Global Burden And Trends of Lung Cancer Incidence And Mortality

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Abstract

Objective: Lung cancer is the leading cause of cancer-related deaths around the world for many years. The aim of this study is to investigate the global patterns and trends of lung cancer, and expects to promote health education and sustainable cancer prevention measures.

Methods: Lung cancer incidence and mortality were derived from GLOBOCAN 2020 database. Continued data from Cancer Incidence in Five Continents Time Trends was used to analyze the temporal trends from 2000 to 2012 by using Joinpoint regression, and annual average percent changes were calculated. The association between Human Development Index and lung cancer incidence and mortality were assessed by linear regression.

Results: An estimated 2.2 million new lung cancer cases and almost 1.8 million lung cancer deaths occurred in 2020. The age-standardized incidence ranged from 36.8 per 100 000 in Denmark to 5.9 per 100 000 in Mexico. The age-standardized mortality rates varied from 32.8 in Poland to 4.9 in Mexico. Both the age-standardized incidence and mortality rates were about 2 times higher in men than in women. The ASIR of lung cancer were downward trend in United States of America (USA) between 2000 and 2012, which was more prominent in males. The age-specific incidence rates of male and female lung cancer in the age group of 50-59 years were upward trend in China.

Conclusions: The burden of lung cancer is still not optimistic, especially in developing countries like China. Taking into consideration the effectiveness of tobacco control and screening in developed countries, such as USA, we need to further strengthen health education, accelerate the establishment of tobacco control policies and regulations, and improve the early cancer screening awareness to curb the future lung cancer burden.

Introduction

Lung cancer is the second most commonly diagnosed cancer and the leading cause of cancer-related deaths around the world. According to the GLOBOCAN 2020, an estimated 2.2 million new lung cancer cases (11.4%) and almost 1.8 million lung cancer deaths (18.0%) occurred in 2020 [1]. The burden of lung cancer varied between different countries mainly because of divergence of risk factors, such as prevalence of smoking, environmental pollution and even dietary habits [2]. In the United States, the incidence of lung cancer has gradually declined since 1990 [3], which were benefit from the effective tobacco control policies and regulations. However, some developing countries, including China, exhibit lower incidence and higher mortality of lung cancer. The reasoning for these patterns include incomplete early cancer screening, poor medical conditions, and imperfect tobacco control policies and regulations [4].

Therefore, this paper aims to describe and compare country-specific morbidity and mortality of lung cancer rates in 2020, and analysis the incidence trend in major countries. It is beneficial to further improve the prevention and treatment strategy of lung cancer.

Materials And Methods

Data sources

The incidence and mortality of lung cancer were derived from GLOBOCAN cancer today database in 2020 (<https://gco.iarc.fr/>) [5]. It is a web-based interactive platform that describes the International Agency for Research on Cancer (IARC) of global cancer statistics for 36 cancer types in 185 countries or territories, providing information for cancer control and research.

To analysis the temporal trends of lung cancer incidence, we extracted cancer incidence data from Cancer in Five Continents Time Trends (CI5*plus*) database [6], which containing high quality population-based cancer registries, including the continuous incidence data from 108 countries or territories or subnational population-based cancer registries.

The Human Development Index (HDI) is a comprehensive index based on the three basic variables of "life expectancy, education level, and quality of life" according to a certain calculation method. Countries were categorized into 4 levels according to the HDI values (very high HDI, high HDI, medium HDI and low HDI).

In this study, ICD-10 data code C33-34 was derived from the overall cancer database for analysis the lung cancer incidence and mortality rates.

Selected Countries

The 20 countries with the highest age standardized incidence rate (ASIR) of lung cancer defined by the United Nations Population Division were selected to assess lung cancer incidence and mortality in 2020. A representative sample of five countries (China, South Korea, the United States, the United Kingdom, and Australia) on four continents were selected and they had complete and continuous data to analyze the incidence trends from 2000 to 2012.

Statistical analysis

The ASIR and age standardized mortality rate (ASMR) were calculated from Segi's world standard population [7]. Lung cancer incidence and death rates in 2020 were grouped by country, sex and age (0-24, 25-39, 40-54, 54-69, ≥ 70 years). We used the Joinpoint regression (version 4.3.1.0, National Cancer Institute) to analyze temporal trends of lung cancer incidence and mortality for five countries and calculated the annual average percent change (AAPC). Z test was used to assess whether the changes were statistically different from zero. The association between the ASIR or ASMR of lung cancer and the HDI value was detected by using linear regression. P values < 0.05 was considered statistically significant.

Results

Lung cancer incidence and mortality rates in 2020

There were an estimated 2.2 million new lung cancer cases and 1.8 million deaths occurred in 2020, accounting for about 11.4% world total cancer cases and 18.0% total cancer deaths. The crude incidence and mortality of lung cancer were 28.3 and 23.0 per 100,000. The ASIR and ASMR were 22.4 and 18.0 per 100,000, respectively. (Table 1, Table 2). For different continents, more than one-half of lung cancer cases and 61.9% deaths occurred in Asia in 2020, with the ASIR and ASMR were 22.9 and 32.7 per 100,000, followed by Europe accounting for 21.6% of cases and 21.3% deaths, with the highest ASIR (29.4 per 100,000) and ASMR (22.6 per 100 000), whereas Africa had the lowest ASIR (6.2 per 100,000) and ASMR (5.6 per 100 000).

Table 1
The incidence of lung cancer among word's major countries in 2020

Country/Region	Total			Male			Female		
	Cases	Crude Rate	ASIR	Cases	Crude Rate	ASIR	Cases	Crude Rate	ASIR
World	2206771	28.3	22.4	1435943	36.5	31.5	770828	19.9	14.6
Asia	1315136	28.3	22.9	891898	37.6	32.7	423238	18.7	14.0
China	815563	56.3	34.8	539181	72.7	47.8	276382	39.2	22.8
Japan	138532	109.5	32.1	94487	153.0	47.0	44045	68.1	19.5
South Korea	28651	55.9	25.5	19797	77.1	39.1	8854	34.6	14.8
India	72510	5.3	5.4	51675	7.2	7.8	20835	3.1	3.1
Iran	10465	12.5	12.6	7184	16.9	16.9	3281	7.9	8.1
Europe	477534	63.8	29.4	315054	87.1	43.6	162480	42.0	18.1
United Kingdom	51983	76.6	32.3	26943	80.3	35.2	25040	72.9	29.9
Germany	64804	77.3	31.9	38436	92.8	39.2	26368	62.2	25.7
Italy	41953	69.4	25.3	28369	96.4	36.0	13584	43.8	16.4
France	48299	74.0	34.9	31941	101.1	49.1	16358	48.6	22.7
Poland	29509	78.0	36.2	18277	99.7	51.5	11232	57.6	24.6
Denmark	5047	87.1	36.8	2399	83.3	36.9	2648	90.9	36.8
Africa	45988	3.4	6.2	33282	5.0	9.8	12706	1.9	3.2
South Africa	8950	15.1	18.3	6144	21.0	29.6	2806	9.3	10.0
Egypt	6538	6.4	8.0	4851	9.4	12.8	1687	3.3	3.8
Oceania	16975	39.8	24.0	9277	43.4	27.4	7698	36.1	21.0
Australia	13162	51.6	25.3	7208	56.8	28.7	5954	46.5	22.3
New Zealand	2425	50.3	24.9	1164	49.1	24.7	1261	51.4	25.0
America	351138	34.3	21.9	186432	37.0	25.5	164706	31.8	19.0
USA	227875	68.8	33.1	116335	71.0	36.3	111540	66.7	30.4
Mexico	7588	5.9	5.3	4503	7.1	7.0	3085	4.7	4.0
Argentina	12110	26.8	19.2	7738	35.1	28.1	4372	18.9	12.3
Brazil	40409	19.0	14.3	23162	22.2	18.4	17247	16.0	11.1
Canada	25574	67.8	28.9	12706	67.8	30.4	12868	67.7	27.7
Cuba	6689	59.1	28.5	4077	72.5	36.9	2612	45.8	21.2

ASIR, Age-standardized incidence rate; USA, United States of America; HDI, Human Development Index.

Country/Region	Total			Male			Female		
	Cases	Crude Rate	ASIR	Cases	Crude Rate	ASIR	Cases	Crude Rate	ASIR
HDI									
High HDI	1047707	36.0	26.2	697411	47.5	37.1	350296	24.3	16.5
Very high HDI	975665	62.4	29.9	611867	79.1	41.1	363798	46.0	20.6
Medium HDI	165943	7.1	8.0	116316	9.8	11.5	49627	4.4	4.6
Low HDI	16418	1.7	3.5	9713	2.0	4.5	6705	1.4	2.6
ASIR, Age-standardized incidence rate; USA, United States of America; HDI, Human Development Index.									

Table 2
The mortality of lung cancer among word's major countries in 2020

Country/Region	Total			Male			Female		
	Deaths	Crude Rate	ASMR	Deaths	Crude Rate	ASMR	Deaths	Crude Rate	ASMR
World	1796144	23.0	18.0	1188679	30.2	25.9	607465	15.7	11.2
Asia	1112517	24.0	19.3	757218	31.9	27.8	355299	15.7	11.6
China	714699	49.4	30.2	471546	63.6	41.8	243153	34.5	19.7
Japan	82369	65.1	14.7	57334	92.8	24.2	25035	38.7	7.1
South Korea	20505	40.0	16.5	15147	59.0	28.9	5358	20.9	7.4
India	66279	4.8	4.9	47701	6.7	7.2	18578	2.8	2.8
Iran	9071	10.8	10.9	6229	14.7	14.6	2842	6.8	7.0
Europe	384176	51.3	22.6	260019	71.9	34.9	124157	32.1	12.9
United Kingdom	36518	53.8	20.8	19109	57.0	23.1	17409	50.7	18.9
Germany	50282	60.0	23.1	31664	76.5	30.6	18618	43.9	16.8
Italy	33602	55.6	18.0	22792	77.4	26.3	10810	34.8	11.4
France	37095	56.8	25.4	25214	79.8	37.2	11881	35.3	15.4
Poland	27444	72.5	32.8	17461	95.2	48.4	9983	51.2	21.2
Denmark	3927	67.8	27.0	2032	70.6	29.3	1895	65.1	25.2
Africa	41171	3.1	5.6	29760	4.4	8.9	11411	1.7	2.9
South Africa	7730	13.0	15.8	5280	18.1	25.4	2450	8.1	8.7
Egypt	5817	5.7	7.2	4319	8.4	11.5	1498	3.0	3.4
Oceania	12012	28.1	16.1	6902	32.3	19.5	5110	24.0	13.2
Australia	8867	34.8	15.8	5139	40.5	19.1	3728	29.1	12.9
New Zealand	1924	39.9	18.4	965	40.7	19.1	959	39.1	18.0
America	246268	24.1	14.9	134780	26.7	18.0	111488	21.5	12.3
USA	138225	41.8	18.9	73009	44.6	21.9	65216	39.0	16.4
Mexico	7100	5.5	4.9	4304	6.8	6.6	2796	4.2	3.6
Argentina	10729	23.7	16.8	6881	31.2	24.8	3848	16.6	10.7
Brazil	35160	16.5	12.3	19743	18.9	15.5	15417	14.3	9.8
Canada	21362	56.6	22.5	10907	58.2	24.4	10455	55.0	21.2
Cuba	6173	54.5	25.9	3876	68.9	34.7	2297	40.3	18.3

ASMR, Age-standardized mortality rate; USA, United States of America; HDI, Human Development Index.

Country/Region	Total			Male			Female		
	Deaths	Crude Rate	ASMR	Deaths	Crude Rate	ASMR	Deaths	Crude Rate	ASMR
HDI									
High HDI	918661	31.6	22.8	610626	41.6	32.5	308035	21.4	14.3
Very high HDI	711630	45.5	20.6	462513	59.8	30.0	249117	31.5	12.9
Medium HDI	149887	6.4	7.2	106011	8.9	10.6	43876	3.9	4.1
Low HDI	15108	1.5	3.2	8987	1.8	4.2	6121	1.2	2.4
ASMR, Age-standardized mortality rate; USA, United States of America; HDI, Human Development Index.									

Of different countries, China had the largest number of lung cancer cases and deaths, accounting for about 37.0% and 39.8% in 2020, followed by America (10.3% cases and 7.7% deaths) and Japan (6.3% cases and 4.6% deaths). Both the ASIR and ASMR among countries varied over 6-fold. The highest ASIR from 36.8 per 100 000 in Denmark to 5.3 per 100 000 in Mexico, while the highest ASMR from 32.8 per 100 000 in Poland to 4.9 per 100 000 in Mexico. The ASIR and ASMR in Demark, Poland, France, China and the USA much higher than the world ASIR (22.4 vs 18.0 per 100 000), whereas the ASIR and ASMR in Iran, Egypt, India and Mexico lower than the world ASIR (Table 1, Table 2).

The highest ASIR occurred in Poland for both men and women (51.5 vs 24.6 per 100,000), followed by France (49.1 vs 30.4 per 100 000) and China (47.8 vs 29.9 per 100 000), while the lowest ASIR were observed in Mexico (7.0 vs 4.0 per 100,000) (Fig. 1, Table 1). The highest ASMR occurred in Poland in men (48.4 per 100 000), while in Demark in women (25.2 per 100 000). The lowest ASMR were observed in Mexico in men (6.6 per 100,000), while in India in women (2.8 per 100 000) (Fig. 1, Table 2).

Association between HDI and the ASIR, ASMR of lung cancer

Over 90% lung cancer cases and 77.1% lung cancer deaths occurred in very high and high HDI countries. Less than 10% of lung cancer cases and deaths occurred in the medium and low HDI countries. The ASIR and ASMR in very high/high HDI countries were over 3 times higher than that in medium/low HDI countries (Table 1, Table 2). The association between ASIR, ASMR and HDI were significant (Fig. 2).

Temporal Trends Of Lung Cancer Incidence

The ASIR of lung cancer showed a consistent downward trends in South Korea (AAPC=-1.2%), Australia (AAPC=-1.2%), the United Kingdom (AAPC=-1.5%), China (AAPC= -2.0%), and the USA (AAPC= -2.5%) in men (Table 3, Fig. 3). For age specific rates, the greatest decrease was occurred in men younger than 40 years in South Korea (AAPC=-3.4%) and China (AAPC=-3.2%), while the biggest downtrend trends was observed in the USA (AAPC= -4.1%) and the United Kingdom (AAPC=-2.7%) in age group 40-49 years (Table3, Fig. 4). The ASIR of lung cancer showed upward trends among Australia (AAPC=1.6%), the United Kingdom (AAPC=1.4%) and South Korea (AAPC= 1.1%), while downward trends in the USA (AAPC= -0.9%) in women. Among women, the largest increase were observed in the United Kingdom in age over 80 years (AAPC= 4.1%) and South Korea in age group 40-49 (AAPC= 3.2%), while the greatest decrease trends were appeared in the USA (AAPC=-3.6%) (Table3, Fig. 5). Detailed information of trends analysis was provided in **supplementary Tables**.

Table 3
Trends for lung cancer incidence rates by countries, 2000 to 2012 (%)

Age groups	China	South Korean	America	Australia	United Kingdom
Male					
ASR	-2.0*(-2.4,-1.5)	-1.2*(-1.6,-0.9)	-2.5*(-2.8,-2.2)	-1.3*(-1.7,-0.9)	-1.5*(-1.9,-1.1)
<40	-3.2*(-5.5,-0.9)	-3.4*(-5.6,-1.1)	-3.9*(-4.9,-3.0)	-0.3(-2.3,1.8)	-0.2(-2.0,1.5)
40-49	-1.6*(-3.1,-0.2)	-1.6*(-2.7,-0.5)	-4.1*(-4.8,-3.4)	-0.3(-2.1,1.6)	-2.7*(-4.5,-0.9)
50-59	1.5*(0.2,2.8)	-1.8*(-2.3,-1.2)	-2.4*(-2.5,-2.2)	-1.7*(-2.2,-1.3)	-1.8*(-2.1,-1.5)
60-69	-2.6*(-3.4,-1.9)	-1.1*(-1.7,-0.6)	-3.2*(-3.4,-2.9)	-1.7*(-2.4,-1.1)	-1.6*(-1.9,-1.2)
70-79	-2.9*(-3.4,-2.3)	-1.6*(-2.2,-1.0)	-1.9*(-2.1,-1.6)	-1.6*(-2.2,-1.0)	-1.5*(-2.5,-0.6)
80+	-2.6*(-3.3,-1.9)	0.6(-0.3,1.5)	-0.8*(-1.2,-0.3)	0.5(-0.1,1.2)	-0.4(-1.4,0.6)
Females					
ASR	-0.1(-1.3,1.1)	1.1*(0.5,1.8)	-0.9*(-1.2,-0.7)	1.6*(1.1,2.1)	1.4*(1.0,1.8)
<40	-1.9(-8.3,4.9)	2.0(-0.4,4.6)	-3.6*(-4.4,-2.8)	1.7(-1.1,4.6)	0.9(-2.1,4.0)
40-49	1.8*(0.9,2.8)	3.2*(1.8,4.7)	-1.4*(-2.5,-0.3)	-0.4(-1.8,1.0)	-1.1*(-2.1,-0.1)
50-59	2.6*(0.6,4.6)	2.8*(1.7,4.1)	-1.0*(-1.4,-0.6)	1.0(-0.1,2.1)	1.0*(0.2,1.7)
60-69	-0.2(-2.4,2.0)	1.3*(0.1,2.6)	-1.9*(-2.2,-1.6)	1.7*(1.0,2.4)	1.7*(0.6,2.9)
70-79	-1.2*(-2.0,-0.5)	-0.3(-1.0,0.3)	0.1(-0.6,0.8)	1.7*(1.3,2.1)	0.9*(0.5,1.3)
80+	-1.9*(-2.4,-1.3)	1.2*(0.2,2.2)	1.2*(0.7,1.7)	3.2*(2.2,4.1)	4.1*(3.5,4.7)
ASR, age-standardized rate using world Segi's standard population; *, average annual percent change during 2000 to 2012 is significantly different from zero ($P<0.05$).					

Discussion

In this study, we performed the updated epidemiology of lung cancer burden in 2020 and analysis the trends of incidence and mortality rates during 2000-2012. All in all, the burden of lung cancer is still not optimistic, especially in developing countries like China.

The overwhelming cause for high incidence of lung cancer is smoking [8], no matter active smoking or passive smoking [9]. Smoking was prevalent in western developed countries such as Europe, North America, Australia, Japan, South Korea, earlier in history, and reached its peak in the middle of the last century, so the burden of lung cancer is heavier. The prevalence of smoking among men had subsequently declined with the introduction of tobacco control policies in these countries, and the incidence of lung cancer in men had gradually declined [10], which is consistent with the trend was observed in this study.

However, the burden of lung cancer in women in these developed countries (United Kingdom, South Korea and Australia) kept plateauing and had a gradually upward trend, except for USA. This indirectly reflects that female smoking is still prevalence in developed countries. The heavy burden of lung cancer in China is partly due to the large population base. China has the largest number of smokers in the world and consumes about 40% of the world's tobacco every year [11]. Meanwhile, exposure to secondhand smoke is also worthy of attention. Approximately 70% of Chinese people are

exposed to secondhand smoking every year, and nearly lead to 60,000 lung cancer deaths (8%) [12]. China signed the WHO Framework Convention on Tobacco Control (FCTC) in 2003. Chinese government had issued a series of management regulations (Regulations on the control of smoking in public places) on tobacco control work, and had vigorously promoted the dangers of smoking in public media, so that the prevalence of male lung cancer had shown a significant decline in recent years. Although these regulations had initially shown positive effects, the efforts to control tobacco are obviously not strong enough, such as raising tobacco taxes or tobacco prices [13, 14].

Another important high-risk factor for lung cancer is ambient air pollution. A number of studies in European and American had found that the concentration of particulate matter (PM) in the environment, especially PM less than 2.5 μ m (PM_{2.5}), is closely related to the risk of lung cancer [15–17]. Therefore, outdoor air pollution was listed as a human carcinogen by the International Agency for Research on Cancer (IARC) in 2013 [18]. Ambient air pollution is also one of the reasons for the high incidence of lung cancer in developing countries such as China, India and Egypt. In recent years, with the rapid development of Chinese industrialization and transportation, especially the large use of coal and petroleum, a large number of harmful substances had been discharged into the atmosphere. The main causes of urban air pollution were the unreasonable energy consumption structure and low utilization rate. In 2012, China first proposed to monitor PM_{2.5} in key areas such as the Beijing-Tianjin-Hebei region, municipalities directly under the central government and provincial capital cities. In 2015, it was proposed that all prefecture-level cities carry out monitoring of PM_{2.5}. The Chinese government had always been committed to promoting energy conservation and emission reduction, and had formulated corresponding measures. In 2020, China announced to the world the national goal of reaching a carbon peak by 2030 and striving to be carbon neutral by 2060. In addition, another factor contributing to the high incidence of lung cancer is indoor air pollution, including soot from household burning, heating or cooking. This might explain why the incidence of lung cancer among non-smoking East Asian women, including China and South Korea, remain high, especially between the ages of 40-59 [19–20].

Lung cancer is one of the malignant tumors with the worst prognosis. Lung cancer often were initially asymptomatic and typically discovered at advanced stages. People pay more and more attention to the early screening of lung cancer. A number of studies in Europe and America had shown that low-dose computed tomography (LDCT) scanning for high-risk individuals can help early detection of cancer [21, 22]. The National Comprehensive Cancer Network (NCCN), European Society of Radiology (ESR)/ European Respiratory Society (ERS), and the National Cancer Center of China had successively issued guidelines for lung cancer screening, and recommend risk assessments for people with smoking history, radon exposure, cancer history, family history of lung cancer in first-degree relatives and disease history (COPD or pulmonary fibrosis). Lung cancer screening agency experts recommend low-dose CT examinations for high-risk groups. Early diagnosis and early treatment can reduce the death rate of lung cancer [23–27]. This can explain why the incidence of lung cancer is higher in developed countries than in developing countries, and the mortality rate is lower.

Researches showed that the five-year survival rate of lung cancer in China was 18.6% in 2000, but increased to only 19.8% in 2010 [28–30]. In comparison, the five-year survival rate for lung cancer in Japan in 2010 was 32.9%, USA was 21.2% and South Korea was 25.1% [31]. The improvement of survival rate of lung cancer is not only related to cancer screening, but also to the medical level of the country and the pathological subtype of lung cancer. Lung cancer has traditionally been divided into two categories, non-small cell lung cancer (NSCLC) and small cell lung cancer, with the former accounting for about 85%. Lung adenocarcinoma is the most common pathological subtype [32]. Studies had shown that about 10-15% of NSCLC patients in Europe harbor the epidermal growth factor receptor (EGFR) gene mutation, and about 30-35% in Asia [33, 34]. About 60% of Asian, non-smoking female adenocarcinoma patients harbor the EGFR gene mutation [35, 36]. A series of studies had shown that patients with $\geq$ stage NSCLC harboring EGFR-sensitive mutations had significantly improved both progression-free survival (PFS) and overall survival (OS) using epidermal growth factor receptor-tyrosine kinase inhibitor (EGFR-TKI) compared with patients receiving standard

chemotherapy [37–39]. Squamous cell lung cancer is insensitive to chemotherapy and radiotherapy except surgery. Small cell lung cancer has the highest degree of malignancy and the worst prognosis, which is easy to recurrence and distant metastasis. These two pathological subtypes had little choice in the previous systemic treatment. However, in recent years, lung cancer had entered the era of immunotherapy. For specific populations, no matter which subtype of lung cancer is likely to benefit from immunotherapy [40–42]. All in all, no matter the advanced treatment methods, excellent medical environment or perfect medical insurance system, these may be beyond the reach of many developing countries or poor areas.

This study had some limitations. Firstly, the data of this study comes from public databases, which lack detailed data such as pathological subtypes, disease stages, and treatment processes. If they can be combined with trend analysis, it will have more value for public health and clinical practice. Second, the latest data for the last 10 years cannot be obtained from this database.

Conclusion

The burden of lung cancer is still heavy in the world, especially in developing countries. Tobacco remains the primary threat to human health. The effectiveness of tobacco control has initially shown, but we still need to continue to strengthen tobacco control efforts and determination. We need to further strengthen health education, improve the early cancer screening awareness and optimize medical conditions to curb the future lung cancer burden.

Abbreviations

ASIR: Age standardized incidence rate; ASMR: Age standardized mortality rate; IARC: International Agency for Research On Cancer; *CI5plus*: Cancer Incidence in Five Continents Time Trends; USA: the United States of America; WHO: World Health Organization; HDI: Human Development Index; UNDP: United Nations Population Division; AAPC: Annual average percent changes.

Declarations

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Author's contributions

Conception and design: Chao Li, Shaoyuan Lei, Xiaonan Wu, Yongqiang Zhang, Lin Li

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Manuscript writing: All authors

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Availability of data and materials

The datasets generated and/or analyzed during the current study are available in the GLOBOCAN repository.
[<https://gco.iarc.fr/>]

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Figures

Figure 1

Age-standardized incidence(ASIR) and mortality(ASMR) rates per 100,000 of populations for lung cancer in selected countries in 2020.(A) male; (B) female. Sources: The data was obtained from the GLOBOCAN database

Figure 2

Association between HDI and age-standardized incidence and mortality of lung cancer

Figure 3

Trends for age-standardized incidence of lung cancer (A) males (B) females between 2000 and 2012

Figure 4

Trends for age specific incidence of male lung cancer between 2000 and 2012. (A) 0-39 years; (B) 40-49 years; (C) 50-59 years; (D) 60-69 years; (E) 70-79 years; (F) ≥ 80 years.

Figure 5

Trends for age specific incidence of female lung cancer between 2000 and 2012. (A) 0-39 years; (B) 40-49 years; (C) 50-59 years; (D) 60-69 years; (E) 70-79 years; (F) ≥ 80 years.

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