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Research Article

Global Patterns of Incidence and Mortality in Lung Cancer

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Abstract

Objectives: Lung cancer has been the leading cause of cancer mortality, and its incidence is growing throughout the world. This study aims to compare the distribution of the six World Health Organization by configural frequency analysis (CFA).

Methods: The National data (GLOBOCAN 2012) were included in the analysis. Data were analyzed by CFA which is used for the analysis of multiway contingency tables.

Results: In Africa, East Mediterranean, Europe, and Southeast Asia, lung cancer incident cases were observed to be higher than expected. Under the years <70, in Africa, East Mediterranean, Europe, and Southeast Asia, lung cancer mortality is significantly underrepresented and therefore antitypes. Here, lung cancer mortality was observed lower than expected. In the more developed regions, lung cancer incident cases and mortality were significantly overrepresented in almost all age groups in both male (years <55) and female, but in the less developed regions, it was significantly underrepresented in almost all age groups.

Conclusion: The majority of the global lung cancer burden occurred in the more developed countries. If the current situation remains unchanged, incidence and mortality may continue to increase.

Keywords: Configural frequency analysis, lung cancer, World Health Organization regions

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Worldwide, cancer is a major cause of morbidity and mortality. It is estimated that, in 2012, there were about 14 million new cancer cases and 8.2 million deaths from cancer in a world population of about 7 billion.[1] Globally, in 2012, the most common cancers diagnosed were those of the lung (1.8 million cases, 13.0% of the total). Moreover, the most common causes of cancer deaths were cancers of the lung (1.6 million, 19.4% of the total).[2]

Lung cancer is the primary cause of cancer deaths in men and the second leading cause of cancer deaths in women worldwide. In economically developing countries, the most commonly diagnosed cancers were lung in males, which is the third most commonly diagnosed cancer in females. In economically developed countries, the second most commonly diagnosed cancer was lung among males, which is the third most commonly diagnosed cancer among females. In both economically developed and developing countries, the three most common cancer sites were also the three leading causes of cancer deaths.[3]

Lung cancer is one of the most preventable cancers. Most lung cancers could be averted by preventing smoking initiation among adolescents and increasing smoking cessation among adults. This requires a comprehensive tobacco control program that includes raising the price of tobacco products through excise taxes, banning smoking in public places and tobacco sales to minors, restricting tobacco advertising and promotion, counter-advertising, and providing treatment and counseling for tobacco dependence.[4]

Lung cancer has been the leading cause of cancer mortality, and its incidence is growing throughout the world. The high morbidity and mortality of lung cancer largely result from the fact that most people are diagnosed at advanced disease stage.[5]

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This study aims to compare the distribution of the six World Health Organization (WHO) regions of all subjects (for males and females, respectively) with the distribution of the all age groups by configural frequency analysis (CFA).

Methods

GLOBOCAN provides estimates of cancer incidence, mortality, and prevalence worldwide, and for countries (in 184 countries) and regions. We mainly used the GLOBOCAN 2012 data for analyzing lung cancer (trachea, bronchus, and lung: C33–34 [ICD, 10th revision]) incidence and mortality given on.[6] These statistics are based on GLOBOCAN worldwide estimates of cancer incidence and mortality produced by the International Agency for Research on Cancer for 2012.[7,8] Incidence and mortality estimates in 2012 have been prepared for lung cancer, grouped by sex and 8 age groups (40–44, 45–49, ..., 75 and over). As there were very few lung cancer prevalence and mortality, the results are not shown for ages <40 years. The WHO divides the world into six regions (Africa, the Americas, Eastern Mediterranean, Europe, Southeast Asia, and Western Pacific) for the purposes of reporting, analysis, and administration.[9]

Applying complex statistical methods for analyzing patterns tends to create a large distance to the data being analyzed: They are seen through a complex lens. Hence, there is a need for a method that helps the researcher to see and easily understand more directly the structures that appear in the data.[10] This need has led to the development of CFA, which is a very useful statistical method for the analysis of multiway contingency tables. CFA is a person-centered method rather than a variable-centered statistical method. Person-oriented analyses are typically used for two purposes, i.e., to identify types of individuals and individual trajectories. CFA is a widely used method of explorative data analysis. It tries to detect patterns in the data that occur significantly more or significantly less often than expected by chance. The patterns detected are used to generate information about the underlying mechanisms of the data. In CFA, a pattern or configuration that contains more observed cases than expected is called a type. On the other hand, a configuration that is less observed than expected is called an antitype, and if there is no significant difference between observed value and expected value, then configuration is neither a type nor an antitype. Thus, each configuration can, in principle, have three different states. It can be a type, an antitype, or not classified.[11–14] With this classification, a certain combination of different categorical variables can be found to be typical or atypical.

Using CFA, we compared the distribution of the six WHO regions for males and females, with the distribution of the all age groups. The standard normal z-approximation of the binomial test is applied since such an approach is known to perform well when samples are reasonably large,[11] which is the case in the present study. We considered a level of significance (alpha) at 0.05. To control for alpha error inflation, we applied the Holm procedure for all cases.[15] All figures are run using the ArcGIS package programming (version 10.3).[16]

Results

An estimated 1.824.493 new cases occurred in 2012, accounting for about 13.0% of total cancer diagnoses. Overall, 1.241.423 cases (68.0%) were males and 583.070 cases (31.9%) were females. Sex ratio (male to female) in the world was 2.13.

In this study, patterns of lung cancer in sex, six WHO region, and age groups were studied using CFA (for incidence and mortality).

Lung cancer mortality frequencies for male and female, clear types, and antitypes are shown in Figure 1. Women living in the Americas and Western Pacific regions are clearly underrepresented and therefore antitypes in almost all the age groups. Women who live in Africa (<65 years), East Mediterranean (<75 years), Europe (>45 years), and Southeast Asia (<75 years) are significantly overrepresented and, therefore, types due to higher lung cancer mortality compared to the expected. Males who live in Western Pacific (>45 years), Southeast Asia (>60), and East Mediterranean and Europe (>55 years) are significantly underrepresented and, therefore, antitypes. Here, lung cancer mortality was observed lower than expected. The male living in the other regions (Africa [<75] and the Americas [all age groups]) are overrepresented and therefore types. Here, lung cancer mortality was noted above the expected ones.

The frequency of lung cancer incident cases, clear types, and antitypes that are identified is shown in Figure 2. It is found that the difference is mostly between regions. The findings are as follows: In the Americas (all age groups) and Western Pacific (<70 years) regions, lung cancer incident cases in male were seen less frequently in comparison to expected by chance in other regions, whereas, in Africa (<65 years), East Mediterranean, Europe, and Southeast Asia, lung cancer incident cases were observed to be more than the expected ones in male. Similarly, female living in the Americas (except 50–54 years) and Africa regions are clearly overrepresented and, therefore, types in almost all age groups. Furthermore, the females who live in Western Pacific in all age groups (except 40–44 and 75+ years) and the females who live in the East Mediterranean, Europe, and Southeast Asia in all age groups (except <55 years) showed similar results.

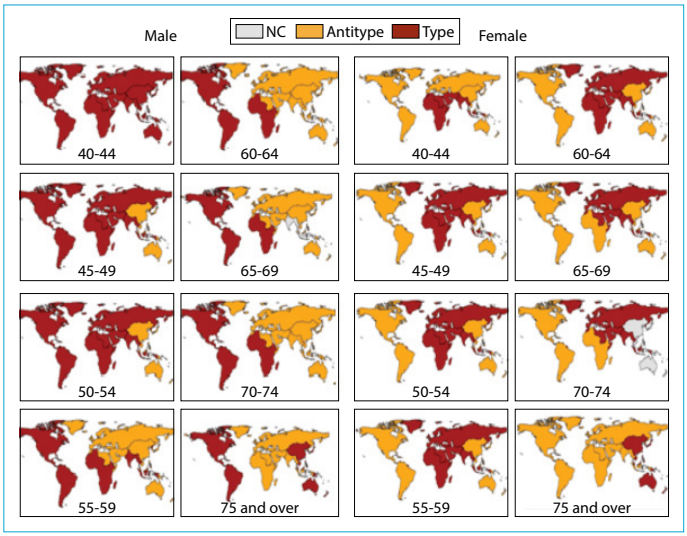

Figure 1. Types and antitypes with sex, World Health Organization region, and age groups for mortality (NC: not classified).

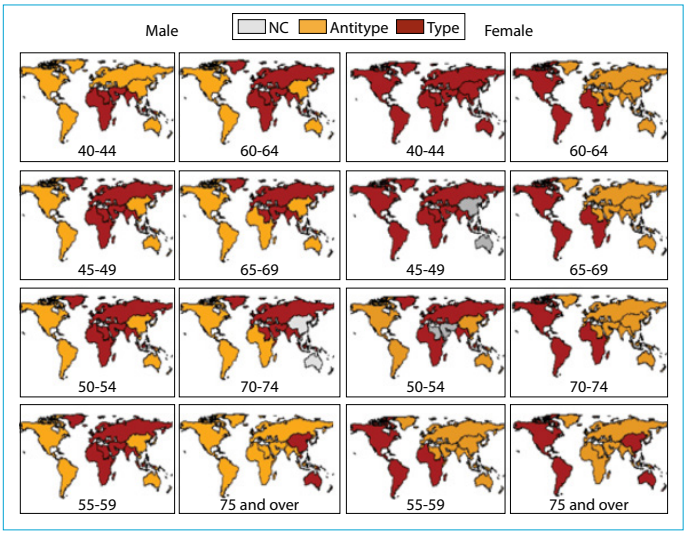

Figure 2. Types and antitypes with sex, World Health Organization region, and age groups for incidence (NC: not classified).

Discussion

This study is the first global research that applied CFA in the world as a whole, as well as in each of its six regions. The global and region-specific (sex and age-specific) estimates presented here and more detail online provide a key resource.[6]

An estimated 1.8 million new lung cancer cases occurred in 2012. In Europe, Southeast Asia, East Mediterranean, and Africa (all age groups under the 65 years) regions, lung cancer incident cases and mortality were seen more frequently in comparison to expected by chance in other regions. The majority of cancer in Africa is diagnosed in advanced stages of the disease, due to lack of screening and early detection services and limited awareness of early signs and symptoms of cancer among societal and health-care providers.[17] Lung cancer mortality rates in males in Europe have seen a substantial decrease in recent decades, but they are still increasing in women.[18]

Only in the Americas and Western Pacific regions, lung cancer incident cases and mortality were significantly less frequent than expected. In this region, individuals in most countries of the Western Pacific region have not been smoking as long, or as much (pack/years) as individuals, and hence, current hazard rates are smaller for this region.[19] In America, lung cancer incident cases were observed lower than expected. The reason for this is that, in the United States, state comprehensive tobacco control programs have markedly decreased smoking rates and accelerated the reduction in lung cancer occurrence, particularly in California.[20] Exposure to tobacco smoke is the primary etiologic factor responsible for lung cancer, and its importance is illustrated by the decline in lung cancer incidence in the United States that has accompanied the decline in smoking. Declines in lung cancer incidence and mortality rates continue to be larger in men than in women.[21, 22]

In males, the highest lung cancer incident cases were in Europe, Southeast Asia, East Mediterranean, and Africa and the lowest cases were in the Americas and Western Pacific (Fig. 2). Lung cancer is the most common cancer and is the leading cause of cancer death in men in 2012.[23]

Among women, the highest lung cancer cases were in Africa and the Americas. In Africa, infectious agents and indoor or outdoor air pollution is the most important cause of cancer.

Not only in African countries but also in Arabian Peninsula, tobacco smoking is becoming more and more popular among men.[24] The estimated number of lung cancer cases, worldwide, has increased in men and women.[21]

In the age group, 75 years and older, in both females and males in all regions, the incidence and mortality were detected lower than expected. Treatment and preventive measures should be taken, especially, for younger age groups to reduce incidence and mortality. In males, in almost all regions except the Americas and Western Pacific, lung cancer incident cases have been seen more than expected. Lung cancer mortality and prevalence can be reduced by reducing the risk factors in these regions. Even though Bosetti et al.[25] states that the lung cancer rate is increased in Europe, in women living in the European and Western Pacific regions, both incidence and mortality were found to be below expected levels. Moreover, lung cancer rates in Chinese women (20.4 cases per 100.000 women) are higher than rates among women in some European countries, despite a lower prevalence of smoking.[23] Although

many risk factors such as tobacco exposure have been included, it has been determined that air pollution has a significant effect on the development of lung cancer.[5] Understanding the epidemiology and causal risk factors of lung cancer may provide more arguments for prevention.[24]

Risk factors for lung cancer include tobacco smoking, air pollution, sex, race and ethnicity, age, diet and obesity, occupational or environmental exposure to secondhand smoke, asbestos, certain metals, radiation, and diesel exhaust. The genetic factor plays a role in the development of lung cancer, especially in those who develop disease at a young age.[21] Taking these risk factors into consideration, preventive measures should be taken in areas (Figs. 1 and 2) where lung cancer mortality and incidence are more likely to be seen in both men and women, especially in Africa, East Mediterranean, and Southeast Asia. Implementation of universal tobacco control programs can reduce the prevalence of this risk factor and consequently help to reduce the burden of lung cancer in high-risk areas. Necessary medical treatment and preventive measures should be maintained in both women and men, especially in areas (Figs. 1 and 2) where the incidence and mortality observed from lung cancer is lower than expected.

Conclusion

Tobacco consumption, air pollution, unhealthy lifestyles, and other risk factors for exposure would be reflected in future data if we did nothing for disease control. This study is of great importance and value, in the sense that it leads us to the areas where all kinds of measures should be taken to prevent lung cancer. These outcomes emphasize the need for continuous prevention and control strategies to reduce the burden of lung cancer, due to the outbreak of lung cancer in the world and the lack of effective treatment for advanced lung cancers. We believe that the WHO can be used to set priorities for the world's lung cancer control actions in different regions.

Disclosures

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Conflict of Interest: None declared.

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