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Tobacco-Related Cancers in Utah Compared to the United States: Quantifying the Benefits of the Word of Wisdom

Ray M. Merrill, Gordon B. Lindsay, and Joseph L. Lyon

*And again, tobacco is not for the body, neither for the belly, and is not good for man, but is an herb for bruises and all sick cattle, to be used with judgment and skill. (D&C 89:8)*

In recent decades, tobacco smoking has been linked to chronic diseases such as heart disease, stroke, and cancer.¹ The first studies to suggest a possible link between tobacco smoking and lung cancer appeared in the 1950s.² Epidemiologic studies have since provided further evidence of the causal association between tobacco smoking and at least eight cancer sites.³ In addition to lung cancer,⁴ increased mortality risk due to tobacco smoking occurs for cancers of the larynx,⁵ oral cavity (including pharynx),⁶ esophagus,⁷ bladder,⁸ kidney,⁹ and pancreas¹⁰ in both men and women and cervical cancer¹¹ in women. Note that the primary tumors of the kidney are renal cell and renal pelvis cancers, accounting for 82 percent and 18 percent of the tumors, respectively.¹² Although cigarette smoking is causally linked to these tumors, the association with renal pelvis cancers is much stronger.¹³

In the past hundred years in the United States, annual per capita cigarette consumption went from near zero at the turn of the century to peak at about 4,300 per year in 1964—the year of the first Surgeon General’s report and subsequent media coverage of the potentially harmful effects of tobacco.¹⁴ Social influences followed to produce declines in the demand for tobacco (for example, the nonsmokers’ rights movement, increased federal excise tax, and health warning labels).¹⁵ As a result, the percentage of current tobacco smokers 18 years of age and older decreased between 1965 and 1995 from 51 to 26 percent for white men, 60 to 29 percent for black men, 34 to 24 percent for white women, and 32 to 23 percent for black women.¹⁶

Tobacco smoking in Utah has remained the lowest in the country. Utah is currently the only state to achieve the national health objective for the year 2000 of tobacco smoking prevalence among adults of 15 percent or lower.¹⁷ Table 1 presents the percentage of cigarette-smoking prevalence among Utah and United States adult populations, 18 years of age and older, for select years 1965–97.¹⁸ This observation may be attributed to the widespread influence of The Church of Jesus Christ of Latter-day Saints (LDS)
in Utah, which since 1833 has strongly discouraged the use of tobacco among its members (D&C 89). A previous case-control study in Utah showed that for the period 1967–75, significantly fewer LDS men and women smoked cigarettes than non-LDS men and women. The percentage of Utah's population affiliated with the LDS religion has remained near 70 percent since the 1950s (specifically, 68 percent in 1950, 68 percent in 1960, 71 percent in 1970, 69 percent in 1980, and 70 percent in 1990).

Table 1. Percentage of Tobacco-Smoking Prevalence among Utah and US Adult Populations, 18 Years of Age and Older, Selected Years 1965–1997

<table>
<thead>
<tr>
<th>Year</th>
<th>Utah</th>
<th>United States</th>
<th>Year</th>
<th>Utah</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td>NA</td>
<td>42.4</td>
<td>1988</td>
<td>14.7</td>
<td>28.1</td>
</tr>
<tr>
<td>1966</td>
<td>NA</td>
<td>42.6</td>
<td>1989</td>
<td>16.4</td>
<td>NA</td>
</tr>
<tr>
<td>1970</td>
<td>NA</td>
<td>37.4</td>
<td>1990</td>
<td>16.7</td>
<td>25.5</td>
</tr>
<tr>
<td>1974</td>
<td>NA</td>
<td>37.1</td>
<td>1991</td>
<td>14.3</td>
<td>25.6</td>
</tr>
<tr>
<td>1978</td>
<td>NA</td>
<td>34.1</td>
<td>1992</td>
<td>15.6</td>
<td>26.5</td>
</tr>
<tr>
<td>1979</td>
<td>NA</td>
<td>33.5</td>
<td>1993</td>
<td>14.4</td>
<td>25.0</td>
</tr>
<tr>
<td>1980</td>
<td>NA</td>
<td>33.2</td>
<td>1994</td>
<td>15.7</td>
<td>25.5</td>
</tr>
<tr>
<td>1983</td>
<td>NA</td>
<td>32.1</td>
<td>1995</td>
<td>13.2</td>
<td>24.7</td>
</tr>
<tr>
<td>1985</td>
<td>15.6</td>
<td>30.1</td>
<td>1996</td>
<td>15.9</td>
<td>NA</td>
</tr>
<tr>
<td>1986</td>
<td>18.2</td>
<td>NA</td>
<td>1997</td>
<td>13.8</td>
<td>NA</td>
</tr>
<tr>
<td>1987</td>
<td>15.0</td>
<td>28.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


The purpose of this paper is to evaluate the influence tobacco smoking has had on cancer incidence in Utah and the United States. Utah provides an ideal comparison with the rest of the United States because of its historically low rates of tobacco use. We explore the tobacco-related cancer burden in Utah and show what it would have been had Utah experienced similar tobacco rates as the United States. Because the lower tobacco use in Utah is largely attributed to the influence of the LDS faith, in a sense this article quantifies the benefit of the Church’s health code, known as the Word of Wisdom.

Methods

Cancer data are obtained from the Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute, which provides
the primary source of national estimates of cancer. The SEER Program includes tumor registries from five states (Connecticut, Iowa, New Mexico, Utah, and Hawaii), four metropolitan areas (Atlanta, Georgia; Detroit, Michigan; Seattle, Washington; and San Francisco, California), and represents about 10 percent of the United States population. Because the Utah tumor registry is included in the SEER Program, our analysis will compare Utah with SEER, Utah removed (hereafter referred to as SEER-u).

Cancer incidence data were available from 1973 through 1995. Mortality data, which were also considered, were obtained from death certificates among people in each state and the District of Columbia, as recorded by the National Centers for Health Statistics. Available mortality data cover the years 1971 to 1995. Incidence and mortality rates were computed by combining these data with United States Bureau of the Census population estimates. The rates are age-adjusted to the 1970 United States standard population. Trends in cancer are conventionally assessed using age-adjusted rates because these rates remove the confounding effects of a changing age structure of the population over time.

Cancer sites previously shown as related to tobacco and considered in this analysis include lung and bronchus, larynx, oral cavity and pharynx, esophagus, urinary bladder, kidney and renal pelvis, pancreas, and cervix. We consider only whites because they represent over 94 percent of the population in Utah. In contrast, 81 percent of the remaining population in the SEER Program is classified as white. All carcinoma in situ are excluded such that the analysis is solely based on invasive-staged cancers.

Incidence Rates

Trends in age-adjusted tobacco- and nontobacco-related cancer incidence rates for white men and women are presented in figures 1 and 2. Large differences exist in the incidence rates between Utah and SEER-u for tobacco-related cancer sites. For both men and women, the trends in rates for the tobacco-related sites remain flatter and much lower in Utah than in SEER-u. In contrast, the trends and magnitude in nontobacco-related sites are similar for men. For women, the trends are similar between Utah and SEER-u but the magnitude is lower in Utah for nontobacco-related sites.

For the years 1991 through 1995, we also present the age-specific tobacco- and nontobacco-related cancer incidence rates for white men and women in Utah and SEER-u (figs. 3 and 4). There is a pronounced difference in incidence rates between Utah and SEER-u for the tobacco-related cancers, particularly in men ages 70 and older and in women ages 65 to 84. For men, the incidence rates are similar between Utah and SEER-u for nontobacco-related sites except at ages 80–84, where they are lower in Utah. For women, the incidence rates tend to be lower, particularly at later ages, in
Fig. 1. Tobacco- and Nontobacco-Related Cancer Incidence in White Men by Year of Diagnosis, Comparing Utah and SEER-U
**Fig. 2. Tobacco- and Nontobacco-Related Cancer Incidence in White Women by Year of Diagnosis, Comparing Utah and SEER-ut**

- **Nontobacco Related, SEER-ut**: ▲
- **Tobacco Related, SEER-ut**: ▲
- **Nontobacco Related, Utah**: ■
- **Tobacco Related, Utah**: ■

Year of Diagnosis:
- 1973
- 1974
- 1975
- 1976
- 1977
- 1978
- 1979
- 1980
- 1981
- 1982
- 1983
- 1984
- 1985
- 1986
- 1987
- 1988
- 1989
- 1990
- 1991
- 1992
- 1993
- 1994
- 1995
FIG. 3. Tobacco- and Nontobacco-Related Age-Specific Cancer Incidence in Utah and SEER-u, 1991–1995, for White Men
Fig. 4. Tobacco- and Nontobacco-Related Age-Specific Cancer Incidence in Utah and SEER-u, 1991–1995, for White Women

Nontobacco Related, SEER-u
Nontobacco Related, Utah
Tobacco Related, SEER-u
Tobacco Related, Utah
Utah versus SEER\textsuperscript{u} for nontobacco-related sites. The incidence rates for men approach twice those of women by age 50 for the tobacco-related cancers and by age 65 for the nontobacco-related cancers.

The percent of tobacco-related cancer cases among all cancer cases for whites by gender and age are presented for Utah and SEER\textsuperscript{u}, 1991–95, in table 2. The percent of all cancer cases represented by a tobacco-related cancer remain lower for men and women in Utah compared to SEER\textsuperscript{u} in each age group. The percent of all cancer cases represented by a tobacco-related cancer is greatest in the age group 50–59 for men and 60–69 for women.

Table 2. Percent of Tobacco-Related Cancer Cases to All Cancer Cases for Whites by Gender and Age, Utah Compared to SEER\textsuperscript{u}, 1991–1995

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Utah</th>
<th>SEER\textsuperscript{u}</th>
<th>Utah</th>
<th>SEER\textsuperscript{u}</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–39</td>
<td>8.6</td>
<td>10.4</td>
<td>13.0</td>
<td>14.5</td>
</tr>
<tr>
<td>40–49</td>
<td>27.8</td>
<td>31.1</td>
<td>13.8</td>
<td>14.7</td>
</tr>
<tr>
<td>50–59</td>
<td>28.4</td>
<td>38.4</td>
<td>15.3</td>
<td>22.8</td>
</tr>
<tr>
<td>60–69</td>
<td>24.0</td>
<td>35.1</td>
<td>18.1</td>
<td>28.2</td>
</tr>
<tr>
<td>70–79</td>
<td>21.3</td>
<td>32.2</td>
<td>17.6</td>
<td>27.8</td>
</tr>
<tr>
<td>80+</td>
<td>23.7</td>
<td>31.3</td>
<td>17.8</td>
<td>22.9</td>
</tr>
<tr>
<td>All ages combined</td>
<td>22.7</td>
<td>32.3</td>
<td>16.4</td>
<td>24.0</td>
</tr>
</tbody>
</table>

Burden

The burden of disease implies the number of cases or deaths in a defined population at a given point in time and has important implications to health and related services, as well as to society in general.\textsuperscript{23} Figure 5 presents the number of tobacco-related cancers diagnosed in Utah from 1991 to 1995 for white males and females. The bars labeled as Males\textsuperscript{*} and Females\textsuperscript{*} represent the estimated number of tobacco-related cancers diagnosed in Utah during 1991 to 1995 for white males and females assuming Utah experienced the same tobacco-related cancer incidence rates as in SEER\textsuperscript{u}. The burden of tobacco-related cancers is noticeably higher in males than females. However, for both males and females, the number of tobacco-related cancer cases is between one-third and one-half of what it would have been had tobacco use and subsequent tobacco-related cancer rates in Utah been similar to that in SEER\textsuperscript{u}.

Table 3 presents the number of tobacco-related cancers in Utah for 1991–95 for white males and females by cancer site. In addition, the number of tobacco-related cancers is shown by cancer site under the assumption that Utah experienced the same tobacco-related cancer rates as SEER\textsuperscript{u}. Overall, 4,294 fewer cases in males and 3,047 fewer cases in females resulted among whites in Utah compared to SEER\textsuperscript{u} because of the relatively
**FIG. 5. Tobacco-Related Invasive Cancer in Utah for White Males and Females by Calendar Year of Diagnosis**

![Graph showing tobacco-related invasive cancer in Utah for white males and females by calendar year of diagnosis.](image)

- **Number:**
  - Males (Actual): 1,482, 1,513, 1,555, 1,556, 1,540
  - Females (Actual): 620, 671, 664, 691, 693
  - Males* (Theoretical): 949, 981, 1,002, 1,007, 1,052
  - Females* (Theoretical): 234, 420, 433, 506, 392

low use of tobacco. Further, a large number of deaths will be avoided among these tobacco-related cancers.

**Table 3. Number of Invasive Tobacco-Related Cancer Cases for Whites in Utah**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Cancer Site</th>
<th>Utah (Actual)</th>
<th>Utah (Theoretical)</th>
<th>Fewer Cancers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Oral Cavity and Pharynx</td>
<td>432</td>
<td>726</td>
<td>294</td>
</tr>
<tr>
<td></td>
<td>Esophagus</td>
<td>120</td>
<td>280</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Pancreas</td>
<td>249</td>
<td>471</td>
<td>222</td>
</tr>
<tr>
<td></td>
<td>Larynx</td>
<td>129</td>
<td>339</td>
<td>210</td>
</tr>
<tr>
<td></td>
<td>Lung and Bronchus</td>
<td>1,323</td>
<td>3,689</td>
<td>2,366</td>
</tr>
<tr>
<td></td>
<td>Urinary Bladder</td>
<td>782</td>
<td>1,524</td>
<td>742</td>
</tr>
<tr>
<td></td>
<td>Kidney and Renal Pelvis</td>
<td>313</td>
<td>613</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>All Tobacco-Related Sites</td>
<td>3,339</td>
<td>7,642</td>
<td>4,294</td>
</tr>
<tr>
<td>Female</td>
<td>Oral Cavity and Pharynx</td>
<td>189</td>
<td>353</td>
<td>164</td>
</tr>
<tr>
<td></td>
<td>Esophagus</td>
<td>28</td>
<td>107</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Pancreas</td>
<td>258</td>
<td>507</td>
<td>249</td>
</tr>
<tr>
<td></td>
<td>Larynx</td>
<td>34</td>
<td>83</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Lung and Bronchus</td>
<td>699</td>
<td>2,645</td>
<td>1,946</td>
</tr>
<tr>
<td></td>
<td>Cervix</td>
<td>337</td>
<td>411</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>Urinary Bladder</td>
<td>235</td>
<td>533</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Kidney and Renal Pelvis</td>
<td>197</td>
<td>383</td>
<td>186</td>
</tr>
<tr>
<td></td>
<td>All Tobacco-Related Sites</td>
<td>1,975</td>
<td>5,022</td>
<td>3,047</td>
</tr>
</tbody>
</table>

*Based on 1991–95 SEER data.
†Assuming Utah experienced the same tobacco-related cancer incidence rates as SEER–Utah.

**Mortality**

Thus far we have compared tobacco- and nontobacco-related cancer incidence rates for whites between Utah and SEER–Utah. We assumed the cancer incidence data from SEER–Utah were representative of the United States. Because data were not available to compare SEER cancer incidence data with that of the United States, we cannot directly evaluate this assumption. However, a comparison was made of tobacco- and nontobacco-related cancer mortality rates between SEER and the United States (data not shown), which found the rates to be very similar.

The lower tobacco-related cancer incidence in Utah was directly evident in the mortality rates. A ranking of the age-adjusted mortality rates of all the states and the District of Columbia for each of the considered tobacco-related cancer sites by time (1971–75 to 1991–95) and gender showed consistently low rates in Utah. Utah’s average ranking across time periods, with 1 being low and 51 being high, was between 1 and 5 for each
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tobacco-related cancer site and gender combination. Cervical cancer had the poorest average because of a drop in the mortality ranking in the most recent time period (Utah ranked 2, 1, 3, 3, and 16, respectively). Because this ranking is the only one of all the cancer-mortality rankings to drop below 3 in men and 6 in women for the time period 1991–95, changes in risk factors other than tobacco smoking are likely responsible (for example, sexual behaviors).

Discussion

The increase in tobacco smoking in the United States between the early and mid part of this century is likely due to the public’s lack of knowledge of the link between tobacco and many chronic diseases such as cancer. A similar increase did not occur in Utah, where the population is predominately affiliated with the LDS religion, a religion that strongly discourages tobacco use among its members (see D&C 89). The generally declining use of tobacco in the last four decades in the United States indicates that a large portion of the population is responding to preventive efforts. Yet, much of the population continues to consume tobacco, in part because of nicotine addiction, and in part because of peer pressure, and in part because of lack of information.

If the declining use of tobacco continues in the United States, tobacco-related cancer incidence and mortality rates should eventually approach those observed in Utah. The latency or incubation period for some types of tobacco-related cancers may be decades long (for example, lung cancer). The contemporary tobacco-related cancer incidence rate in Utah is largely the result of smoking during the 1950s through the 1970s. The earliest systematic measurement of behavioral risk factors was conducted in Utah in 1980. It showed an adult smoking prevalence of 18 percent. Because LDS church membership has remained near 70 percent since the 1950s, smoking prevalence in the decades prior to 1980 were probably not significantly higher than 18 percent.

The difference between Utah and SEER[^4] for the tobacco-related cancers indicates the large amount of cancer burden avoided in Utah as well as the potential reduction in the United States cancer burden if national tobacco-smoking trends continue to decline to levels experienced in Utah. Because nontobacco-related cancer incidence and mortality rates were similar between Utah and SEER[^4] in men, we have greater confidence that the eight cancers considered are, in fact, strongly influenced by tobacco and that the remaining cancers are not. Different trends in nontobacco-related cancers between Utah and SEER[^4] in women are largely due to cancers of the breast, colon, and rectum.

For any given tobacco-related cancer, differences in other risk factors between Utah and SEER[^4] may contribute to the large differences in observed
cancer incidence and mortality. The results indicate that recent changes (since the mid-1980s) in risk factors other than tobacco may explain why Utah women are now experiencing higher levels of cancers of the cervix. Further study of the reasons for these recent developments is needed.

Several related studies have evaluated the health benefits experienced by practicing LDS Church members in Utah.29 Many of these studies attempt to control for the potential confounding effect of region by comparing active and nonactive members of the church, with the belief that church activity is a surrogate for abstaining from tobacco and other potential risk factors of disease. The overwhelming evidence from these studies supports our findings that lower levels of tobacco use can substantially reduce the burden of tobacco-related cancers, as well as other diseases.

The data did not allow us to control for other risk factors for certain diseases, such as alcohol in the case of cancer of the esophagus. Tobacco smoking and alcohol may have a synergistic effect on promoting tumors, such as tumors of the oral cavity and pharynx. Some of the observed differences in the tobacco-related cancers between Utah and SEER30 may also be due to alcohol, as the LDS Church also discourages alcohol use among its members. In 1980 the prevalence of alcohol was 37 percent in Utah compared to 67 percent in the United States. However, per capita alcohol consumption in this country has remained fairly constant for whites in the last decade,31 and the relative impact of alcohol compared to tobacco on cancer is small.31

Conclusion

In the LDS religion, adherence to the Word of Wisdom was based on faith for over a century before scientific evidence began to support its precepts in the area of tobacco. It was not until the 1950s that epidemiologic studies provided sufficient evidence to implicate tobacco as a risk factor for several chronic diseases. Although tobacco-smoking prevalence has since declined in the United States, it remains significantly above the historically low levels experienced in Utah. Consequently, substantial differences in the burden of tobacco-related cancers exist and will continue to exist for several years to come.

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9. DHHS, Reducing the Health Consequences of Smoking, 148, 150.


20. Personal correspondence with the LDS Member and Statistical Records Department, April 1999.


27. Personal correspondence with the LDS Member and Statistical Records Department, April 1999.


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