

# Smoke-free laws for reducing lung cancer incidence in Kentucky: warrants further implementation and investigation

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According to the latest update of cancer statistics in the United States, lung cancer has been the leading cause of cancer death for more than 25 years (1). Its incidence in both males and females is the second highest among all cancer types, with a total of 234,030 estimated new cases in 2018. The 5-year survival rate is low (only 18%), almost the worst of all cancers. Much attention should be paid to the fact that Kentucky is still the state with both the highest lung cancer incidence and the highest mortality during the past 10 years (1,2).

Sufficient evidence has proved that smoking is a strong risk factor of lung cancer (3,4). In Kentucky, the prevalence of tobacco usage is very high. Based on the newest state-level report, the prevalence of adults aged  $\geq 18$  years who have current use of any tobacco product is 26.2% in Kentucky, which is the third highest among all states (lowest: 10.2% in California; highest: 27.7% in Wyoming) (5). In addition to the prevalence of the smoking usage, the impact of smoking on lung cancer mortality is also severe. According to a recently published report of the smoking-attributable mortality in the United States, Kentucky is the state with the highest proportion (22.1%) of deaths in the population caused by smoking (national level: 17.8%); the number of the estimated deaths due to smoking in a year is 9,476 (female: 4,049; male: 5,427) (6).

For a smoke-free environment, the Kentuckians have made efforts including smoke-free laws. Hahn *et al.* analyzed the association between smoke-free laws and lung cancer incidence based on a total of 83,727 Kentuckians aged  $\geq$ 50 years with a new diagnosis of lung cancer from 1995 to 2014 (7). They found that the people who lived in those counties with comprehensive smoke-free laws (100% smoke-free workplaces, restaurants and bars) were 7.9% less likely to be diagnosed with lung cancer compared to those who lived in the counties without smoke-free laws (P=0.002); compared to those without smoke-free laws, the people with moderate (100% smoke-free restaurants and bars but not all 100% smoke-free workplaces) or weak ("protecting workers and patrons in some public and workplace venues with significant exemptions") smoke-free laws were only 2.8% less likely to be diagnosed with lung cancer (P=0.40) (7). According to these results, the comprehensive smoke-free laws contributed to a reduction of lung cancer incidence in Kentucky.

In addition to the smoke-free laws, the author is curious about whether there are other factors behind the study that account for the difference in lung cancer incidence between the counties with comprehensive smoke-free laws and the counties without any smoke-free laws. This curiosity is derived from other results of this study: some factors protected the people from developing lung cancer, including female gender, younger age, lower countylevel adult smoking rate and higher county-level median household income (P<0.05) (7).

All these factors may reflect the socioeconomic and health inequalities on a geographic level in Kentucky counties. For example, some people are living in the areas of Kentucky with heavy coal mining. Christian *et al.* found that the incidence of lung cancer in Kentucky was related to the coal-mining industry, especially in southeastern Kentucky like the Appalachian area (8). The above result can be explained by a study conducted by Johnson *et al.*: the

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residents who lived in Appalachia had higher concentrations of arsenic, chromium and nickel (carcinogens from coal) compared to the residents who lived in Jefferson, an urban county not in the Appalachian area; also, the residents who lived in Appalachia had a higher incidence of lung cancer compared to the Jefferson residents (9). Another study focusing on mortality also supported the association between lung cancer and the coal-mining industry in Appalachia (10). Interestingly, the author found that among the 15 counties in southeastern Kentucky with high lung cancer incidence and high coal productivity in the Christian et al. study, only two counties had the comprehensive smoke-free laws as indicated in the Hahn et al. study (7,8). In another words, the coal-mining industry may also contribute to the difference in lung cancer incidence between counties, accounting for the high incidence of lung cancer in counties without comprehensive smoke-free laws. Additionally, the difference in lung cancer incidence between Kentucky counties may be related to other county-level factors as well, including poverty, education and employment conditions, access to public water systems (8,11).

Due to the severity of lung cancer and smoking issues in Kentucky-highest incidence and mortality of lung cancer (1,2), the third highest prevalence of current tobacco usage (5), as well as the highest smoking-attributable mortality among all states (6)-the author appreciates the findings and implications from the Hahn et al. study: comprehensive smoke-free laws are important to achieve the reduction of lung cancer incidence in Kentucky. Further efforts on the corresponding legislation process should be made, even if the journey at the state level is not easy, mainly because of the conflict of values as well as other socioeconomic considerations (12). The implementation at the local level may be more acceptable. Along with the smoke-free laws, other efforts for tackling lung cancer and smoking issues in Kentucky should be kept in progress, such as increases of cigarette tax rate, tobacco-free media campaigns, smoking cessation programs, restrictions on tobacco in marketing, lung cancer screening programs, expending coverage of government-funded insurance for smoking cessation and lung cancer screening, improvement of public awareness of healthcare, as well as the improvement of public facilities' standards and accessibility (6,8,13,14).

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