



Lung Cancer Trend in the U.S.

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ABSTRACT Cancer has become the second leading cause of morbidity and mortality around the world. According to the data from the WHO, about 8.2 million deaths of cancer and more than 14 million new cases in 2012. Among the top five common cancers listed by the WHO, lung cancer has been the No.1 cause of death which took away 1.69 million lives in 2015 [1]. Similar as worldwide statistical data, the lung cancer is also the first killer and second most commonly diagnosed among all cancers in the United States. Through organization of the lung cancer historical data, it can easily show the distribution and trends of incidence rate in different regions, races and ages. Meanwhile, with the analysis of selected groups, it can generate some inspiration for lung cancer prevention or treatment.

KEYWORDS : lung cancer, statistical analysis, aged-adjusted group, state-adjusted group, races

I. INTRODUCTION

Every November is the lung cancer awareness month which is a global initiative launched by International Association for the Study of Lung Cancer (IASLC) in 2001. After 20th-century, the incidence rate of lung cancer was keeping rising, and have gradually developed into one of the most common cancer in the world. Overall, one person will have 6% chance to develop lung cancer. In 2012, more than 1.8 million new cases and about 1.6 million deaths were estimated by the cause of lung cancer [2]. The incidence rates of typical 5 cancers in the U.S. are shown in Table I. Each year, more Americans die of lung cancer than other four cancers combined. Although lung cancer is the leading cause of cancer death in the United States, accounting for 158,080 deaths estimated in 2016 [3], the overall incidence rate is showing a declining trend year by year.

Table 1 Typical 5 Cancer Incidence Rate per 100,000 in 2011, 2012, and 2013, U.S. [4]

Year	2011	2012	2013
All Cancer Rate	461.3	447.2	439
Lung and Bronchus Cancer	62.3	61.2	59.4
Liver Cancer	7.6	7.9	7.9
Colon and Rectum Cancer	40.6	39.3	38.4
Stomach Cancer	6.7	6.6	6.6
Female Breast Cancer	123.5	123.1	123.7

II. DATABASE AND METHODS

Incidence rates of lung cancer for 1999-2013 were obtained from Centers for Disease Control and Prevention (CDC), Surveillance, Epidemiology, and End Results (SEER) Program and State Cancer Profiles [4][5][6]. CDC and State Cancer Profiles provide detailed data of lung cancer for the whole population including age-adjusted, race-adjusted and state-adjusted group. And incidence trends from 1975 to 2013 are collected from SEER. For the data of recent 3 years, this study refers to "Cancer Statistics, 2014", "Cancer Statistics, 2015", "Cancer Statistics, 2016" and research results from American Cancer Society [3][7][8][9]. With the application of R language, those complicated data can be quickly sorted and regression analyzed. All results are exported as tables and graphs.

The key statistics are summed up:

- 1) The estimated new cases in 2017 are about 222,500 which will be 13.2% of all cancer cases
- 2) The estimated deaths in 2017 are about 155,870 which will be 25.9% of all cancer deaths
- 3) The percentage of 5-year survival rate in 2017 is about 18%
- 4) The annual decreasing rate of incidence in 2017 is about 0.8%

A. Data Analysis by Race, Age and Gender

Although white people account for the majority of the population, incidence data showed black people had the highest rate which is about 61.2 per 100,000 compared with other ethnic groups (white (60.1), Asian (35), American Indian (41.5) and Hispanics (31.3)) in 2013 [4].

A combined age-adjusted incidence distribution was shown in Fig. 1. The annual incidence rate per 100,000 in 2013 was distributed with the following order: black people always the highest (71); followed by white people (67.8), American Indian or Alaska Native (46.7), Asian people (37.7) and Hispanic people (36.4). The findings of the combined data in Fig. 1 indicate black people are more likely have lung cancer among population younger than 70 years old, while American Indian and Asian people have the lowest risk of lung cancer in all age groups. All races have highest incidence and death rate at age of 70-80 which is about 30% , and up to 80% of lung cancer patients are older than 60. The risk of having lung cancer increases with age. In 2013, a total of 212,584 persons were diagnosed with lung cancer in the United States. From the view point of the age group, 47% cases are 60-75 years (98929), followed by older than 75 years (73599), 45-59 years (37237), 30-44 years (2565) and less than 30 (254), Fig. 2 present the distribution of incidence rate by age.

Racial disparities in incidence are associated with many risk factors, such as tobacco smoking [10][11]. Researchers from USC concluded that: with the same amount of cigarette smoking, black people had a nearly 50% higher risk of lung cancer than white, and 60% to 80% higher than Asian and Hispanics [12]. In fact, one possible reason for this appearance is that black smokers are more sensitive to carcinogen of lung cancer when they smoke. Some studies also revealed similar results that association between cigarette smoking and high risk of lung cancer among black people: black people have higher cotinine levels than others even they smoke fewer cigarettes which means they inhale more nicotine every smoking than others [12][13][14]. The other possible reason focused on the differences in smoking behavior between black people and others: compared with white people, black people are more likely to prefer menthol cigarettes (45.1% black men and 46.5% black women vs. 17.3% of white men and 17.6% of white women). Although not many studies can support that there is a link between a higher risk of lung cancer and menthol cigarettes, many researchers found those smokers with menthol cigarettes hard to quit smoking [12][14][15]. The incidence rate of lung cancer has generally shown a downward trend for decades. Every ethnic group revealed a steady reduction by years. The trend of lung cancer incidence rate of each race from 1999 to 2013 is shown in Fig. 3.

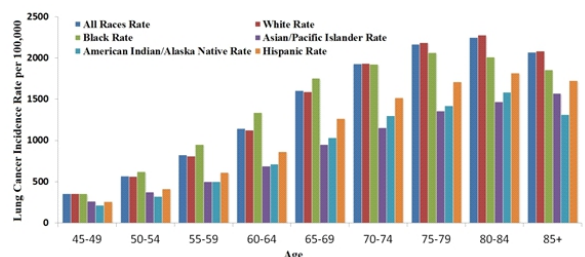


Figure 1 2013 Age-adjusted (>45) Lung Cancer Distribution by Race

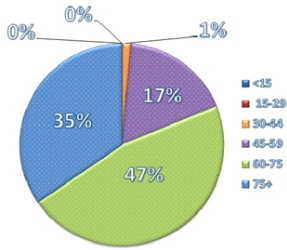


Figure 2 All Races Rate by Age-grouped in 2013

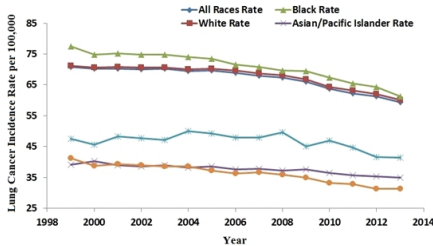


Figure 3 1999-2013 Lung Cancer Trend by Race

As known that many risk factors of lung cancer have been identified, tobacco smoking is the leading one which results in about 80% of incidences and deaths nationwide [14]. In fact, the probability of smokers suffering from lung cancer is 13 times that of non-smokers [1]. The differences in lung cancer incidence patterns between men and women reflect historical difference in tobacco use. On one hand, men were more affected by tobacco smoking than women. For men, such countries are classified as high risk of lung cancer includes the United Kingdom, the United States and China where prevalence of cigarette smoking are quite common. But on the other hand, in terms of women incidence, these countries have different situations. In china, the high incidence rate among women is mostly resulted from exposure to secondhand cigarette smoke (passive smoking) and the deteriorating air quality. With the age-adjusted national incidence rate of lung cancer from 1999 to 2013, women have a much lower rate than men which is 74.6 versus 53.3 per 100,000. However through the trend of lung cancer in these 15 years which is shown in Fig. 4, it shows incidence among men has been significantly reduced, whereas this case not happened for women. And even during the mid-2000s the incidence among women has increased slightly. Coincidentally, the trend of tobacco smoking in the U.S. (shown in Fig. 5) just matched the trends of lung cancer incidence among women in recent 10 years.

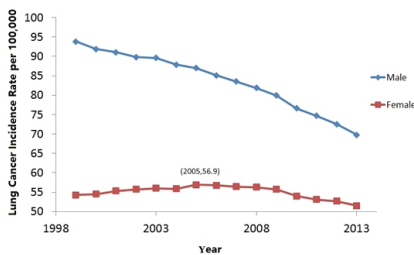


Figure 4 1999-2013 Lung Cancer Incidence Rate by Sex

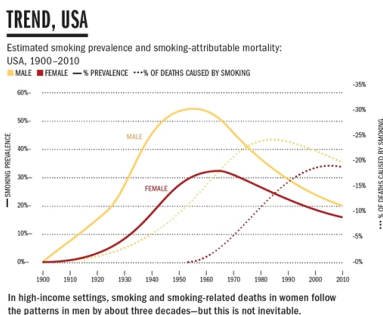


Figure 5 Tobacco Smoking Trend in the U.S. [16]

Therefore, a summary of incidence - trends [4][17] with the view of race and gender can be listed:

- 1) The annual decrease rate among white men will be 2.5%, among women will be 0.9%
- 2) The annual decrease rate among black men will be 2.8%, among women will be 1.1%
- 3) The annual decrease rate among American Indian will be 2.6%, among women will be 0.01%
- 4) The annual decrease rate among Asian men will be 1.8%, among women will be remain the same level
- 5) The annual decrease rate among Hispanic men will be 3.1%, among women will be 1.3%

B. Data Analysis by State

The top 5 states with the highest average lung cancer incidence rate per 100,000 from 1999 to 2013 were: Kentucky (96.4), West Virginia (81.2), Arkansas (77.1), Mississippi (76.4) and Maine (74.6) [4]. On the other hand, what is interesting is that the 5 highest smoking rate states were also these states, especially in 2015, the smoking rates larger than 23% among adults are Kentucky, and West Virginia. Besides, Kentucky, West Virginia, Mississippi and Maine also have very high incidence rate in all cancer combined. Contrary to this phenomenon, Utah had the lowest smoking rate and also the lowest lung cancer incidence rate. Fig. 6 and Fig. 7 show the incidence rate distribution by state in 2013 and 2003, separately.

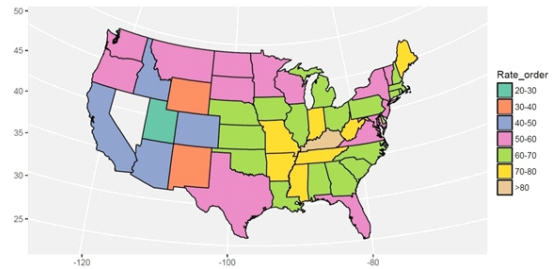


Figure 6 2013 Age-adjusted Lung Cancer Incidence Rate by State

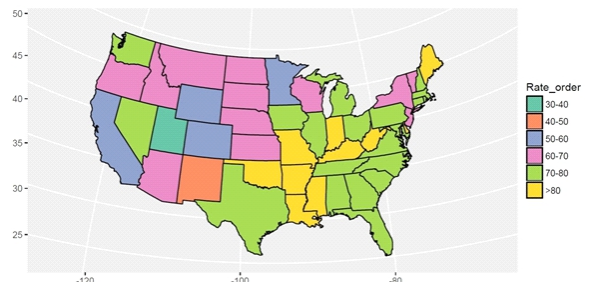


Figure 7 2003 Age-adjusted Lung Cancer Incidence Rate by State

From the geographical point of view, there is a relatively high incidence rate in Midwest (64.3) and South (63.4), and the lowest is West (58.8). Through these two figures, it can be noticed that the incidence rate of lung cancer has decreased significantly in many states including: Wyoming (decreased by 33.4%), Texas (25.2%), Washington (22.3%), Idaho (22%) and Florida (20%). Trends of lung cancer incidence among these five states were shown in Fig. 8. Actually, from the data it indicates that lung cancer incidence was not declining every year in these states, sometimes, a small fluctuation would appear. But what obvious is that all these states decreased very much after 2012. According to cigarette smoking data [4], after 2012, Washington, Idaho and Florida all had smoke-free law to prohibit smoking in some specific places like restaurant, or smoke-free workplace. Meanwhile, data from Idaho and Florida also showed that smoking rate among youth ages keep decreasing from 2002. On the other hand, from the trends of Washington and Wyoming, there were significant rise in both of them. In fact, with the data from CDC [4], these two states also had a significant increase of smoking rate from 2002 to 2006. Also, based on some study of lung cancer rates in selective state [18], the effective tobacco control policy can significantly decline the incidence of lung cancer.

The new trend of each state in 2018 is quite similar to the case in 2013.

The Fig. 9 shows the incidence distribution by states in 2018. Actually, lung cancer in every state continues decreasing with a steady rate. Combined with previous discussion about tobacco issues, it is naturally found that if those highest tobacco smoking states can implement effective smoking control policy the incidence rate of lung cancer will be notably controlled in future.

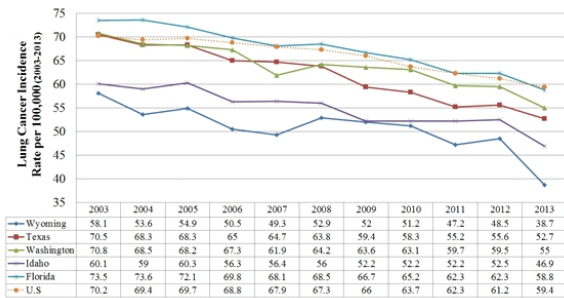


Figure8 Lung Cancer Trends in Five States

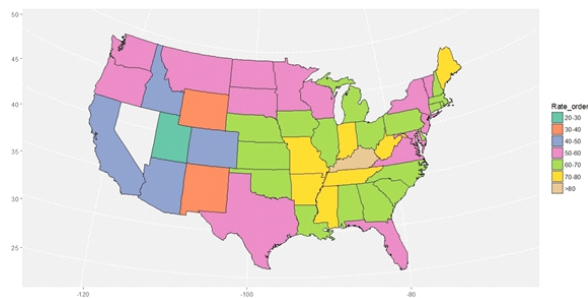


Figure 9 Estimated Lung Cancer Incidence Rate by State in 2018

III. CONCLUSION

This study analyzes the statistical data of lung cancer from the perspective of race, age, gender and distribution in state. Combined with discussion of the major risk factor, tobacco smoking, it is can draw the following results:

- 1) The continuous decline of lung cancer incidence and death resulted from a better prevention in many states.
- 2) By now, lung cancer is still the leading cause of death for many American people.
- 3) In many Southeastern states, the incidence rate still continues with a high level.
- 4) Through primary prevention programs, such as the tobacco-control policy it can effectively prevent lung cancer.
- 5) No matter which race, people over 60 years old should be given a regular check-up for the prevention of lung cancer.

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