RECENT TRENDS IN INCIDENCE RATES FOR SELECTED ALCOHOL-RELATED CANCERS IN THE UNITED STATES

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Abstract — Aims: To examine recent trends in incidence rates for cancer types most strongly associated with alcohol use, using data from US cancer registries. Methods: Age-standardized annual incidence rates (ASIRs) for squamous cell carcinomas of the oral cavity and pharynx, esophagus and larynx diagnosed in the most recent 10-year period (1992–2001) were examined for geographic areas included in the US National Cancer Institute’s Surveillance, Epidemiology and End Results (SEER) program of high-quality cancer registries. Results: For all geographic areas combined, ASIRs for these cancers declined over time, with no evidence for a recent plateau or upturn. This also held true for ASIRs in younger adults (age 20–54 years at diagnosis). For white males, declines in ASIRs occurred in each of the 11 geographic areas, and were statistically significant in nine areas. The declines in ASIRs were consistent with temporal declines in apparent alcohol consumption by state, although the prevalence of binge and heavy drinking in adults increased in some states. Conclusion: Although there was no evidence for a recent plateau in ASIRs, continued surveillance is needed, in view of recent increases in the prevalence of binge and heavy drinking among US adults.

INTRODUCTION

Reviews on alcohol as a risk factor for various cancers have emphasized the strong associations with cancers of the upper aerodigestive tract, including oral cavity and pharynx (often combined), esophagus and larynx (Zeka et al., 2003; Corrao et al., 2004; Seitz et al., 2004; Poschl and Seitz, 2004). These cancers each rank among the top 15 most common sites in US males, using age-standardized incidence rates (ASIRs), although only oral cavity–pharynx ranks high in females; for mortality rates, esophagus ranks eighth in US males (Jemal et al., 2004).

According to analyses of data from the US National Alcohol Survey, the prevalence of current alcohol drinking (including weekly heavy drinking) declined considerably from 1984 to 1990, but then increased slightly from 1990 to 1994 (Greenfield et al., 2000). Data from the US Centers for Disease Control and Prevention (CDC) Behavioral Risk Factor Surveillance System (BRFSS) of telephone surveys of adults (age ≥18 years) indicated that trends in the prevalence of binge drinking from 1991 to 1999 (i.e. ≥5 drinks on any occasion during the previous month) differed by state but prevalence increased in 19 states (Nelson et al., 2002). Therefore, surveillance of trends in incidence rates for alcohol-related cancers in recent years should be of interest.

High-quality cancer registries in some states allow the monitoring of trends in cancer incidence rates, rather than relying on mortality data that are less likely to reflect any effects of recent changes in prevalence of risk factors (such as alcohol use patterns). This report examines the recent trends in age-adjusted incidence rates for selected alcohol-related cancers using data from the latest 10-year period of diagnosis (1992–2001) for high-quality population-based cancer registries. Consistency in the temporal trends in incidence rates across geographic areas, as well as recent trends in alcohol consumption and adult prevalence of binge drinking by geographic area was also examined.

SUBJECTS AND METHODS

The US National Cancer Institute’s Surveillance, Epidemiology and End Results (SEER) Program of high-quality population-based cancer registries maintains a large database from high-quality cancer registries. While SEER Program areas combined differ sociodemographically from the entire US, trends in cancer mortality in SEER have been similar to those in the entire US and SEER incidence trends are often used in the absence of data for the entire country (Hankey et al., 1999; Merrill and Dearden, 2004).

ASIRs 100 000 population/year for 1992–2001 were calculated by gender for all of the SEER geographic areas combined. For the latest 10-year period (years of diagnosis 1992–2001), the 12 SEER areas or populations are metropolitan Atlanta GA, Connecticut, metropolitan Detroit MI, Hawaii, Iowa, New Mexico, San Francisco-Oakland CA, Los Angeles County CA, San Jose-Monterey CA, Seattle-Puget Sound WA, Utah, and Alaska Natives (National Cancer Institute, 2004; Ries et al., 2004). SEER data files for several of these registries started only with cancers diagnosed in 1992.

The three selected alcohol-related cancer site groups were: oral cavity and pharynx (International Classification of Diseases for Oncology, site codes C000–148), esophagus (codes C150–159) and larynx (C320–329). Routinely published SEER statistics on incidence do not include data on histologic types. Squamous cell carcinomas (ICD-O morphology codes 8051–8084) (Percy et al., 1995) were selected, and have accounted for >95% of all cancers in the upper aerodigestive tract in SEER statistics (Muir et al., 1995). For the esophagus, adenocarcinomas are much less strongly associated with alcohol (and tobacco) than squamous cell carcinomas (Adam et al., 2002). Certain other cancer sites (liver, breast and colorectal) have been weakly associated with alcohol use (Bagnardi et al., 2001; Rehm et al., 2003; Poschl and Seitz, 2004) but were excluded because temporal trends in ASIRs have been strongly influenced by hepatitis (for liver cancer) and by cancer screening rates (for breast and colorectal).
ASIRs were calculated by the direct method using age-specific incidence rates in five-year age intervals (through age 85+ years) and weights based on the age distribution of the US population in 2000. Version 5.2 of the SEER*Stat software was used to obtain the annual percentage change (APC) in ASIRs for years of diagnosis 1992 through 2001, using weighted least squares; 95% confidence intervals (CIs) were calculated based on both ASIRs and APCs (National Cancer Institute, 2004). ASIRs within younger adults, such as age 20–44 years at diagnosis, may be more strongly affected by recent changes in risk-factor prevalence and may predict future cancer trends (Doll, 1991). For this study, the age group 20–54 years was used because of the low incidence rates before the age of 45 years; for ASIRs within age 20–54 years, standardization involved the use of weights based on the distribution of the US population within this age group (National Cancer Institute, 2004).

Geographic variation in ASIRs was examined only in males with the SEER ‘race’ item (usually based on reports from hospitals) coded as ‘white’ in the SEER database; populations of other racial groups in many SEER areas were small, and ASIRs for females were low (with statistically unreliable rates). All the selected alcohol-related cancer types were combined, to increase the statistical reliability of the ASIRs in each SEER area. In interpreting geographic variation in these ASIRs, data were tabulated on trends in the estimated per capita (PC) consumption (age $\geq 14$ years) of alcohol (ethanol in gallons) by state for 1980, 1990 and 2000 (Nephew et al., 2003). PC consumption is a standard measure for temporal and geographic analyses of alcohol use (Greenfield and Kerr, 2003). Data for 1980 were included because of the unknown average lag period between changes in consumption and changes in ASIRs. Declines in consumption have been due almost entirely to spirits vs wine and beer (Greenfield et al., 2000), but total alcohol ingestion (all types of beverages) has been regarded as relevant to cancer risk (Poschl and Seitz, 2004).

Data on estimated prevalence of heavy drinking (defined as an average of $\geq 2$ drinks/day for men, and $\geq 1$ drink/day for women, during the preceding 30 days) were available by state from the 1991 and 2001 BRFSS surveys (Aihluwalia et al., 2003), and for both states and counties or selected metropolitan areas from the BRFSS 2002 survey only (Centers for Disease Control, 2004). Published data on trends in the prevalence of binge drinking among adults from 1991 to 1999 (Nelson et al., 2002) were also tabulated. Patterns of drinking, as well as total consumption measures, are important in assessing alcohol-related diseases (Midanik and Room, 2005). In epidemiologic studies, heavy alcohol use accounts for much of the estimated attributable fraction of cancers related to alcohol (Zeka et al., 2003), including squamous cell carcinoma of the esophagus (Brown et al., 2001).

RESULTS

ASIRs for squamous cell carcinomas in each of the three alcohol-related upper aerodigestive cancer site groups for all SEER areas combined declined from 1992 to 2001 in both males and females (Table 1). Declines (APCs) were slightly larger for esophagus than for the other two site groups, although all APCs were statistically significant except for larynx in females. Declines in ASIRs were generally continuous across the time period, except for oral cavity–pharynx in females (where no clear decline was evident until 1999) (Table 1), which supports the use of APCs as a summary statistic (Ries et al., 2004). There was no evidence for a recent plateau or upturn in ASIRs. The 95% CIs for 1992 no longer overlapped with those for later years starting around 1995–1999 in males but not until 2000 or 2001 in females (Table 1). For ages 20–54 years at diagnosis, all ASIRs also declined, with statistically significant APCs in males for larynx and esophagus, although 95% CIs overlapped for 1992 and 2001 (except for larynx in males) and ASIRs were low in females (Table 1).

ASIRs for white males showed a limited variation among the 11 SEER areas but were highest in Hawaii (with wide confidence limits, owing to the relatively small white population) and lowest in Utah (Table 2). Alaska natives and APCs were statistically significant for nine areas (Table 2). Apparent alcohol consumption declined in each state involved in the SEER Program; however, declines were larger from 1980 to 1990 than from 1990 to 2000 in some areas. The prevalence of binge drinking in adults (all races and both sexes combined) in states that comprise or include SEER areas showed slight declines in some areas, but slight increases in four areas (statistically significant in Georgia, Iowa and New Mexico). Some of the SEER areas with the smallest declines in APCs were states (or regions within states) with relatively small declines in alcohol consumption (Michigan and Iowa), and/or either very small declines (Washington) or actual increases (Michigan and Iowa) in binge-drinking prevalence. All the states except Hawaii and Utah showed increases in the prevalence of heavy drinking in adults from 1991 to 2001; Hawaii and Utah showed the largest declines in ASIRs. However, Georgia and New Mexico had the largest increases in the prevalence of heavy drinking (greater than the increase in median prevalence for all states in the US), but showed declines in ASIRs.

DISCUSSION

Declines in ASIRs occurred from 1992 to 2001 in the entire SEER program area for the selected alcohol-related cancers in both males and females, with little evidence for any recent plateau or increase, even among the younger population (for whom the first indication of increases might be expected).
Study limitations include use of data from the SEER program, in lieu of unknown ASIRs for the entire country. In addition, delayed reporting of cancers from hospitals to central registries may lead to slight underestimation of incidence rates for recent years of diagnosis, particularly for lung cancer (Ries et al., 2004). This study was limited to the upper aerodigestive system cancers, and was not intended to assess trends in all alcohol-related cancers. In interpreting trends and geographic differences in ASIRs, data on alcohol use were limited. Binge drinking is under surveillance as a leading US health indicator in Healthy People 2010 (Miller et al., 2004) and is a standard measure of heavy drinking episodes (Midanik and Room, 2005), but neither binge drinking nor heavy drinking (as defined in BRFSS surveys) may capture the drinking patterns that explain most of the cancers attributable to alcohol.

In interpreting trends in ASIRs in relation to alcohol use, confounding with trends in other cancer risk factors is a potential problem. Fruit and vegetable consumption, while associated with reduced risk of upper aerodigestive cancers (Adami et al., 2002), has changed little in the US in recent decades (Serdula et al., 2004). For laryngeal cancer, relative risks are higher for tobacco than alcohol (Bosetti et al., 2002), but the reverse is true for squamous cell carcinoma of the esophagus (Engel et al., 2003) and declines in ASIRs were greater for esophageal cancers than for oral cavity–pharynx and larynx (Table 1). The estimated alcohol-attributable fraction owing to any alcohol consumption is high for esophageal squamous cell carcinoma (i.e. 72% for both sexes combined) in the US (Engel et al., 2003). Declines in ASIRs for the alcohol-related sites (Table 1) were larger than those reported for lung cancer, which is strongly associated with tobacco but

### Table 1. Age-standardized incidence rates (ASIRs)/100 000, and annual percentage change (APC) in ASIR, for alcohol-associated cancers diagnosed in 1992–2001 by gender: Surveillance, Epidemiology and End Results program

<table>
<thead>
<tr>
<th>Year</th>
<th>Male All Ages, ASIRs</th>
<th>Female All Ages, ASIRs</th>
<th>Male Larynx</th>
<th>Female Larynx</th>
<th>Male Esophagus</th>
<th>Female Esophagus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>15.7 (15.0, 16.4)</td>
<td>5.1 (4.8, 5.5)</td>
<td>8.2 (7.7, 8.7)</td>
<td>1.5 (1.3, 1.7)</td>
<td>3.6 (3.3, 4.0)</td>
<td>1.5 (1.3, 1.7)</td>
</tr>
<tr>
<td>1993</td>
<td>15.2 (14.5, 15.9)</td>
<td>5.5 (5.1, 5.9)</td>
<td>7.5 (7.1, 8.0)</td>
<td>1.3 (1.2, 1.5)</td>
<td>3.6 (3.3, 4.0)</td>
<td>1.4 (1.3, 1.6)</td>
</tr>
<tr>
<td>1994</td>
<td>14.7 (14.1, 15.4)</td>
<td>5.1 (4.8, 5.4)</td>
<td>7.5 (7.1, 8.0)</td>
<td>1.7 (1.5, 1.9)</td>
<td>3.2 (2.9, 3.6)</td>
<td>1.3 (1.2, 1.5)</td>
</tr>
<tr>
<td>1995</td>
<td>13.9 (13.3, 14.5)</td>
<td>5.1 (4.9, 5.5)</td>
<td>7.4 (7.0, 7.9)</td>
<td>1.5 (1.3, 1.6)</td>
<td>3.2 (2.9, 3.5)</td>
<td>1.5 (1.4, 1.7)</td>
</tr>
<tr>
<td>1996</td>
<td>14.5 (13.5, 15.1)</td>
<td>5.2 (4.9, 5.6)</td>
<td>7.0 (6.6, 7.5)</td>
<td>1.5 (1.4, 1.7)</td>
<td>3.3 (3.0, 3.6)</td>
<td>1.4 (1.2, 1.6)</td>
</tr>
<tr>
<td>1997</td>
<td>14.3 (13.7, 14.9)</td>
<td>5.1 (4.7, 5.4)</td>
<td>7.0 (6.6, 7.4)</td>
<td>1.4 (1.3, 1.6)</td>
<td>3.0 (2.7, 3.3)</td>
<td>1.4 (1.2, 1.5)</td>
</tr>
<tr>
<td>1998</td>
<td>14.1 (13.5, 14.7)</td>
<td>5.1 (4.7, 5.4)</td>
<td>6.5 (6.1, 6.9)</td>
<td>1.4 (1.2, 1.6)</td>
<td>3.0 (2.7, 3.3)</td>
<td>1.3 (1.1, 1.5)</td>
</tr>
<tr>
<td>1999</td>
<td>12.9 (12.4, 13.5)</td>
<td>4.6 (4.3, 4.9)</td>
<td>6.6 (6.2, 7.0)</td>
<td>1.5 (1.4, 1.7)</td>
<td>2.4 (2.5, 3.1)</td>
<td>1.2 (0.9, 1.2)</td>
</tr>
<tr>
<td>2000</td>
<td>13.1 (12.5, 13.6)</td>
<td>4.4 (4.1, 4.7)</td>
<td>6.3 (5.9, 6.7)</td>
<td>1.3 (1.2, 1.5)</td>
<td>2.4 (2.2, 2.7)</td>
<td>1.2 (1.0, 1.4)</td>
</tr>
<tr>
<td>2001</td>
<td>12.1 (11.7, 12.8)</td>
<td>4.6 (4.3, 4.9)</td>
<td>5.9 (5.5, 6.3)</td>
<td>1.2 (1.0, 1.3)</td>
<td>2.8 (2.5, 3.1)</td>
<td>1.1 (0.9, 1.2)</td>
</tr>
</tbody>
</table>

**Note:** Squamous cell carcinomas (see text).

**Note:** Confidence intervals (95%) are shown in parentheses.

**Note:** ASIRs for age 20–54 years at diagnosis are shown only for the years of diagnosis 1992 and 2001.

*P* < 0.05.
not alcohol (Rehm et al., 2003) in all SEER areas combined (particularly in females, with an APC of only −0.2%) in 1992–2001 (Jemal et al., 2004). This also supports the conclusion that trends in alcohol consumption had an impact on trends in ASIRs for the alcohol-related cancers, independent of the impact of trends in tobacco use.

A lag of several years duration has been described between changes in the per capita total alcohol consumption and changes in the mortality rates of cirrhosis, although trends in the type of alcohol (i.e. spirits) and hepatitis may also be relevant (Mann et al., 2003). Reductions in the level of alcohol consumption would affect liver disease deaths in the short term, while changes in abstention rates would require many decades to affect mortality (Mann et al., 2003). Lag times for impacts of changes in alcohol use on cancer rates are uncertain but alcohol is believed to act mainly as a promoter and cocarcinogen (through its metabolite, acetaldehyde, interacting with environmental carcinogens) (Seitz et al., 2004). The effect of quitting alcohol (along with tobacco) showed a 70% reduction in esophageal cancer risk within 5–9 years (Castellsague et al., 2000), while longer time periods may be required for risks of laryngeal cancers to decline after stopping drinking (Altieri et al., 2002). Therefore, any impact of increases in alcohol consumption and prevalence of heavy or binge drinking (Table 2) may not yet be apparent in SEER data, and a continued surveillance of ASIRs for alcohol-related cancers is needed.

While geographic variation in ASIRs for the alcohol-related cancer was limited among white males, the low ASIRs for Utah were consistent with data on apparent alcohol consumption and prevalence of binge or heavy drinking in all adults (Table 2). The high ASIRs for white males in Hawaii are unexplained, but the 95% CI were wide and in 2001, overlapped with those for several other SEER areas. Previous studies have shown that Hawaii had the highest ASIRs among SEER areas for cancers of oral cavity–pharynx and larynx but not esophagus (Ries et al., 2004), and also high rates for hepatocellular carcinoma (Davila et al., 2003).
The consistency across all SEER areas in decline in ASIRs for the alcohol-related cancers combined (for white males) (Table 1) support the conclusion that declines are real, and all states involved in the SEER Program showed declines in apparent alcohol consumption (Table 2). However, BRFSS data (from telephone surveys) may underestimate the prevalence of binge drinking, in comparison to the National Survey on Drug Use and Health (an in-person survey) for the 1999 and 2001 surveys combined (Miller et al., 2004), and the prevalence of binge drinking increased from 1991 to 1999 in the entire US and in some states with a SEER registry (Table 2) (Nelson et al., 2002). The prevalence of heavy drinking also increased from 1991 to 2001 in the US and in almost all states with a SEER registry (Ahluwalia et al., 2003), while apparent total alcohol consumption (Nephew et al., 2003) continued to decline (albeit very little in some states) (Table 2). These data support the need for continued surveillance of ASIRs for alcohol-related cancers, to determine if plateaux or increases occur in any geographical areas. Surveillance of ASIRs in the US will be enhanced as the number of high-quality cancer registries continues to grow (Wingo et al., 2003).

Reducing the prevalence of heavy and binge drinking in the US population would be expected to lead to further reductions in incidence rates for alcohol-related cancers, particularly for squamous cell carcinoma of the esophagus (Brown et al., 2001), and the apparent cardiovascular benefits of moderate alcohol consumption are reversed with heavy or binge drinking (Buennemann et al., 2002).

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REFERENCES


