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The Effects of Tobacco Use on Oral Health in Indiana

One of the top ten public health achievements of the 20th century was the recognition that tobacco use[i] is hazardous to human health [1]. In its publication *Healthy People 2010*, the U.S. Department of Health and Human Services calls cigarette smoking "the single most preventable cause of disease and death in the United States" [2]. Although the prevalence of adult smoking has decreased since the Surgeon General's report on the health risks of smoking in 1964, approximately 43.4 million American adults continue to smoke cigarettes. Tobacco causes serious illness in about 8.6 million people, and an estimated 443,000 premature deaths occur annually due to smoking or exposure to secondhand smoke [3].

Tobacco use is associated with a variety of harmful consequences, including increased risk of numerous cancers; coronary heart disease and other cardiovascular diseases; respiratory diseases in adults and children; and pregnancy complications. In addition, tobacco use imposes a considerable economic burden, accounting for $190 billion annually in healthcare expenditures and productivity losses [3].

Tobacco use also contributes significantly to mortality, causing numerous deaths mainly due to vascular and respiratory diseases and cancer. The Surgeon General report (2004) presented strong evidence for a direct causal relationship between tobacco use and the following types of cancer: lung and bronchial, laryngeal, oral cavity and pharyngeal, esophageal, stomach, pancreatic, kidney and renal pelvis, urinary bladder, cervical, and acute myelogenous leukemia. Furthermore, there is a reported association between smoking and the development of liver cancer [4]. In addition, tobacco use and exposure may be related to an increased risk for breast and colorectal cancer, and if indeed there is a causal relationship, the incidence of tobacco-attributed cancers in the nation will rise considerably [5].

From 1999 through 2004, there were approximately 2.4 million cases of tobacco-related cancer diagnosed in the United States. Cancer incidence rates were higher in U.S. states with higher smoking prevalence. Most cases occurred in people older than 70, with incidence rates higher for men than women. Blacks and non-Hispanic whites typically had higher incidence rates than other races or ethnicities, consistent with a higher prevalence of cigarette smoking in those population groups. About 30 percent of overall cancer deaths and 87 percent of lung cancer deaths were due to tobacco use [5-6]. In fact, cancer of the lung and bronchus was responsible for over one-fourth of cancer deaths in 2009, making it one of the most common fatal cancers in both men and women [7]. From 1999 through 2004, over a million people were diagnosed with lung and bronchial cancer in the United States; in 2009 alone, there were almost 220,000 diagnosed cases [5, 7].

Tobacco-related cancer mortality tends to be higher in males than females. Variation is also evident among different racial and ethnic groups, even though most cancer survival rates have improved for all population groups in recent years. The highest cancer incidence and mortality is seen in black males, a population that has a particularly high smoking prevalence.

Although the factors that contribute to racial disparities vary by cancer type, a major disadvantage is the lack of timely diagnosis and treatment. Racial and ethnic minorities are more likely to have their cancer diagnosed at an advanced stage,[ii] resulting in a worse prognosis. With few exceptions, they also have a greater probability

[i] Tobacco use includes cigarettes, smokeless tobacco (snuff or chewing tobacco), cigars, pipes and imported cigarettes such as bidis (which consist of a small amount of tobacco wrapped in the leaf of another plant, or small filterless flavored cigarettes), and kreteks.

[ii] Cancer can be classified according to stages: early cancer, when it is localized or limited to the organ in which it began; regional, when it has spread beyond the primary site to nearby organs, tissues or lymph nodes; and distant, when it has spread from the primary location to distant organs or distant lymph nodes.

of dying from cancer within five years of diagnosis, even after accounting for the differences in the stage-at-diagnosis. Other variables affecting cancer incidence and outcomes among minorities include exposure to underlying risk factors, limited access to medical services and regular screenings, and lower levels of educational attainment [5, 7].

The detrimental effects of smoking and smokeless tobacco on overall morbidity and mortality are widely known. Still, people often fail to recognize the link between tobacco use and oral health. The U.S. Department of Health and Human Services (2000) warns that the use of tobacco can cause a number of serious oral health problems, including periodontitis; tooth loss; and cancer of the mouth, gum, and larynx [2].

Tobacco Use and Oral Health

People who use tobacco products are at high-risk for developing potentially painful and costly oral health problems that could impact oral functioning and aesthetics.

Tobacco users may have to deal with stained teeth and dental restorations, bad breath, and buildup of calculus (hardened dental plaque on tooth surfaces that can only be removed by an oral health professional). Furthermore, tobacco use has been strongly associated with the development of oral mucosal lesions, a condition that can be precancerous [9-10]. More than half of smokeless tobacco users develop these lesions in areas of the mouth where they place the tobacco product [11].

> "The prominent role of tobacco use, especially in combination with alcohol, in causing oral cancer is a major incentive to develop effective health promotion and disease prevention efforts."
>
> SURGEON GENERAL, 2000 [8]

People who use tobacco are at an increased risk of developing gum disease, loss of the supporting bone and tissue around teeth, tooth loss, and gum recession that results in exposed roots and increased sensitivity to heat and cold. In addition, tobacco users have less success with dental implants and with gum disease treatment because tobacco impairs the healing process [10-13].

Users of smokeless tobacco typically develop gum recession. They can also develop cavities adjacent to the area where the smokeless tobacco product is placed. Evidence shows that users of chewing tobacco have an increased risk for developing root caries, since this type of tobacco has a high sugar content and is placed adjacent to the teeth. Smokeless tobacco can also decrease the perception of taste and smell [10, 12].

Clinical and epidemiological studies have shown that tobacco use is one of the biggest risks factors for the development and progression of gum disease. Smokers are about three to six times more likely to have their gums and supporting tissues around the teeth damaged. Severity of gum disease appears to depend on the smoking status, duration of tobacco use, and amount of daily tobacco use. Although tobacco users benefit from gum disease treatment, they respond less well to the treatment. Damage caused by tobacco use cannot be reversed, but smoking cessation has been found to benefit gum health [11].

However, the most substantial oral health problem associated with tobacco is oral cancer.

Oral Cancer

A recognized cause of oral cancer in men and women is the use of tobacco. Indeed, it has been estimated that about 8 out of 10 people with oral cancer use tobacco. Oral cancer can occur anywhere in the mouth (oral cavity) or throat (oropharynx),[iii] but the most common site is the tongue, followed by the floor of mouth [14-15].

The risk of developing oral cancer is related to how much and how long someone has smoked or chewed tobacco. The importance of tobacco cessation is underscored by the fact that cancer risk among former smokers is consistently lower than among current smokers; furthermore, the risk declines with increasing number of years since quitting [16]. A synergistic effect has been reported for smoking and the use of smokeless tobacco and/or alcohol: Smoking in combination with consumption of alcohol or other tobacco products greatly increases the risk of developing oral cancer and other cancers, because each substance augments the other's harmful effects [16]. The risk of oral cancer in people who are heavy drinkers and smokers can be over 100 times higher than for people who abstain from using these substances [17]. Other factors, such as the Human Papillomavirus (HPV), have also been implicated in oral cancer, but tobacco and alcohol are the major risk factors [8, 18].

Smokeless tobacco, such as snuff or chewing tobacco, is not safer than products that are smoked. Smokeless tobacco can cause cancers of the cheek, gums, and inner surface of the lips. Other tobacco use, such as cigar smoking, has been associated with cancers of the oral cavity, lung, larynx, and esophagus [11-12].

[iii] The oral cavity is comprised of the lips, inner lining of the lips and cheeks (buccal mucosa), teeth, gums, the front of the tongue (anterior tongue), floor of the mouth, bony part of the roof of the mouth (hard palate), and the area behind the wisdom teeth. The oropharynx includes the base of the tongue (posterior one-third), the back of the roof of the mouth (soft palate), tonsils, and the side and back walls of the throat.

For oral cancer, the median age at diagnosis is 62; unfortunately, about half of the people diagnosed will die within 5 years. Paradoxically, oral cancer is not difficult to diagnose, and can be detected at an early stage by a simple and short oral exam. Currently, however, about two-thirds of the cases are discovered at a more advanced stage [19-20]. Two related objectives of *Healthy People 2010*, increasing the percentage of oral and pharyngeal cancers detected at an earlier stage (Objective 21-6) and increasing the numbers of adults who report having had an examination to detect oral and pharyngeal cancer (Objective 21-7), have not yet been accomplished [21]. The proportion of oral cancers detected at an early stage has remained unchanged for decades [19-20], and the number of adults who report having had an examination to detect oral and pharyngeal cancer is low [22]. Since premalignant lesions and early malignant lesions tend to be asymptomatic, early detection of oral cancer requires healthcare providers to review the patient's medical and dental history (especially risk factors such as use of tobacco and alcohol), and to perform a systematic and comprehensive examination of the head, neck, and oral cavity [23].

Oral cancer is the eighth most common cancer among men in the United States [5]. In 2009, an estimated 2.4 percent (35,720 cases) of all new cancers in the nation occurred in the mouth and throat [7]. The national age-adjusted incidence rate of oral cancers was 10.4 per 100,000 population in 2006, with a rate significantly higher for males (15.5 per 100,000 population) than for females (6.1 per 100,000 population) [24]. Oral cancer used to be six times more common in males than in females; now, it is two to four times as common. More and more women are being affected, consistent with an increase in their use of tobacco products [7].

Nationally, whites, followed by blacks, had the highest incidence rates [24]. Patterns of exposure to risk factors, principally tobacco and alcohol, are responsible for most differences in oral cancer rates across race and sex [25].

In 2006, a total of 7,720 oral cancer deaths occurred in the United States, representing a mortality rate of 2.5 per 100,000 population. The mortality rate was more than twice as high among men as among women [24]. Cancer survival rates depend on the stage at diagnosis; i.e., survival is higher when cancer is detected early. For oropharyngeal cancers, survival rate is considerably lower for African-Americans, regardless of the cancer stage at diagnosis, with survival rates around 60 percent for whites, but only around 40 percent for blacks [7]. Blacks had a significantly higher annual death rate (3.3 per 100,000 population) than whites (2.4 per 100,000 population) [24].

Cancer survivors have a greater risk of developing a new head or neck cancer, especially if they are smokers. Quality of life is poor, since aggressive treatment can result in facial disfigurement and loss of oral function (difficulty chewing, swallowing, and talking) [15].

Indiana Epidemiology—Indiana saw 650 new cases of oropharyngeal cancer in 2006, representing an incidence rate of 9.8 per 100,000 population; statistically similar to the U.S. rate. The incidence rate was significantly higher among Hoosier men (15.1 per 100,000 population) than women (5.4 per 100,000 population). However, no significant differences were observed by race/ethnicity [24].

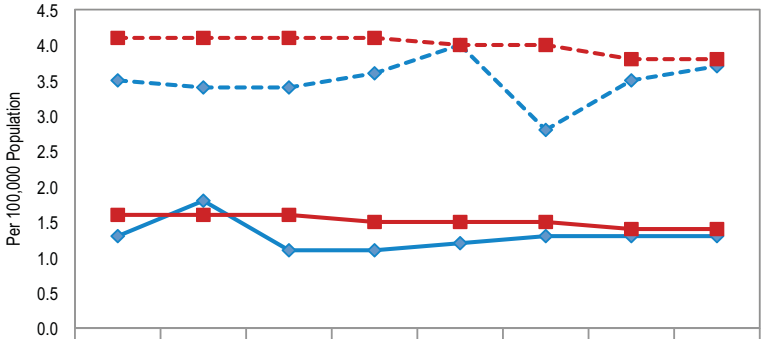
In 2006, 154 Hoosiers died due to oral cancers, representing a mortality rate of 2.3 per 100,000 population. The rate was almost three times as high for males (3.7 per 100,000 population) as for females (1.3 per 100,000 population) (see Figure 1) [24, 26].

Tobacco Use in Indiana

The U.S. Department of Health and Human Services considers tobacco use to be one of the 10 leading health indicators in the nation. The goal stated in *Healthy People 2010* is to reduce tobacco use, which includes the following specific objectives [2]:

- Objective 27-1a: Reduce cigarette smoking by adults (the target prevalence for adult smoking is 12 percent)
- Objective 27-2b: Reduce cigarette smoking by adolescents (the target prevalence for adolescent smoking is 16 percent)

Figure 1: Oropharyngeal Cancer Deaths (age adjusted per 100,000 standard population)



	1999	2000	2001	2002	2003	2004	2005	2006
IN female	1.3	1.8	1.1	1.1	1.2	1.3	1.3	1.3
US female	1.6	1.6	1.6	1.5	1.5	1.5	1.4	1.4
IN male	3.5	3.4	3.4	3.6	4.0	2.8	3.5	3.7
US male	4.1	4.1	4.1	4.1	4.0	4.0	3.8	3.8

Note: Oral cancer death rates were based on ICD-10 Codes C00-C14
Source: Centers for Disease Control and Prevention, n.d. [26]

According to the Behavioral Risk Factor Surveillance System (BRFSS), smoking prevalence among U.S. adults varies considerably from state to state [27]. In 2008, Indiana had the second highest adult smoking prevalence (26.0 percent) in the nation, a rate significantly higher than the U.S. rate of 18.4 percent, and also substantially higher than the *Healthy People 2010* goal of 12 percent. Throughout the years, Indiana has had consistently higher smoking prevalence rates than the nation, and has been among the states with the highest percentage of smokers [27]. Furthermore, almost one in five Hoosiers smoked every day in 2008 [27].

In 2008, current (past-month) smoking was reported by 28.3 percent of men and 23.9 percent of women in Indiana; moreover, 21.5 percent of men and 18.1 percent of women smoked every day [27].

One-third (33.3 percent) of blacks and one-fourth (24.5 percent) of whites smoked in the past month; of these, 21.1 percent and 19.3 percent, respectively, smoked every day [27]. (Insufficient information was available for Hispanics.)

Educational attainment and income level were inversely related to adult smoking prevalence; i.e., Hoosiers with higher levels of education or income had lower smoking rates [27].

Youth Use—Nationwide, it has been reported that almost 4,000 young people ages 12 to 17 initiate cigarette smoking each day. The younger they start smoking, the more likely they are to become addicted to nicotine. It is estimated that about half of young smokers will become regular smokers and one-third will die of smoking-related diseases [28-31].

According to the 2007 Youth Risk Behavior Surveillance System (YRBSS), over half of all Indiana high school students (53.3 percent) have tried cigarette smoking at least once and 22.5 percent smoked in the past month (see Figure 2). These results were similar to those at the national level, but still above the *Healthy People 2010* goal of 16 percent [30].

No statistically significant differences in current smoking rates were observed by gender, race/ethnicity, or grade level in Indiana [2, 30].

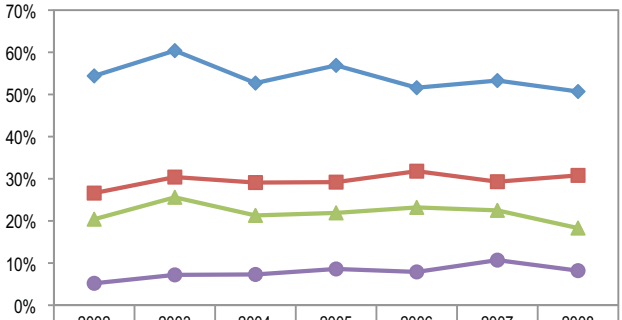
The Indiana Youth Tobacco Survey (IYTS) is a statewide sample of participating middle schools (grades 6 through 8) and high schools (grades 9 through 12) in Indiana, selected randomly by the Centers for Disease Control and Prevention (CDC). In 2008, 47 high schools and 52 middle schools participated, representing approximately 3,700 and 3,300 students, respectively. The survey contains questions about tobacco use knowledge, attitudes, and behavior, as well as questions about exposure to secondhand smoke and pro-tobacco marketing.

Current use of cigarettes decreased from 2000 through 2008 for both middle and high school students in Indiana. Among middle school students, the rate dropped from 9.8 percent in 2000 to 4.1 percent in 2008. No significant differences were observed by gender; however, more white than black students reported current smoking, and 7th and 8th grade students were more likely to have smoked in the past month than 6th graders [33].

Among high school students, the rate dropped from 31.6 percent in 2000 to 18.3 percent in 2008 (see Figure 2). Similarly to the pattern in middle school, no significant differences were detected by gender; white students had higher smoking rates than black students, and upper grade levels were more likely to smoke than lower grade levels [33].

Also, smokeless tobacco was used by 3.3 percent of Indiana middle school students and 8.2 percent of high school students in 2008 [33].

Figure 2: Tobacco Use among HS in Indiana (even years IYTS, odd years YRBSS)



	2002	2003	2004	2005	2006	2007	2008
Lifetime Cigarette Use	54.4%	60.4%	52.7%	56.9%	51.6%	53.3%	50.7%
Current Tobacco Use	26.6%	30.4%	29.1%	29.2%	31.8%	29.3%	30.8%
Current Cigarette Use	20.4%	25.6%	21.3%	21.9%	23.2%	22.5%	18.3%
Current Smokeless Tobacco Use	5.2%	7.2%	7.3%	8.6%	7.9%	10.7%	8.2%

Note: Even years are based on results from the Indiana Youth Tobacco Survey, odd years on findings from the Youth Risk Behavior Surveillance System.
Source: Centers for Disease Control and Prevention, 2008; Indiana Tobacco Prevention and Cessation Agency, 2009 [32-33]

Public Health Implications

Oral health is a critical component of public health because of its contribution to overall morbidity, the high cost of treatment, and the persistence of oral health inequities. Tobacco use also affects disadvantaged populations disproportionately; adult smoking prevalence is highest among individuals with the lowest levels of education and income [27].

Despite advances in treatment, oral cancer continues to have one of the lowest survival rates, unchanged for decades. This could change if lesions were detected at earlier stages, when treatment would be less costly, less aggressive, and have better outcomes in terms of patient's' quality of life and survival. More significantly, change could be brought about by preventing or reducing tobacco use, a key risk factor for developing oral cancer.

Oral cancer exhibits major disparities in terms of detection and survival. Survival rates for oral cancer are considerably lower for blacks (particularly black males) than whites. Over the years, survival rates for white males have improved slightly, but they have gotten worse for black males. Disparities occur across all cancer stages, ages, and anatomical sites; treatment is another area where disparities are seen [25, 34].

Early diagnosis improves cancer survival rates, but only patients who visit oral health professionals routinely might receive an oral cancer screening and examination. A regular dental checkup is an excellent opportunity to have an oral cancer exam [34]. However, patients who can only afford to visit the dentist on an emergency basis might not receive regular checkups and life-saving comprehensive oral cancer examinations. The American Cancer Society recommends that a comprehensive oral cancer examination should be conducted annually starting at age 40, and people between the ages of 20 and 39 should have a cancer checkup every three years [21, 35-36]. Dentists are knowledgeable about major risk factors for oral cancer, although they are not always aware of other risk factors or of the fact that these cancers are most often diagnosed at a late stage. When screening for oral cancer, most dentists ask about patients' current tobacco use; however, many feel they lack adequate training in tobacco cessation. Also, the U.S. adult population is not well informed about risk factors or signs and symptoms[iv] of oral cancer, and few report having had an oral cancer examination [22].

There are no reported differences by gender for receiving oral cancer exams. However, people living below the federal poverty level, people with a high school education or lower, and racial/ethnic minority groups are less likely to have received an oral cancer exam in the previous year [37].

Lack of medical and dental insurance limits access to oral care and routine dental visits in a setting where an oral cancer examination can be performed and where risks of tobacco use can be addressed. From 2008 through 2009, over 600,000 Indiana adults were not covered by health insurance [38]. The number of people without dental insurance has been reported to be almost three times higher than the number of people without medical coverage [39]. Older adults are more likely to develop oral cancers, but they are less likely to have dental insurance and obtain dental services, including an oral cancer examination and tobacco use counseling. Even though they comprise the population where oral cancer is most prevalent, older adults often do not receive screening and early diagnosis. However, receiving such services, would improve survival rates considerably.

People on Medicare who are diagnosed with a smoking-related disease, including heart disease, cerebrovascular disease (stroke), multiple cancers, lung disease, weak bones, blood clots, and cataracts, can get coverage for counseling on smoking and tobacco use cessation. These diseases account for the bulk of Medicare spending today. Medicare recipients who take any medication whose effectiveness is affected by tobacco use (for example, insulin and some medicines for high blood pressure or depression) are also eligible for counseling. Medicare covers up to eight visits with a qualified doctor or approved practitioner during a 12-month period [40]. Medicaid expenditures related to tobacco total more than $400 million per year in Indiana [41].

Overall, the state of Indiana pays more than $2 billion annually in medical costs associated with smoking. In other words, each pack of cigarettes sold in Indiana costs Hoosiers over $7 in smoking-related health care.

The Institute of Medicine's (IOM) primary recommendation to address the tobacco problem is that each state should fund a comprehensive tobacco control program at the level recommended by CDC [44]. CDC's recommended funding levels are established according to states' populations, demographics, and prevalence of tobacco use. In 2007, the recommended annual funding level for Indiana's tobacco control program was $31.5 million for state and community interventions and $11.6 million for health communication interventions (for a total of $78.8 million total recommended program costs). The recommended per capita funding level for Indiana was $12.46 for total program costs ($4.99 for state and community interventions and $1.83 for health communication interventions) [43].

In the 2008–2009 fiscal year, Indiana invested $16.2 million, much less than the $78.8 million of federal funding recommended to implement an effective and comprehensive tobacco control program [41, 44].

[iv]Symptoms of oral cancer can include: white or red patches in the mouth, a mouth sore that will not heal, oral bleeding, loose teeth, difficulty or pain with swallowing, a lump in the neck, and/or an earache.

Thoughts for Policymakers

Tobacco-related oral diseases, especially oral cancers, continue to be a public health concern in Indiana. Reducing the incidence and mortality of such cancers will depend on increased efforts to promote oral cancer screenings as well as effective prevention and cessation strategies to reduce the use of tobacco products.

Intervention strategies should be comprehensive and should include a variety of educational, behavioral, clinical, and regulatory components, targeting the general public, health professionals, and policymakers.

Educational resources, programs, and campaigns on tobacco use and its connection to oral disease will help increase awareness among the general public. Health professionals, including dentists and physicians, could be actively involved in these education efforts, counseling patients on tobacco's deleterious effects on overall health as well as oral health and emphasizing the need to quit. Healthcare providers would benefit from being well trained in identifying, counseling, and referring high-risk patients.

The general public needs information about symptoms of oral cancer, how to self-examine, and the importance of annual visits to the dentist for screenings.

A variety of strategies to reduce tobacco use can be implemented at the policy level, including support for comprehensive tobacco control; restrictions on tobacco advertising; strengthening smoking bans and restricting smoking in public places; policy changes such as enforcement of minors' access laws; and increased taxation [42-43, 45]. The Centers for Disease Control and Prevention (CDC) have published a "best practices" guide, which describes the programmatic structure for implementing interventions proven to be effective and the recommended level of state investment to reach the goal of reducing tobacco use [43].

Also, special attention is needed to address disparities in detection and survival of oral cancers based on racial, educational, and other socio-demographic factors.

The U.S. Surgeon General has reported that quitting smoking significantly reduces the risk of developing and dying from cancer. Quitting has other health benefits, even in people who have smoked for many years [6]. A reduction in the use of tobacco would have a great impact in reducing the incidence of oral cancer, periodontal disease, and a myriad of other health problems. The state would also benefit financially from reducing the significant burden of tobacco-related oral diseases.

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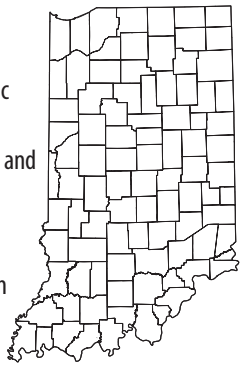

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