Smoking attributable mortality among the indigenous population of the Mariana Islands

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Abstract

WHO reports that tobacco consumption in the pacific region increased by 15% between 1988–1992. Basic epidemiological information about smoking is unknown in the former US territories of the Pacific. This study examines the smoking epidemic in the US Commonwealth of the Northern Mariana Islands (CNMI) by estimating smoking attributable mortality among the indigenous population. It is a descriptive epidemiological study for the years 1992–1995. Etiologic fractions developed previously were used to calculate smoking attributable mortality rates, which were then age-adjusted.

The age-adjusted smoking-attributable mortality rate for the two indigenous populations, Carolinian and Chamorro, were 1032.5 and 368.0 per 100,000 respectively. The rate for Carolinians was almost three times the U.S. median rate (363.3). Carolinian women have a rate (839.9) over four times that of Chamorro women (194.3). Chamorro males have rates three times higher then their female counterparts.

This study establishes that the two indigenous populations of the CNMI are experiencing high rates of smoking-attributable mortality and subsets of the population have alarming rates. Further studies are needed to determine smoking prevalence and more in-depth epidemiological information.

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Introduction

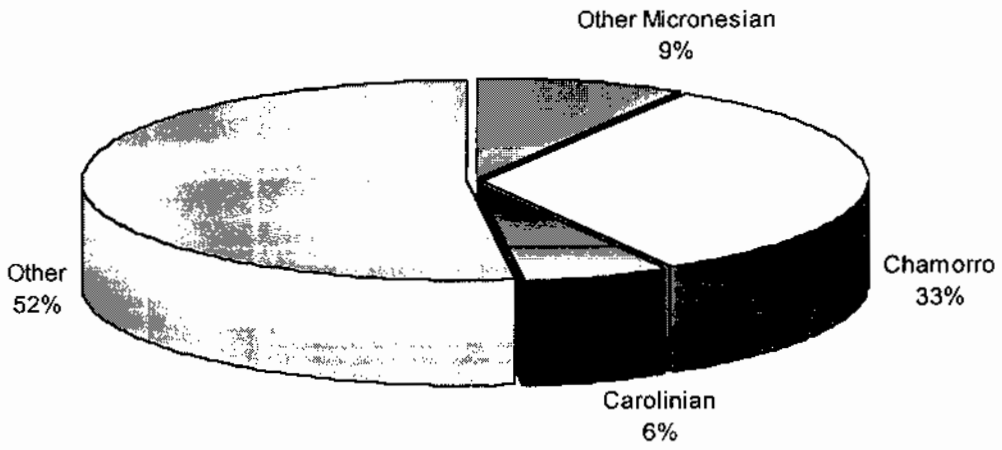
Cigarette smoking has long been identified as the single greatest source of premature deaths in both developed and developing countries.[1] As early as the mid-1950s, scientists were able to identify with certainty that cigarette smoking was responsible for the precipitous rise in lung cancer deaths occurring during the early 1940s. Since that time, several reports have been published establishing that cigarette smoking is the cause of many other diseases.[2] Cigarette smoking causes mortality through a range of diseases including several sites of cancer, vascular diseases and chronic lung diseases.[3] With prolonged smoking, smokers have a death rate about three times higher than nonsmokers at all ages after young adulthood.[4]

The increase in smoking worldwide since 1950 has seen its most dramatic rise in developing countries. The current global health care costs associated with tobacco use exceed $200 billion per year. This figure is twice the current health budgets of all developing countries combined.[5] The tobacco industry is increasingly targeting markets in the Pacific Region, as smoking prevalence drops by 1.1% annually in developed countries.[6] The tobacco industry has predicted sales increases in Asia of 33% between 1991 and the year 2000. WHO reports that tobacco consumption in the Pacific Region has already increased by 15% between the years 1988 and 1992, making it the only WHO region where per capita consumption of tobacco is increasing.[7] Basic epidemiological information, including smoking prevalence and rates of tobacco consumption are currently unknown in many of the Pacific island jurisdictions within the Western Pacific region. In most instances, these islands have yet to undertake a national survey on smoking prevalence. There is rising concern that lack of government restrictions on use of cigarettes in this region has led to high smoking prevalence and subsequently high smoking attributable mortality.[7]

Cigarette smoking causes mortality through a range of diseases including several sites of cancer, vascular diseases and chronic lung diseases.

This study sets out to determine the extent of the smoking epidemic in the United States Commonwealth of the Northern Mariana Islands (CNMI) by estimating mortality attributable to cigarette smoking.

Fig. 1. Population distribution of CNMI, by ethnicity



CNMI Division of Central Statistics

Methods

A descriptive epidemiological study design was utilized to quantify mortality information for the years 1992 through 1995 in the CNMI. Mortality data were obtained by reviewing all death certificates, then assigning an ICD-9 code to each condition listed on the certificate, and finally selecting the underlying cause of death using guidelines established by the U.S. National Center for Health Statistics (NCHS). The mortality rates per 100,000 were then calculated, adjusting for age and ethnicity. All the data presented in this study are limited to the age group 35 and above. This age group was chosen to make it possible to compare mortality rates with those of the United States. The only available data on U.S. national mortality rates at the time of this study were from the year 1990.

Estimation of population

The CNMI Department of Commerce, Division of Central Statistics, provided population estimates for the CNMI. These estimates are based on the 1992 CNMI Household Survey and the 1995 CNMI Mid-Decade Census. Population estimates for years between 1992 and 1995 were extrapolations provided by the Division of Central Statistics. This study looks only at indigenous populations of the CNMI (Table 1). The two recognized indigenous populations in the CNMI are Chamorros and Carolinians, which are examined separately because they are two distinct ethnic/cultural groups. The category "Other-Micronesians" is included in the study to assess the level of impact this population has on smoking attributable mortality in the CNMI. Other Micronesians consist of immigrants from the Republic of the Marshall Islands, Republic of Palau, and the Federated States of Micronesia (Chuuk, Kosrae, Pohnpei and Yap).

It should be noted that although Chamorro, Carolinian and other Micronesian populations are considered separately, all three are of Micronesian extraction and are part of the islands of Micronesia. Each island group has its own distinct cultural identity and language; however, the Chamorros have a strong Spanish influence having been colonized for about 400 years. The Department of Public Health has concluded that ethnicity shall be determined by the ethnic origin of the mother because of frequent intermarriage between the diverse ethnicities of the Northern Mariana Islands and the strong matrilineal culture found throughout Micronesia. This policy was followed when making determinations of ethnicity on death certificates.

Calculation of etiologic fraction

In the CNMI, smoking prevalence rates, incidence rates and the relative risk of developing disease among smokers compared to non-smokers are unknown. Therefore, in order to determine smoking attributable mortality, relative risk figures were obtained from a study by English et al. entitled "The quantification of drug caused morbidity and mortality in Australia 1995".[8] This study performed a meta-analysis of the world's literature on smoking to determine pooled relative risks for developing certain smoking attributable diseases.

The first diagnosis, smoking attributable fractions from ischemic heart disease were applied to cardiac dysrhythmias under the assumption that most cardiac dysrhythmias, especially those causing sudden death or significant morbidity, are the result of ischemic heart disease. The second diagnosis, smoking attributable fractions from chronic obstructive pulmonary disease (COPD) were applied to pulmonary circulatory disorders, based on the assumption that COPD is the underlying pathology in the vast majority of cases of pulmonary circulatory conditions, excluding pulmonary embolism. The third diagnosis, smoking attribut-

Table 1. Population distribution in the CNMI, by ethnicity

Ethnic group	Estimated population (%)
Chamorro	18,023 (31%)
Carolinian	4024 (7%)
Other Micronesian	4165 (7%)
Other*	32,634 (55%)
Total	*58,846 (100%)*

**Includes mostly Filipino, Chinese, and Caucasian American. CNMI Division of Central Statistics, 1995 Mid-Decade Census*

able fractions for heart failure were apportioned by using attributable fractions for ischemic heart disease and other specified heart disease codes in accordance with the proportional distribution of heart conditions in the CNMI. This is based on the assumption that a diagnosis of heart failure is non-specific and does not identify the underlying pathology which may be ischemic in nature, or due to hypertension, cardiomyopathy or rheumatic disorders. These pooled relative risks, along with Australia's smoking prevalence (32% male smokers, 25% female smokers) were then applied to this study of the CNMI. As preliminary smoking prevalence studies in the CNMI indicate that between 32-45% of males and females are smokers, applying Australia's smoking prevalence would provide a conservative estimate of smoking prevalence in the CNMI (see Table 2).

Statistical analysis

Data organization and analysis was performed on Microsoft Excel spread sheets and EpiInfo Version 6.02. Variables analyzed with EpiInfo included sex, age, underlying cause of death, and ethnicity. In order to compare CNMI smoking attributable mortality rates to the US rates, all CNMI rates were age-adjusted using a direct method of adjustment to a standard million based on the 1990 US Census population. Comparison of proportions of smoking mortality as well as age-adjusted mortality rates was performed by EpiInfo using 95% confidence intervals and chi-squared analysis and two-sided Fisher Exact Test.

Results

There were a total of 303 deaths among the population age 35 and greater, due to all causes between the years 1992 - 1995 among the two indigenous populations, Chamorro and Carolinian, in the CNMI. Of these 303 deaths, 229 (75.6%) were Chamorro, 74 (24.4%) were Carolinian, and 29 (9.6%) were Other Micronesian. After applying the etiologic fractions (see Table 2), the deaths determined to be attributable to smoking were 39.9 deaths among Chamorros, 16.4 deaths among Carolinians, and 7.2 among Other Micronesians (see Table 3).

The proportion of smoking-attributable deaths was 23.1% for Chamorro males and 10.2% for Chamorro females (see Table 3). The Chamorro male proportion is significantly higher ($p<0.01$) than the proportion (10.2%) of Chamorro female deaths attributable to smoking. The proportion of Chamorro female deaths attributable to smoking was significantly less that the US Median proportion of smoking attributable deaths of 19.2% ($p=0.018$). The proportion of smoking attributable deaths for all other groups in this study, including Chamorro males (23.1%), Carolinian males (23.1%) and females (21.1%), and Other Micronesian males (28.5%) and females (18.2%) did not differ significantly ($p>0.05$) and none were significantly different than the US Median proportion of 19.2% ($p>0.05$).

The age-adjusted smoking-attributable mortality rate for Carolinians was significantly higher than the rate for Chamorros ($p<0.05$) and significantly higher than the US Median rate of 363.3 deaths per 100,000 ($p<0.05$). Although the age-adjusted smoking-attributable mortality rate for Chamorros and Other Micronesians was higher than the US Median rate, the difference was not significant ($p>0.05$). Carolinian males and Other Micronesian males had age-adjusted smoking attributable mortality rates of 1279.5 and 1006.5 deaths per 100,000 respectively, which were significantly higher than the US Median rate ($p<0.05$). Chamorro males and Carolinian females also had age-adjusted smoking-attributable mortality rates not significantly ($p>0.05$) higher than the US Median rate. Chamorro females and Other Micronesian females had age-adjusted smoking-attributable mortality rates not significantly ($p>0.05$) higher lower than the US Median rate. The differences between the rates for males and females in each of the ethnic groups were not significant ($p>0.05$). This difference between genders is similar to the current U.S. trend[9] (see Table 3).

Discussion

This study examines smoking-attributable mortality among the indigenous populations of the CNMI. The Chamorro and Carolinian populations of the CNMI are

among the smallest ethnic minorities in the United States. Perhaps for this reason, they have received little research attention in the past. To our knowledge, this is the first study in the CNMI to estimate mortality attributable to cigarette smoking in these two populations.

The results of this study confirm earlier reports that the Western Pacific Region is the only WHO region in which tobacco consumption is still increasing[7]. Higher rates of smoking-attributable mortality were found in both the Chamorro and Carolinian populations as compared with the U.S. The highest smoking attributable mortality rates were those of the Carolinian population, whose age-adjusted smoking-attributable mortality rate of 1032.5 deaths per 100,000 is three fold higher than the U.S. median smoking attributable mortality rate of 363.3 deaths per 100,000. The Chamorro age-adjusted smoking-attributable mortality rate of 368.0 is similar to the U.S. median smoking-attributable mortality rate. This rate among Chamorros may continue to rise over the next decade, reflecting the long latency period of smoking-attributable disease.

Table 2. Etiologic fractions used in determining smoking attributable mortality in the CNMI*

Diseases among adults (>=35 yrs of age). Disease category (ICD-9) (#1)	Pooled Relative Risk (95% CI)	Etiologic fraction	
		Males	Females
Neoplasms			
Oropharyngeal (141, 143-6,148-9)	4.55 (3.97-5.20)	0.57	0.51
Esophageal (150)	4.01 (3.37-4.77)	0.54	0.46
Stomach (151)	1.41 (1.29-1.55)	0.14	0.11
Anal (154.3, 154.4)	3.18 (2.49-4.05)	0.48	0.41
Pancreatic (157)	1.86 (1.73-2.00)	0.24	0.19
Laryngeal (161)	7.48 (4.77-11.7)	0.73	0.40
Lung (162) -- Male	13.0 (12.2-13.7)	0.84	0.77
-- Female	11.4(10.5-12.3)	0.84	0.77
Cervical (180, 233.1)	1.75 (1.66-1.85)	-	0.19
Vulvar (184.4)	3.42 (2.99-3.92)	-	0.40
Penile (187.1-187.4)	1.80 (1.34-2.42)	0.30	-
Bladder (188)	2.72 (2.60-2.85)	0.43	0.36
Renal parenchymal (189.0)	1.64 (1.47-1.84)	0.28	0.21
Renal pelvic (189.1)	3.96 (2.93-5.36)	0.55	0.48
Respiratory ca-in-situ (231)	NA	0.84	0.77
Cardiovascular diseases			
Ischemic heart disease (410-414)			
Persons ages 35-64 yrs	3.06 (3.00-3.13)	0.45	0.40
Persons ages >=65 yrs	1.66 (1.59-1.74)	0.15	0.09
Cardiac dysrhythmias (427)			
Persons ages 35-64 yrs	NA (#2)	0.45	0.40
Persons ages >=65 yrs	NA (#3)	0.15	0.09
Heart Failure (428-429)	NA (#4)	0.24	0.20
Cerebrovascular diseases (430-438)			
Persons ages 35-64 yrs	3.12 (2.80-3.47)	0.44	0.39
Persons ages >=65 yrs	1.65 (1.52-1.79)	0.16	0.09
Atherosclerosis (440-448)	2.54 (2.42-2.67)	0.43	0.35
Pulmonary circulatory dis. (415-417	NA	0.82	0.76
Respiratory diseases			
Pneumonia (480-487)	1.47 (1.33-1.61)	0.19	0.14
Chronic airway obstruction (490-2,496)	9.80 NA	0.82	0.76
Deaths from fire injuries (E890-E899)	NA	0.23	0.23

**Disease categories, pooled relative risks and etiologic fractions (except as noted) derived by English et al. study*

NA Relative risks not available - etiologic fraction estimated using a direct method.
(1) International Classification of Diseases, Ninth Revision
(2) Etiologic fraction for Chronic airway obstruction assigned to these codes
(3) Etiologic fraction for Ischemic heart disease assigned to these codes
(4) Deaths assigned to these codes were apportioned to ischemic heart disease and other specified heart disease codes in accordance with the proportional distribution of specified heart conditions in the CNMI

The latency period between the peak in smoking prevalence and the subsequent peak in smoking attributable mortality takes several decades to manifest.[3,10,11] Smoking attributable deaths occurring in the CNMI today had their origin three to four decades ago. As in most areas in the Western Pacific, the CNMI does not have reliable epidemiological data regarding smoking prevalence from decades prior to 1990. However it is known that the importation of cartons of cigarettes have increased by 85% between 1987 and 1992.[12] While cigarette smoking initiation rates have continued to decline in the U.S. since 1965, smoking prevalence surveys of the CNMI youth population show high smoking initiation rates.[10,11,13] The smoking attributable mortality rates among Chamorros and Carolinians are evidence of a high degree of smoking prevalence among adults in past decades. Increasing rates of smoking prevalence in the CNMI will result in a continual rise in numbers of smoking attributable deaths in the next several decades. In addition, the gap between smoking attributable mortality rates between the CNMI and the U.S. will continue to widen due to the long latency period of smoking. The CNMI is just beginning to experience the impact of smoking attributable mortality on its indigenous populations, while the U.S. has been experiencing increased smoking attributable deaths for the past three decades.[14,15,16]

Table 3. Estimated smoking attributable mortality (SAM), CNMI 1992-1995*

	Total deaths	SAM	Proportion of smoking deaths	Age-adjusted SAM rate (a)
Chamorro				
Male	128	29.6	23.1%	562.6
Female	101	10.3	10.2%	194.3
Combined	*229*	*39.9*	*17.4%*	*368.0*
Carolinian				
Male	42	9.7	23.1%	1279.5
Female	32	6.7	21.1%	839.9
Combined	*74*	*16.4*	*22.2%*	*1032.5*
Other Micronesian				
Male	19	5.4	28.5%	1006.5
Female	10	1.8	18.2%	255.9
Combined	*29*	*7.2*	*25.0%*	*513.3*

** All data >= 35 years of age*
(a) Age-adjusted to Standardized 1990 US Population

Previous authors have noted that tobacco consumption in the Western Pacific Region has increased by 15% between the years 1988 and 1992.[7] In the CNMI during this same four-year period, import statistics show a 41% rise in consumption of cartons of cigarettes.[12] While part of this rise can be attributed to population growth and duty free sales to tourists, it demonstrates the trend toward increasing rather than decreasing cigarette consumption in this part of the Western Pacific Region.

Several studies have suggested there is a period of time during which smokers initiate smoking; starting around age 10 years and ending around age 25.[11,17] Surveying youth, therefore, provides estimates of initiation rates and expected future mortality rates due to cigarette smoking. Between 1993 and 1994, the CNMI conducted a teen behavioral risk survey in its public and private schools. The results showed smoking prevalence rates of 39% for males and 32% for females, grades 7-12. By the time students reached grade 12, prevalence of smoking was 52%.[13,18] In the U.S. during the year 1993 only 19% of high school seniors were smokers.[10,11,19] By examining the age population structure of the CNMI, the impact of these smoking prevalence rates of CNMI youth can be used as a determinant in predicting future premature deaths due to smoking. The CNMI presently has a very young population, with almost half its indigenous population under the age of 15 (46.1%). The youth, age 25 and under, constitute 63% of the total indigenous population.[20] If prevalence of smoking among youth is increasing as current surveys show, then a future surge in illness and premature deaths can be expected. Prevention and control measures are needed to decrease smoking initiation among youth in the CNMI.

Perhaps the most interesting finding of this study is the smoking-attributable mortality rate that is found in the Carolinian population. One out of every five deaths occurring in the Carolinian population is attributable to smoking. Carolinian females have an equally high percentage of smoking attributable deaths as Carolinian males, which does not follow the typical gender ratio findings noted in other studies[9]. Carolinian females were also found to have an age-adjusted smoking-attributable mortality rate over 4 fold higher than Chamorro females and higher than the rate seen in Chamorro males. These findings would seem to indicate that the Carolinian population has significantly higher smoking prevalence rates. However, the only available epidemiological data on prevalence indicate that only 27% of Carolinian youth are smokers as compared to 42% of Chamorro youth.[13]

Possible explanations for this incongruence between smoking prevalence and smoking attributable mortality in comparing Carolinians to Chamorros may lie in the practice of betel nut chewing among Carolinians. Betel nut is chewed all over Micronesia as well as several parts of the world. Betel nut is a 2-inch long, 1-inch wide nut, which is a member of the palm family. It has recently become common practice to add tobacco to the betel nut, leaf, and lime combination.[21] While both Chamorros and Carolinians chew betel nut, a 1981 CNMI survey of 150 households indicated that 81% of Carolinians chewed as compared to 29% of Chamorros.[22]

This same survey indicated that 62% of Carolinian adults smoked cigarettes as well. Future research should look into a synergistic effect of chewing betel nut with tobacco and cigarette smoking. Another explanation for the higher smoking attributable mortality rates among Carolinians may be that the Carolinian population has had a longer latency period of smoking. If the findings of the two population surveys are correct, then smoking prevalence may be on the decline among Carolinians during the past 15 years, indicated by the drop from 62% to 27% reported smokers. A national prevalence survey and tracking smoking attributable mortality trends by ethnicity is needed to answer these questions.

The results in this study are subject to limitations. First, the smoking attributable fractions are based on Australian smoking prevalence. These smoking prevalence rates are 32% for males and 25% for females. The prevalence surveys of youth indicate a prevalence of smoking between 32-52% for males and females.[13,18] By utilizing Australian smoking prevalence, the smoking attributable deaths will be underestimated. In addition, prevalence of smoking is known to vary between the different ethnicity's being studied. If this is the case, ethnic-specific etiologic fractions should be utilized for each ethnicity. However, exact prevalence data is not known for each of the indigenous ethnic populations.

... this study confirms the two indigenous populations of the Commonwealth of the Northern Mariana Islands are experiencing high levels of smoking attributable mortality compared with the United States. Carolinian rates of smoking attributable mortality, for both males and females are far above the U.S. median rate.

As effects of cigarette smoking take two to four decades to result in premature death due to smoking, results of this study should not be taken as an indicator of the current extent of the smoking epidemic. Instead, these results reflect smoking rates of at least two to four decades ago.

Comparisons should be made carefully between U.S. mortality data with that of the CNMI. The U.S. estimates its smoking attributable mortality by utilizing software called SAMMEC (Smoking Attributable Morbidity Mortality and Economic costs). SAMMEC uses smoking prevalence data, mortality data and economic cost data to make population calculations. Due to the absence of smoking prevalence data in the CNMI, and the fact that SAMMEC software produces unreliable estimates of disease impact in populations of less than a few hundred thousand persons; the English et al. methodology was adopted for use in this study.[23] The English et al. methodology calculates etiologic fractions of smoking attributable diseases by combining pooled relative risks obtained from a meta-analysis study.[8] Two readily apparent differences between the SAMMEC and English et al. methodology are those of inclusion and exclusion of different smoking attributable conditions, and a variance in determination of etiologic fractions.

In conclusion, this study confirms the two indigenous populations of the Commonwealth of the Northern Mariana Islands are experiencing high levels of smoking attributable mortality compared with the United States. Carolinian rates of smoking attributable mortality, for both males and females are far above the U.S. median rate. A national prevalence survey needs to be undertaken in the CNMI to produce information on prevalence and smoking mortality trends. It is also important that data be collected on a regular basis to evaluate effectiveness of various anti-smoking measures. The data collection methodology in the national prevalence survey should be similar to methodologies utilized in other countries in the Western Pacific Region to allow for comparisons. Further research should be done to determine why the Carolinian smoking attributable mortality rate is significantly higher than Chamorro smoking attributable mortality rates. As prevalence of smoking is known to vary between the two indigenous populations under study, individual prevalence data for each population is needed. Socioeconomic variables such as educational attainment, rates of unemployment and level of income may also help to explain smoking attributable mortality rate differences between the Carolinian and Chamorro populations.[24,25,26] Some researchers have suggested a genetic predisposition to tobacco effects.[27,28] This research should be examined to determine its validity to the CNMI indigenous populations. Other directions of future research include assessing morbidity and economic costs of smoking attributable illness in these two populations.

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When you are so poor that you cannot afford to refuse eightpence from a man who is too poor to pay you any more, it is useless to tell him that what he or his child needs is not medicine, but more leisure, better clothes, better food, and a better drained and ventilated house.

George Bernard Shaw in The Doctors Dilemma