smokers (current and former sole and poly cigar smokers) to obtain total cigar-smoking-attributable healthcare expenditures.

Results. 2.3% of adults aged 35+ were current sole cigar smokers and 1.7% were current poly smokers. Prevalence rates for former sole and poly cigar smokers were 0.7% and 4.8% respectively. Sole cigar smoking was associated with excess annual utilization of 0.07 million hospital nights, 0.04 million ER visits, and 0.45 million home care visits. Annual sole-cigar-smoking-attributable healthcare expenditure were $284 million ($625 per sole smoker), and total annual cigar-attributable healthcare expenditures were $1.8 billion per year.

Conclusions. Cigar smoking attributed to substantial healthcare expenditures in the US.

Keywords: Healthcare utilization; excess utilization; healthcare expenditures; cigar smoking

INTRODUCTION

Cigar sales have been increasing globally, in the US,[1] Canada,[2] the UK, and Germany,[3] and also in emerging markets including China, Brazil and Russia.[3] In the US, total cigar consumption increased by 123% during 2000-2011, while cigarette consumption declined over this period.[1] Since 1990, the tobacco industry has targeted cigars to a younger population so that cigar smoking is no longer only a behavior of older men; it has become popular among young people.[4] In 2014, 8.2% of US high school students used cigars at least one day in the past 30 days.[5] During 2013-2014, 8.4% of young adults aged 18 to 24 years had smoked cigars in the past 30 days while 4.9% of US adults were current cigar smokers.[6] In 2013, an estimated 12.4 million people in the US aged 12 years or older (5.2%) were current cigar smokers.[7] With its increasing popularity, especially among the young, cigar smoking is a growing public health concern.

Cigars differ from cigarettes in that cigars are wrapped in a tobacco leaf or in a substance that contains tobacco, while cigarettes are wrapped in paper.[8,9] Therefore, cigar smoke contains toxic constituents from both the tobacco and the wrapper, including higher levels of tobacco-specific nitrosamines, carbon monoxide and nitrogen oxide than cigarette smoke.[9] Cigar smoking is causally associated with cancers of the lung and oral cavity, oropharynx, hypopharynx, larynx and esophagus, pancreas, stomach, and urinary bladder.[10-12] The health risk associated with cigar smoke increases with the dose and level of inhalation. Even without inhalation, cigar smoking is associated with an elevated risk of death from cancers of the oral cavity, larynx, and esophagus.[12] Furthermore, more than 50% of current cigar smokers are dual or poly tobacco users, [13] and hence may be exposed to higher health risks than experienced by those who smoke cigars alone.

Given the increasing popularity of cigar smoking, it is important to have a comprehensive estimate of the health-related economic cost of cigar smoking. A recent study of cigar attributable mortality estimated that cigar smoking resulted in 9,000 premature deaths, 140,000 years of life lost, and $23 billion in lost productivity among US adults aged 35 + in 2010.[14] No study has estimated healthcare expenditures attributable to cigar smoking in the US. This study will fill this gap by estimating healthcare utilization and expenditures attributable to cigar smoking among US adults. Because usually intermediate-term and long-term health effects of combustible tobacco use are more clinical apparent and therefore more use of healthcare services

attributable to combustible tobacco use will happen on the middle and older ages, [15]our study focused on US adults aged 35+.

METHODS

Data Source

National Health Interview Survey (NHIS). The NHIS is a nationally representative cross-sectional face-to-face household interview survey of the civilian non-institutionalized population.[16,17] The NHIS contains information about socio-demographics, cigarette smoking status, health insurance coverage, and healthcare utilization. Since 1987, a Cancer Control Supplement has been conducted periodically to collect other tobacco product use information. Although the survey has collected information on the use of smokeless tobacco (ST) and combustible tobacco (cigars, pipes and hookah lumped together) since 2012, cigar use is only collected in the Cancer Control Supplements. We pooled data from the latest four waves of Cancer Control Supplements in 2000, 2005, 2010 and 2015 to obtain a large enough sample for the analysis of healthcare utilization of cigar smoking.

Medical Expenditures Panel Survey (MEPS). The MEPS is a nationally representative, face-to-face household interview survey of the US civilian noninstitutionalized population. It includes detailed questions about healthcare utilization and expenditures and can be linked to the NHIS. However, only about one-sixth of the respondents aged 18+ in the NHIS Cancer Control Supplement are included in the MEPS. Therefore the sample size of cigar smokers from the linked MEPS-NHIS data is too small to study healthcare utilization. The 2014 MEPS data was used to calculate the unit costs per hospital night, emergency room visit, doctor visit, and home care visit among all adult respondents aged 35+.[18]

Outcome Variables

Hospital nights in the past 12 months were obtained from the question “Altogether how many nights were you in the hospital during the past 12 months?”

Emergency room (ER) visits in the past 12 months were obtained from the question “During the past 12 months, how many times have you gone to hospital emergency room about your own health?”

Doctor visits in the past 2 weeks was obtained from the question: “How many times did you visit a doctor or other health care professional?” among those who answered “yes” to the prior question “Did you visit a doctor or other health prior professional in an office, clinic, emergency room, or some other place during the past 2 weeks?”

Home care visits in the past 2 week was determined from the question “How many home visits did you receive during the last 2 weeks?”

Covariates

Tobacco use status. Three tobacco products ─ cigarettes, cigars, and smokeless tobacco (ST) ─ were included in our study. Based on self-reported tobacco use, all adults were classified into six groups: 1) current sole cigar smokers, 2) current poly cigar smokers, 3) former sole cigar smokers, 4) former poly cigar smokers, 5) other tobacco users, and 6) never tobacco users. Current cigar smokers were those who answered “yes” to: “Have you smoked at least 50 cigars, cigarillos, or little filtered cigars in your entire life?” and answered “every day” or “some days” to “Do you now smoke regular cigars, cigarillos, or little filtered cigars every day, some days, or not at all?”. Current sole cigar smoker were current cigar smokers who have never smoked ≥100 cigarettes or never used ST ≥20 times. Current poly cigar smokers were current cigar smokers who have ever smoked ≥100 cigarettes or used ST ≥20 times. Former cigar smokers were those who have smoked at least 50 cigars and now do not smoke cigars at all. Former sole cigar smokers were former cigar smokers who have never smoked ≥100 cigarettes or never used ST ≥20 times. Former poly cigar smokers were former cigar smokers who have ever smoked ≥100 cigarettes or used ST ≥20 times. Sole cigar smokers included both current and former sole smokers and poly cigar smokers included current and former poly smokers. Other tobacco users were those respondents who ever smoked ≥100 cigarettes (current and former) and/or ever used ST (including chewing tobacco and snuff) ≥20 times (current and former) but were not classified as any of the first four groups. Never tobacco users were respondents who have never used any tobacco products in their lifetime (i.e. never smoked ≥100 cigarettes, never smoked ≥50 cigars, and never used ST ≥20 times).

Socio-demographic characteristics. Socio-demographic characteristics included gender, age (35-64, and 65+), race/ethnicity (Hispanic, non-Hispanic (NH) White, NH Black, NH Asian, and NH Other), education (less than high school, high school graduate (including general education development), some college, and ≥college degree), poverty status (poor (<100% of Federal Poverty Level (FPL)), low income (100%-199% of FPL), moderate income (200%-399% of FPL), high income (≥400% of FPL) and unknown), marital status (married, separated/divorced/widowed, never married, and living with a partner), and region of residency (Northeast, Midwest, South, and West). Poverty status was categorized according to the ratio of family income to the FPL after considering family size.[19,20] Given that 16% of adults' income were "unknown", we included them in our analyses because we were concerned that income might not be missing at random.

Other covariates included survey year, binge drinking status, body mass index (BMI) status, and health insurance coverage. Binge drinkers were those who answered one or more days to the question: "In the past year, on how many days did you have 5 or more drinks of any alcoholic beverage?" Body mass index (BMI) was categorized as underweight (BMI <18.5 kg/m^2), normal (BMI = 18.5–24.9 kg/m^2), overweight (BMI = 25.0–29.9 kg/m^2), and obese (BMI >=30.0 kg/m^2). Health insurance coverage was measured by the proportion of months uninsured which equals the number of months without any health insurance coverage in the past 12 months divided by 12.

Econometric Models of Healthcare Utilization

All four healthcare utilization measures contain a non-trivial proportion of zeroes (see Table 2) and have a positively skewed distribution to the right.We explored several models that address these distributional characteristics, including Poisson, negative binomial, two-part model, zero inflated negative binomial and ZIP. We chose the ZIP model based on goodness of fit (the log-likelihood and Akaike and Schwarz information criteria) and root-mean square error criteria. The ZIP model takes account of two types of zeros:[21] sure zeros (those who always choose not to use healthcare services even if they are ill) and regular zeros (those who do not use healthcare services because they are not ill or injured). Therefore, the model is represented by two

processes: the first process generates “sure zeros”, and the second process generates regular zero and positive counts by a Poisson distribution. We used a logit model for the first process and a Poisson model for the second process. For each utilization outcome, we estimated a ZIP model which was specified as a function of tobacco use status (never tobacco users as the reference group) and all other covariates. To facilitate interpretation, we presented adjusted odds ratio in the logit regression and exponentiated the coefficients in the Poisson regression.

Estimation of Cigar Smoking-attributable Healthcare Expenditures

Given a high proportion of cigar smokers who concurrently smoke cigarettes and/or use other tobacco products,[13,22] we teased out the impact of cigarette smoking and other tobacco use on the healthcare utilization and expenditure among cigar smokers, using an approach similar to the one used by Nonnemaker and colleagues.[14] First, we estimated sole cigar smoking-attributable utilization using an “excess utilization” approach as follows. Based on the estimated coefficients from the ZIP model, two sets of predicted healthcare utilization were calculated for both current and former sole cigar smokers in the study sample: the factual and the counterfactual case. The predicted value for the factual case was derived by using the actual values of all covariates in the estimated ZIP model (including both logit and Poisson parts). The predicted value for the counterfactual case was derived for hypothetical “never tobacco-using sole cigar smokers (current and former)” who have the same characteristics as the sole cigar smokers except that they are assumed to be never tobacco users. The difference between the factual and counterfactual predictions is the excess healthcare utilization attributable to sole cigar smoking. For doctor visits and home care visits (two-week measurements), the attributable healthcare utilization estimate was multiplied by 26 to derive the annual values.[23]

Second, for each utilization measure, sole cigar smoking-attributable healthcare expenditures were determined by multiplying the sole cigar smoking-attributable excess healthcare utilization by the unit cost for adults aged 35+ from the 2014 MEPS data ($2,817 per hospital night, $1,099 per ER visit, $201 per doctor visit, and $107 per home care visit). This was then divided by 4 to derive the average annual healthcare expenditure attributable to sole cigar smoking. Finally, the attributable healthcare expenditures per sole cigar smoker was applied to the number of poly cigar smokers to derive cigar-attributable healthcare expenditures for poly cigar smokers. The sum of sole cigar smoking-attributable expenditures and poly cigar smoking-attributable expenditures yielded the total cigar-attributable healthcare expenditures.

Study Sample

The pooled 2000, 2005, 2010, and 2015 NHIS data contained 89,638 adults aged 35+. After excluding 5,460 respondents (6.1%) with missing values for tobacco use status and healthcare utilization measures, there were 84,178 adults for the distribution analyses of the study sample and the estimation of mean healthcare utilization. After further excluding those with missing values for education, marital status, binge drinking, BMI and the proportion of months uninsured, the final study sample for the ZIP model analyses was 79,973.

RESULTS

Table 1 shows the sample distribution with unweighted frequencies and weighted percentages by each covariate. Among 84,178 adults, 75.2% were aged 35-64, 47.3% were male, 13.4% were binge drinkers, more than 50% were overweight or obese, and 32.3% did not have any health insurance. During 2000-2015, 0.6 % of US adults aged 35+ were current sole cigar smokers, 1.7% were current cigar poly smokers, 0.7% were former sole cigar smokers, 4.8% were former cigar poly smokers, and 51.7% were never tobacco users. Among current poly cigar smokers, 39% of them were current dual smokers of cigars and cigarettes, and among former poly cigar smokers, 47% of them were former dual smokers of cigars and cigarettes (data not shown).

Mean Healthcare Utilization

Table 2 shows the percentage of adults with positive healthcare utilization and the mean of healthcare utilization among those who used that service. Hospitalization services, ER services, doctor service and home care services were used by 5.4%, 14.4%, 19.1% and 2.2% of current sole cigar smokers, and by 15.4%, 23.5%, 23.0%, and 1.3% of former sole cigar smokers respectively. Among those who utilized healthcare, the average number of hospital nights, ER visits, doctor visits and home care visits were 5.6, 1.6, 1.3 and 4.3 for current sole cigar smokers and 10.1, 1.6, 1.4 and 6.5 for former sole cigar smokers.

Impact of Cigar Smoking on Healthcare Utilization

Table 3 presents the estimated coefficients for the tobacco use status variable from the ZIP model for each healthcare utilization measure. The logit model results indicate that compared to never tobacco users, current sole cigar smokers were less likely to have “sure zero” home care visits, while former sole cigar smokers were less likely to have “sure zero” hospital nights and ER visits. This indicates that current sole cigar smokers were more likely to have regular zero and positive home care visits, while former sole cigar smokers were more likely to have regular zero or positive hospital nights, and regular zero or positive ER visits. Neither current nor former sole cigar smokers were significantly different from never tobacco users in the probability of “sure zero” doctor visit. The Poisson model results show that neither current nor former sole cigar smokers were statistically different from never tobacco users in their utilization of any of the four types of healthcare services.

Healthcare Expenditures Attributable to Cigar Smoking

Sole cigar smoking attributed to 0.07 million excess hospital nights, 0.03 million excess ER visits, and 0.42 million excess home care visits (Table 4). The annual expenditures attributable to sole cigar use in 2014 dollars were $203 million for hospital care, $36 million for ER visits, and $45 million for home care visits, totaling $284 million. Given the average of 0.46 million sole cigar smokers during the study period, the annual attributable healthcare expenditures per sole cigar smoker was $625. Applying this attributable expenditure per sole cigar smoker to the poly cigar smoking population (235.1 million), we estimated that the poly cigar smoking-attributable healthcare expenditure was an additional $1.5 billion. Including both sole and poly cigar smokers, the total cigar-attributable healthcare expenditures were $1.8 billion per year.

DISCUSSION

This is the first study to assess the healthcare expenditures attributable to cigar smoking in the US. We estimated that cigar-attributable healthcare expenditures for four types of healthcare services amounted to $1.8 billion per year, including $284 million due to sole cigar smoking and $1.5 billion due to poly cigar smoking. A previous study estimated that the value of lost productivity due to premature death attributable to cigar smoking in the US totaled $23 billion.[14] Our results provide another component of the economic costs of cigar smoking. Both studies indicate that the health-related economic burden of cigar smoking in the US is large.

Our findings are consistent with the literature showing that cigar smoking is associated with a number of conditions that would result in healthcare utilization and expenditures, including of oral, pancreatic and lung cancer.[9,24] For example, lung cancer patients visit the emergency room for cancer-related and -unrelated reasons more often than patients with other types of cancer.[25]

Our estimates are subject to several limitations. First, due to data restrictions, we were not able to account for health services such as nursing home care, medications, or dental care. Second, our study included established cigar smokers who had smoked 50 cigars and did not include healthcare expenditures for experimental cigar smokers. However, these costs are likely to be relatively small compared to those of established cigar smokers. Third, the data did not allow us to differentiate between large cigars, cigarillos, and little cigars. Cigar smoking patterns differ

across these products, but we were unable to account for this in our models. Fourth, due to data limitations, our categories of tobacco use did not include e-cigarettes or newer emerging products. As a result, never tobacco users in our study might also use a tobacco product not included in this study, leading to underestimates of cigar smoking-attributable healthcare utilization. Fifth, because of the wording of the NHIS question about doctor visits, there is a possibility that some ER visits were counted as the doctor visits. Finally, self-reported healthcare utilization may be subject to recall bias and could be underreported.[26]

The US Food and Drug Administration (FDA) asserted jurisdiction over cigars in 2016,[27] but the new ruling did not regulate flavors and package size of cigars. Previous studies have shown that flavors,[4,8,28-30] and small package sizes.[30,31] contribute to the popularity of cigars, especially among the young. Therefore, tobacco control policies and interventions should target cigar flavor, and packaging to reduce cigar smoking and the associated excess healthcare costs. Given the common use of cigars and other tobacco products, especially dual use of cigars and cigarettes,[13] it is also important to coordinate cigar and cigarette-focused tobacco control policies to reduce the impact of tobacco use in the US.

CONCLUSION

Our findings showed substantial cigar smoking-attributable healthcare expenditures for US adults. Given the increasing popularity of cigar smoking among youth and young adults, and the growing market for cigars, cigar smoking-attributable healthcare expenditures are expected to increase over time. Comprehensive tobacco control policies and interventions are needed to reduce cigar smoking and the associated healthcare expenditures.

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Table 1: Distribution of the study sample aged 35+, NHIS 2000,2005,2010,2015

	Variables	Study Sample N	%
Total		84,178	100.0
Tobacco use status	Current cigar sole users	409	0.6
	Current cigar poly users	1,340	1.7
	Former cigar sole users	527	0.7
	Former cigar poly users	3,768	4.8
	Other users	34,514	40.6
	Never tobacco users	43,620	51.7
Year	2000	21,631	22.9
	2005	21,189	24.4
	2010	17,947	25.4
	2015	23,411	27.3
Age	35-64	59,694	75.2
	65+	24,484	24.8
Gender	Male	36,547	47.3
	Female	47,631	52.7
Race/Ethnicity	Hispanic	12,244	11.0
	Non-Hispanic White	56,129	73.4
	Non-Hispanic Black	11,766	10.6
	Non-Hispanic Asian	3,653	4.5
	Non-Hispanic Other	386	0.4
Education	Less Than High School	15,234	15.2
	High School	23,523	28.1
	Some College	22,823	27.2
	College +	22,088	28.9
	Missing	510	0.6
Poverty Status	Poor	9,459	8.1
	Low Income	14,022	14.3
	Moderate Income	20,751	24.8
	High Income	26,373	36.6
	Unknown	13,573	16.1
Marital Status	Married	42,820	64.4
	Single/Divorced/Widowed	28,432	22.9
	Never Married	9,675	8.2
	Living with Partner	3,039	4.4
	Missing	212	0.2
Region	Northeast	15,040	18.9
	Midwest	18,781	23.7
	South	30,192	36.1
	West	20,165	21.4
Binge drinking	Yes	9,938	13.4
	No	73,244	85.4
	Missing	996	1.2
BMI	Underweight	1,305	1.4
	Normal	26,967	31.7
	Overweight	29,968	36.2
	Obesity	23,475	27.9
	Missing	2,463	2.9
Health Insurance Coverage Status	Yes	55,568	67.4
	No	28,411	32.3
	Missing	199	0.3

Note: BMI=Body Mass Index; % is weighted percentage.

Table 2: Healthcare utilization by tobacco use status among U.S. adults aged 35+, 2000,2005,2010,2010 (N=84,178)

	In the past 12 months						In the past 2 weeks					
	Hospital nights Among those with ≥1 night			ER visits Among those with ≥1 visit			Doctor visits Among those with ≥1 visit			Home care visits Among those with ≥1 visit		
	%	Mean	sd	%	Mean	sd	%	Mea n	sd	%	Mea n	sd
Current cigar sole users	5.4	5.6	1.9	14.4	1.6	0.2	19.1	1.3	0.1	2.2	4.3	1.1
Current cigar poly users	10.0	7.1	1.2	24.7	2.0	0.1	21.0	1.4	0.0	0.9	5.1	1.4
Former cigar sole users	15.4	10.1	2.6	23.5	1.6	0.1	23.0	1.4	0.1	1.3	6.5	2.0
Former cigar poly users	14.0	8.3	0.6	22.6	2.0	0.1	24.7	1.6	0.0	1.5	6.5	0.8
Other users	11.4	7.6	0.2	22.0	2.0	0.0	22.6	1.5	0.0	1.5	5.2	0.2
Never tobacco users	8.6	6.7	0.2	16.9	1.8	0.0	20.1	1.5	0.0	1.2	5.8	0.2

Note: All the numbers were estimated from the weighted analysis

Table 3: ZIP regression results for sole cigar smoking attributable healthcare utilization in the US aged 35+, 2000,2005,2010,2015(N=79,973)

	In the past 12 months				In the past 2 weeks			
	Hospital nights		ER visits		Doctor visits		Home visits	
	Logit*	Poisson**	Logit*	Poisson**	Logit*	Poisson**	Logit*	Poisson**
Current cigar sole users	1.30	1.88	0.92	1.83	0.46	1.16	**0.26**	2.06
	p=0.28	p=0.63	p=0.78	p=0.60	p=0.17	p=0.15	**p=0.01**	p=0.72
Current cigar poly users	**0.73**	2.63	**0.59**	1.83	**0.60**	1.24	0.90	1.92
	p=0.01	p=0.96	**p<0.01**	p=0.61	**p=0.01**	p=0.22	p=0.77	p=0.65
Former cigar sole users	**0.49**	1.12	**0.54**	2.68	0.69	2.22	0.66	1.68
	p<0.01	p=0.11	**p=0.01**	p=0.99	p=0.20	p=0.80	p=0.35	p=0.52
Former cigar poly users	**0.62**	1.08	**0.74**	**1.02**	**0.74**	1.07	0.76	1.72
	p<0.01	p=0.07	**p<0.01**	**p=0.02**	**p=0.01**	p=0.07	p=0.12	p=0.54
Other users	**0.77**	1.07	**0.78**	**1.02**	**0.85**	1.11	**0.79**	1.16
	p<0.01	p=0.06	**p<0.01**	**p=0.02**	**p<0.01**	p=0.10	**p<0.01**	p=0.15

Note: a. Never tobacco users are reference group; b. Bold results indicate statistically significant results at the p<0.05 level; c. *Odds ratios are presented for logit regression results; d. ** the exponentiated coefficients are reported for Poisson models.3; e. All models control for gender, age, race/ethnicity, education, poverty status, marital status, region, binge drinking, body mass index (BMI), and proportion of months uninsured; f. ER=emergency room;

Table 4. Sole-cigar-smoking attributable healthcare utilization and the total cigar-attributable expenditure among U.S adults aged 35+,2000,2005,2010,2015

	Mean	SE	95% CI	
Hospital nights attributable to sole cigar smoking				
Attributable utilization over 4 years (thousands)	289	16	257	320
Attributable utilization per year (thousands)	72			
Attributable expenditure per year ($ thousands)	203,173			
Emergency room visits attributable to sole cigar smoking				
Attributable utilization over 4 years (thousands)	131	7	118	144
Attributable utilization per year (thousands)	33			
Attributable expenditure per year ($ thousands)	35,990			
Home care visits attributable to sole cigar smoking				
Attributable utilization over 4 years (thousands)	65	5	54	75
Attributable utilization per year (thousands)	420			
Attributable expenditure per year ($ thousands)	44,953			
Annual expenditure attributable to sole cigar smoking*				
Expenditure for all sole cigar smokers($ thousands)	284,116			
Expenditure per sole cigar user	624.9			
Total annual expenditure attributable to poly cigar smoking ($ thousands)	1,469,326			
Total annual expenditure attributable to cigar smoking ($ thousands)	1,753,442			

Note: *Due to non-significant estimated coefficients for current and former sole cigar smoking variables in the ZIP regression model on doctor visits, the attributable utilization and expenditures for doctor visits are set to be zero.