Long-Term Changes in Premature Death of Lung Cancer in a Developed Region of China: A Population-Based Study From 1973 to 2019

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Research Article

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Abstract

Background: Lung cancer is a leading cause of deaths worldwide, and its incidence shows an upward trend. The study in the long-term changes in premature death of lung cancer in a developed region of China has a great exploratiory significance to further clarify the effectiveness of intervention measures.

Methods: Cancer death data were collected from the Mortality Registration System of Shanghai Pudong New Area (PNA). We analysed crude mortality rate (CMR), age-standardized mortality rate by Segi's world standard population (ASMRW), and years of life lost (YLL) of lung cancer from 1973 to 2019. Temporal trends of CMR, ASMRW, and rate of YLL were calculated by joinpoint regression expressed as an annual percent change (APC) with corresponding 95% confidence interval.

Results: 80,543,137 person-years were enrolled in this study in PNA from 1973 to 2019. There were 42,229 deaths in permanent residents from lung cancer. The CMR and ASMRW were $52.43/10^5$ person-years and $27.79/10^5$ person-years. YLL due to premature death from lung cancer was 481779.14 years, and the rate of YLL was $598.16/10^5$ person-years. The CMR, and rate of YLL for deaths had significantly increasing trends in males, females, and the total population ($P<0.001$). The CMR in the total population increased by 2.86% (95% CI=2.66%-3.07%, $P < 0.001$) per year during the study period. The YLL rate increased with an APCC of 2.21% (95% CI = 1.92% to 2.51%, $P < 0.001$) per year. The contribution rates of increased values of CMR caused by demographic factors were more evident than non-demographic factors.

Conclusion: The aging population, progress of treatment, smoking, and even environmental pollution may be the factors that affect the long-term changes in premature death of lung cancer in PNA from1973 to 2019. Our research can help us to understand the changes of lung cancer mortality, and our results could also be used for other similar cities in designing future prevention plans.

Background

Lung cancer is the leading cause of cancer deaths worldwide, with 2,206,771 new lung cancer cases and 1,796,144 deaths in 2020 [1]. Many studies showed tremendous effort in the discovery of potential biomarkers for the detection, classification and progression monitoring of lung cancer. The treatment of lung cancer has made great progress over the past decade. The study on the long-term changes of disease burden of lung cancer has great exploratiory significance to further clarify the epidemiological characteristics of lung cancer and improve the survival time of patients [2].

In the past decades, China has witnessed rapid economic development, and we have also experienced tremendous changes in population and epidemic[3]. Shanghai is an economic, science and technology, industrial, financial, and exhibition center, and is one of the earliest cities in China to enter the aging society. Shanghai is the representative city of modernization development in China. In the next 20 years, other cities in China and other low- and middle- income countries (LMICs) are likely to follow the development characteristics of Shanghai [4]. Shanghai Pudong New Area (PNA) officially began to develop in April 18, 1990. Since then, Pudong has become one of the areas with the fastest urbanization process and economic growth in China. Economic growth and total scale have shown the world the speed and height of Pudong development and opening up. Over the past 30 years, Pudong New Area has adhered to reform, expanded opening up and strengthened innovation. It has developed from a field into a modern urban area with concentrated elements, complete functions and advanced facilities. It has become the epitome of Shanghai's modernization and the symbol of China's reform and opening up[5–6].

Cancer is a kind of disease that seriously endangers people's health. In recent 10 years, cancer is a main cause of death in China [7]. How to treat cancer has become the most important research direction in the world to improve life expectancy [1]. Years of life lost (YLL) refers to the loss of life caused by early death. It can more accurately reflect the burden of the society. Studying the changes of premature death and the mortality differences of sub groups can be used to evaluate the effectiveness of intervention measures[8]. The incidence of lung cancer shows a significant upward trend[1]. Our research studied the long-term changes in premature death of lung cancer to define the public health, from 1973 to 2019 in PNA of Shanghai, China.

Methods

Data source

Cancer death data were collected from the Mortality Registration System of Shanghai PNA, including age, gender, and date and cause of death. The complete population data were provided by the Statistics Bureau and the Public Security Bureau of Shanghai Pudong New Area (http://www.pudong.gov.cn/shpd/InfoOpen/newTongJiList.aspx?CategoryNum=014004002002). Periodic evaluations, data cleaning, and compilation are performed to ensure the completeness of the registration system [5]. The per capita Gross Domestic Product (GDP) of Shanghai and Shanghai PNA were collected from Shanghai Municipal Bureau of Statistics (http://tjj.sh.gov.cn/) and Shanghai PNA Bureau of Statistics (http://www.pudong.gov.cn).

Deaths from malignant neoplasm of trachea (C33) and malignant neoplasm of bronchus and lung (C34) were classified by the underlying cause of lung cancer deaths according to the International Classification of Diseases 10th version (ICD-10)[9]. Since the data covered a long time span of 47 years, data before 1975, coded based on ICD-8, and data for 1975-2001, coded based onICD-9, were converted to the ICD-10 codes.

Causes of death were coded by rigorously trained clinicians, and each record was further verified by local Center for Disease Control and Prevention (CDC).

Statistical analyses

The crude mortality rates (CMR) and age-standardized mortality rates (ASMRW) by Segi’s world standard population of neurological disorders were calculated and shown as per 100,000 (/10^5). The CMR and ASMRW between genders were compared by the Poisson approximation method and Mantel-Haenszel test, respectively.

YLL was calculated according to the original method of Murray and Lopez [5]. The equation used to calculate YLL is presented below [10]:

$$YLL=KCe^{ra}/(r+\beta)^2 \square e^{-(r+\beta)(L+a)}[-(r+\beta)(L+a)-1]-e^{-(r+\beta)a}[-(r+\beta)a-1]\square+[(1-k)/r]*(1-e^{-rL}).$$

a: age at death

β: age weighting parameter (β = 0.04)

C: age weighting fit with constant (C = 0.1658)

r: discount rate (r = 3%)

L: standard life expectancy at the age of death according to the standard reference life table for the GBD study

e: Napier's constant

The calculation of YLL was performed using the WHO template [11].

Temporal trends of CMR, ASMRW, and rate of YLL were calculated using Joinpoint Regression Program 4.3.1.0 (National Cancer Institute, Bethesda, MD, USA) and expressed as an annual percent change (APC) with corresponding 95% confidence interval (95% CI). Z test was employed to assess whether the APC was statistically different from zero. Terms of "increase" or "decrease" were used to describe statistically significant (P<0.05) APC, while "stable" was used for not statistically significant trends.

Age was classified into eights groups: 0-4 years, 5-14 year, 15-29 years, 30-44 years, 45-59 years, 60-69 years, 70-79 years, and 80+ years. Age-specific CMRs were calculated for each age group. The change of mortality rates of each period in 5 years from 1973 to 2019, compared with or the period before it or the data during 1973-1979 , caused by demographic and non-demographic factors were estimated by the decomposition method, in which mortality rates were calculated and compared for each five-year age group, from 0-4 to 85+ years[12]. All statistical analyses were conducted using SPSS 21.0 (SPSS, Inc., Chicago, IL) and R (version 3.4.3). P value of <0.05 was considered as statistically significant.

Results

Baseline Characteristics of Underlying Death from Lung Cancer

From 1973 to 2019, all registered permanent residents in PNA, with a total of 80,543,137 person-years, were enrolled in this study. There were 42,229 deaths in permanent residents from lung cancer. Of them, 30,638 (72.55%) were men. The median age at death from lung cancer was 72.10 years old, and the average age at death was 70.96 ± 11.21 years old. The CMR and ASMRW of lung cancer were 52.43/10^5 person-years and 27.79/10^5 person-years, respectively. The CMR and ASMRW were 77.04/10^5 person-years and 44.27/10^5 person-years in males, while the corresponding rates were 28.43/10^5 person-years and 13.77/10^5 person-years in females (Table 1).

Age-specific Mortality of Lung Cancer

The crude mortality rates in the age groups of 0-4 years, 5-14 year, 15-29 years, 30-44 years, 45-59 years, 60-69 years, 70-79 years, and ≥80 years were 0.09, 0.02, 0.36, 4.26, 35.97, 132.70, 302.76, and 372.98/10^5 person-years, respectively (Table 2).

Burden of Premature Death from Lung Cancer

During 1973-2019, the YLL due to premature death from lung cancer was 481779.14 years, and the rate of YLL was $598.16/10^5$ person-years. YLL and rates of YLL in males (343728.73 years, $864.30/10^5$) were higher than those in females (138050.40 years, $338.58/10^5$) (Table 1). In term of age, the top three in YLL were in the age groups of 60-69 years, 70-79 years, and 45-59 years, which were 159523.69, 134731.32, and 119690.09 years, respectively. The top three age groups in the rates of YLL were 70-79 years, 80+ years, and 60-69 years, which were $2785.91/10^5$, $1975.87/10^5$, and $1837.34/10^5$, respectively (Table 2).

Trends of Mortality and YLL of Lung Cancer

The temporal trends in CMR, ASMRW, and rate of YLL were expressed based on the modeled CMR, ASMRW, and rate of YLL and shown in Figure 1. The CMR, and rate of YLL for deaths from lung cancer showed significantly increasing trends in males, females, and the total population during 1973-2019 (all P<0.001). The ASMRW for deaths was decreased in males by 0.72% (95% CI=-1.05% to -0.40%, P < 0.001) per year, while ASMRW in females and the total population during 1973-2019 were not statistically significant (P=0.23 and 0.18 respectively). The CMR of lung cancer in the total population increased by 2.86% (95% CI=2.66%-3.07%, P < 0.001) per year during the study period. The YLL rate increased with an APCC of 2.21% (95% CI = 1.92% to 2.51%, P < 0.001) per year from 1973 to 2019 (Figure 1A, 1B).

In terms of age-specific mortality and YLL, CMR and ASMRW of the total population had showed from 1973 to 2019 (Figure 1C, 1D). The increasing trends of CMR were also seen in the age groups of 70-79 years (P=0.007), and 80+ years (P < 0.001). The age groups of 30-44 years, 45-59 years, and 60-69 years had the statistically decreasing trends in CMR of lung cancer (P < 0.001). The rate of YLL increased by 8.24% (95% CI =2.83%-13.94%, P =0.005) per year in the age group of 80+ years, 0.03% (95% CI =-0.44%-0.50%, P =0.09) per year in the age group of 70-79 years. However, the rate of YLL decreased by 1.51% (95% CI = -2.51%- -0.05%, P =0.001) per year in the age group of 30-44 years, 1.27% (95% CI = -1.72%- -0.83%, P < 0.001) per year in the age group of 45-59years, and 1.46% (95% CI = -1.84%- -1.09%, P < 0.001) per year in the age group of 60-69 years, respectively (Figure 1C, 1D) .

Quantitatively Impacts of Demographic and Non-demographic Factors on Increased Rates in CMR

The trends of increased rates in CMR caused by non-demographic and demographic factors are shown in Figure 2. Based on the CMR of lung cancer in 1973-1979, no statistically significant trend was found caused by non-demographic factors in the total population, with an APC of 0.17% (95% CI =-11.34%-13.16%, P =0.97) from 1980 to 2019but a significant upward trend was also observed in the increased rate caused by demographic factors [APC (95% CI) = 51.70% (35.48%- 69.88%), P < 0.001]. In males, the increased rate caused by non-demographic factors decreased by 32.96% (95% CI = -51.68%- -6.99%, P = 0.02) during 1980-2019, and the rate caused by demographic factors increased by 46.42% (95% CI = 32.23%-62.03%, P < 0.001). In females, the increased rate caused by non-demographic factors showed an upward trend with an APC of 24.24% (95% CI = 2.60%-50.44%, P = 0.03), and the rate caused by demographic factors also increased [APC (95% CI) = 55.63% (38.54%-74.83%), P < 0.001] (Table 3). Figure 2B-D shown the proportion of increased values of CMR caused by non-demographic and demographic factors. From 1985 to 2019, demographic factors played a decisive role in the contribution rate of CMR compared to 1973-1979.

Discussion

It is crucial to understand long-term changes in premature death of lung cancer for the society and medical treatment to formulate future preventive measures. Reducing the premature mortality rate of non-communicable diseases by 30% has been set as the goal of “Healthy China 2030” [13]. Since 2000, many cities in China have gradually entered the aging society, and Shanghai is the first one entering the aging society. In recent years, the aging of Shanghai has not been alleviated, but gradually increased. Since 2018, PNA as a miniature of Shanghai has already entered the super aging society with a proportion of over 20% (Figure S2). We concluded that the increasing trends of CMR were seen in the age groups of 70–79 years ($P = 0.007$), and 80 + years ($P < 0.001$) in terms of age-specific mortality and burden. The rate of YLL increased by 8.24% (95% CI = 2.83%-13.94%, $P = 0.005$) per year in the age group of 80 + years, 0.03% (95% CI =-0.44%-0.50%, $P = 0.09$) per year in the age group of 70–79 years. The proportion of individuals aged 70–79 years Figure S1 was almost the largest since 1995. While The age groups of under 70 years had the statistically decreasing trends in CMR of lung cancer ($P < 0.001$). It can be seen that aging is mainly contributed to an increase in the mortality of lung cancer.

Economic development such as increased GDP improves public health in general. However, some factors related to the developed economy, such as lifestyle factors,environmental and medical level may also change the mortality rate. Smoking-attributable deaths have increased by 20.1% (15.3–25.2) since 1990 globally, with most deaths occurring in China[14].In China, smoking has either peaked or continues to increase[15]. According to our statistics over the past 50 years, The YLL rate increased with an AAPC of 2.21% per year from 1973 to 2019, and this may be closely related to the increase of smoking rate. The YLL rate of male is higher than that of female in Fig. 1, which is consistent with the difference of smoking proportion between male and female.

Outdoor air pollution exposure is one of the clear carcinogens to human in lung cancer[16]. For decades, after rapid industrialization and urbanization, air pollution in china is getting worse [17]. As one of the top ten death risk factors, air pollution has significantly affected the health of Chinese people [14]. Several large cohorts confirmed that the PM2.5 concentration in the environment was associated with the risk of lung adenocarcinoma of non-smokers and the mortality of lung cancer of lifelong non-smokers [16, 18]. When the development of Pudong New Area started in 1990, the secondary industry accounted for more than three quarters, and the tertiary industry accounted for only 20% of the GDP of PNA. In 2018, the status of the secondary and tertiary industries has been reversed, and the proportion of the tertiary industry has exceeded three quarters of PNA GDP. However, the development of secondary industry cannot avoid air and environmental pollution. A long-period comparative analysis of air pollution in Shanghai analyzed the continuous Morlet wavelet transform on the time series of a 5274-day air pollution index from 2000. The monthly variation in air pollution in Shanghai was not significant, Air pollution in Shanghai showed an ascending tendency, but the situation has reversed since 2015[19]. It can be seen that in the past 50 years, especially before 2015, air pollution in PNA has led to an increase trends in years of life lost due to premature death in people with lung cancer in Shanghai.

The initial treatment of lung cancer was relatively simple, including surgery, chemotherapy and radiotherapy. In the early 2000s, driving genes were found in lung cancer. In this field, molecular detection is the basic method to guide and individualize treatment selection tools. Epidermal growth factor receptor (EGFR) tyrosine kinase inhibitors (TKIs) is a small molecule targeted drug widely used in advanced non-small cell lung cancer (NSCLC). Its effectiveness can be shown in symptom improvement, lesion control and prolongation of progression free survival (PFS). Women and non-smoking patients are the dominant groups in TKI treatment [20]. The introduction of immune checkpoint inhibitors in 2015 was an important milestone in the treatment of lung cancer.

Immunotherapy has been proved to have long-lasting positive effect on patients with NSCLC, and was rapidly upgraded to first-line treatment after the success of second-line and back-line treatment[21–24]. Since 2003, lung cancer targeted drugs, such as gefitinib, erlotinib, oxitinib, have entered the scope of Shanghai medical insurance, and are widely used in the treatment of lung cancer patients. After that, immunotherapy and antiangiogenic drugs were also gradually used in Shanghai. The diversity of drug selection, the individualization and accuracy of treatment schemes directly affect the survival of lung cancer patients. This may explain why the YLL rate had shown a downward trend with an AAPC of the total population after 2005 compared with that before 2005. We found that, except for patients over 80 years old, the rate of CMR and YLL decreased after 2000 in almost all age groups. The changes of these data are related to the rapid development of tumor targeted therapy and immunotherapy in the past 20 years.

This study has major strengths including a large population size (over 8.0 million) and a relative long-time span (47 years). There were several limitations of the current study. First, all our data were from a single district, although this district is the largest one in Shanghai. Second, there is no data on lifestyle, histological type and disease history in our study, so it is impossible to determine the role of each risk factor that may lead to changes in lung cancer mortality [25]. Nonetheless, our study was based on complete and accurate public data over four decades from the government surveillance system, and high data quality is assured.

Conclusion

This study reported the long-term changes in premature death of lung cancer in a developed region of China from 1973 to 2019. The aging population, the progress of treatment, smoking, and even environmental pollution may be the factors that affect the mortality of lung cancer. Our research could also be used for other similar cities in designing future prevention plans.

Abbreviations

LMICs: low- and middle- income countries

GDP : Gross Domestic Product

APC: annual percent change;

ASDR：age-standardized death rate;

ASMRW: age-standardized mortality rate by Segi’s world standard population;

CDC: Center for Disease Control and Prevention;

CMR: crude mortality rate;

95% CI: 95% confidence interval;

95% UI: 95% uncertainty interval;

GBD：Global Burden of Disease;

ICD-9：International Classification of Diseases 9th version;

ICD-10: International Classification of Diseases 10th version;

PNA: Pudong New Area;

YLL: years of life lost

SCLC: small cell lung cancer

NSCLC: non-small cell lung cancer

EGFR: epidermal growth factor receptor

PFS: progression-free survival

Declarations

Ethics approval and consent to participate

Our study did not involve any intervention in human participants. The surveillance protocol was approved by the ethical committee of Shanghai Pudong New Area Center for Disease Control and Prevention. Strict confidentiality of individual data was practiced during the entire study.

Availability of data and materials

The data that support the findings of this study are available from Center for Disease Control and Prevention of the Pudong New Area, Shanghai but restrictions apply to the availability of these data, which were used under license for the current study, therefore are not publicly available. Data are however available from the authors upon reasonable request and with permission of Center for Disease Control and Prevention of the Pudong New Area.

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Author's Contribution

WY, WL and XL drafted the manuscript. XL, WY, YD and YC participated in the collection, analysis and interpretation of data. YC, YD, WY, GZ, LW, CX and XL contributed to data collection and suggestion for analysis. LY, YC and XL conceived the study, and participated in its design and coordination and critically revised the manuscript. All authors read and approved the final manuscript.

Consent for Publication

The study was approved for publication by all authors.

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Tables

Table 1. Baseline characteristics of deaths, 1973-2019

Characteristic	Deaths (N, %)	Age at years (Mean ± SD)	Age at years (Median)	CMR (/10^5)	ASMRW (/10^5)	YLL (years)	YLL rate (/10^5)
Gender							
Male	30638 (72.55)	70.54 ± 10.74	71.56	77.04	44.27	343728.73	864.30
Female	11591 (27.45)	72.08 ± 12.30	73.73	28.43	13.77	138050.40	338.58
Period							
1973–1979	929(2.20)	64.88 ± 10.31	66.38	21.57	23.40	12915.91	299.88
1980–1984	969(2.29)	65.75 ± 11.14	67.08	29.29	28.79	13006.25	393.17
1985–1989	969(2.29)	66.47 ± 10.98	67.48	31.51	28.45	12711.93	413.33
1990–1994	1890(4.48)	67.24 ± 10.42	68.18	40.02	31.10	24095.98	510.23
1995–1999	4797(11.36)	68.32 ± 10.70	69.77	43.16	30.70	59014.12	530.92
2000–2004	6363(15.07)	69.73 ± 11.10	71.43	52.98	31.23	74513.88	620.42
2005–2009	7595(17.99)	71.22 ± 11.33	73.46	57.88	27.68	84179.23	641.55
2010–2014	8832(20.91)	71.66 ± 11.47	73.34	63.10	26.28	96872.05	692.14
2015–2019	9885(23.41)	72.65 ± 10.85	72.62	66.40	24.02	104535.93	702.19
Total	42229 (100.00)	70.96 ± 11.21	72.10	52.43	27.79	481779.14	598.16

Notes: ASMRW, age-standardized mortality rate by Segi's world standard population; CMR, crude mortality rate; YLL, years of life lost.

Table 2. Number of deaths, CMR, YLLs and rates of YLL, 1973-2019

Age group(years)	Deaths (N)	Proportion (%)	CMR (/10^5)	YLL (years)	YLL rate (/10^5)
0–4	3	0.01	0.09	90.93	2.61
5–14	1	0.00	0.02	58.54	0.73
15–29	57	0.13	0.36	1543.65	9.62
30–44	826	1.96	4.26	19559.72	100.95
45–59	6385	15.12	35.97	119690.09	674.25
60–69	11521	27.28	132.70	159523.69	1837.34
70–79	14642	34.67	302.76	134731.32	2785.91
≥ 80	8793	20.82	372.98	46581.20	1975.87
Total	42229	100.00	52.43	481779.14	598.16

Notes: CMR, crude mortality rate; YLL, years of life lost.

Table 3. The increased rates caused by demographic and non-demographic factors and their contribution rates during the period from 1973 to 2019 compared with the CMR of lung cancer during 1973-1979 or the period before it in Shanghai PNA.

	CMR of the based period	CMR of the other period	D-value of Mortality	Impact of demographic factors		Impact of non-demographic factors	
	(/100000)	(/100000)	(/100000)	added value (/100000)	Contribution rate (%)	added value (/100000)	Contribution rate (%)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Panel A (based on the first period)							
1980–1984 vs.1973–1979	21.57	29.29	7.72	2.00	0.26	5.73	0.74
1985–1989 vs.1973–1979	21.57	31.51	9.94	4.11	0.41	5.83	0.59
1990–1994 vs.1973–1979	21.57	40.02	18.45	10.20	0.55	8.25	0.45
1995–1999 vs.1973–1979	21.57	43.16	21.59	12.70	0.59	8.89	0.41
2000–2004 vs.1973–1979	21.57	52.98	31.41	19.86	0.63	11.55	0.37
2005–2009 vs.1973–1979	21.57	57.88	36.31	27.45	0.76	8.87	0.24
2010–2014 vs.1973–1979	21.57	63.10	41.53	34.10	0.82	7.43	0.18
2015–2019 vs.1973–1979	21.57	66.40	44.83	40.24	0.90	4.59	0.10
Panel B (based on the last period)							

Notes: CMR, crude mortality rate; PNA, Pudong New Area.

	CMR of the based period	CMR of the other period	D-value of Mortality	Impact of demographic factors		Impact of non-demographic factors	
1980–1984 vs.1973–1979	21.57	29.29	7.72	2.00	0.26	5.73	0.74
1985–1989 vs.1980–1984	29.29	31.51	2.22	2.66	1.14	-0.44	0.14
1990–1994 vs.1985–1989	31.51	40.02	8.51	7.61	0.89	0.91	0.11
1995–1999 vs.1990–1994	40.02	43.16	3.14	2.72	0.87	0.41	0.13
2000–2004 vs.1995–1999	43.16	52.98	9.82	8.13	0.83	1.69	0.17
2005–2009 vs.2000–2004	52.98	57.88	4.90	10.12	1.34	-5.21	0.34
2010–2014 vs.2005–2009	57.88	63.10	5.22	7.86	1.25	-2.64	0.25
2015–2019 vs.2010–2014	63.10	66.40	3.30	7.80	1.14	-4.50	0.37

Notes: CMR, crude mortality rate; PNA, Pudong New Area.

Figures

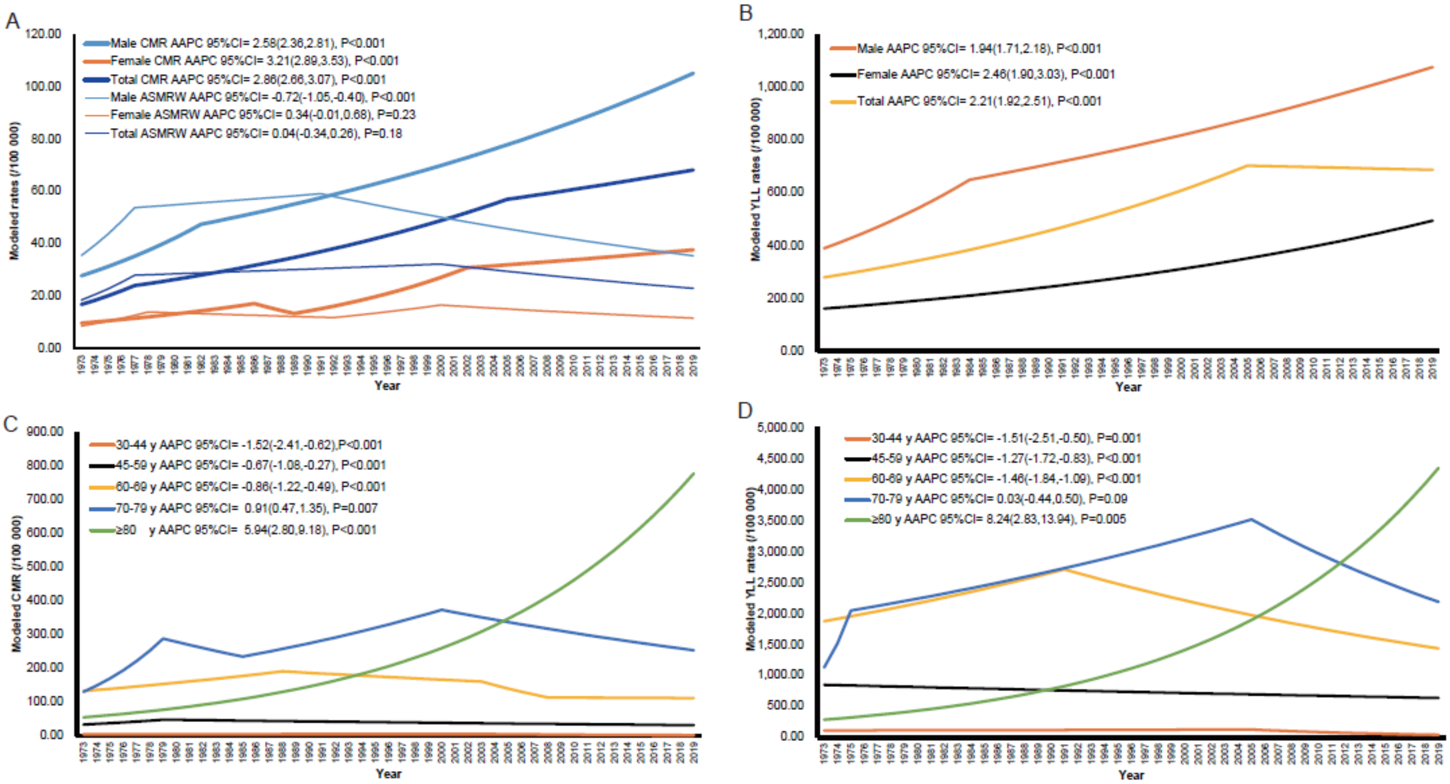

Figure 1

The temporal trends in CMR, ASMRW, and rate of YLL were expressed based on the modeled CMR, ASMRW, and rate of YLL and shown in Figure 1. The CMR, and rate of YLL for deaths from lung cancer showed significantly increasing trends in males, females, and the total population during 1973-2019 (all P<0.001). The ASMRW for deaths was decreased in males by 0.72% (95% CI=-1.05% to -0.40%, P < 0.001) per year, while ASMRW in females and the total population during 1973-2019 were not statistically significant (P=0.23 and 0.18 respectively). The CMR of lung cancer in the total population increased by 2.86% (95% CI=2.66%-3.07%, P < 0.001) per year during the study period. The YLL rate increased with an APCC of 2.21% (95% CI = 1.92% to 2.51%, P < 0.001) per year from 1973 to 2019 (Figure 1A, 1B). In terms of age-specific mortality and YLL, CMR and ASMRW of the total population had showed from 1973 to 2019 (Figure 1C, 1D). The increasing trends of CMR were also seen in the age groups of 70-79 years (P=0.007), and 80+ years (P < 0.001). The age groups of 30-44 years, 45-59 years, and 60-69 years had the statistically decreasing trends in CMR of lung cancer (P < 0.001). The rate of YLL increased by 8.24% (95% CI =2.83%-13.94%, P =0.005) per year in the age group of 80+ years, 0.03% (95% CI =-0.44%-0.50%, P =0.09) per year in the age group of 70-79 years. However, the rate of YLL decreased by 1.51% (95% CI = -2.51%- -0.05%, P =0.001) per year in the age group of 30-44 years, 1.27% (95% CI = -1.72%- -0.83%, P < 0.001) per year in the age group of 45-59years, and 1.46% (95% CI = -1.84%- -1.09%, P < 0.001) per year in the age group of 60-69 years, respectively (Figure 1C, 1D) .

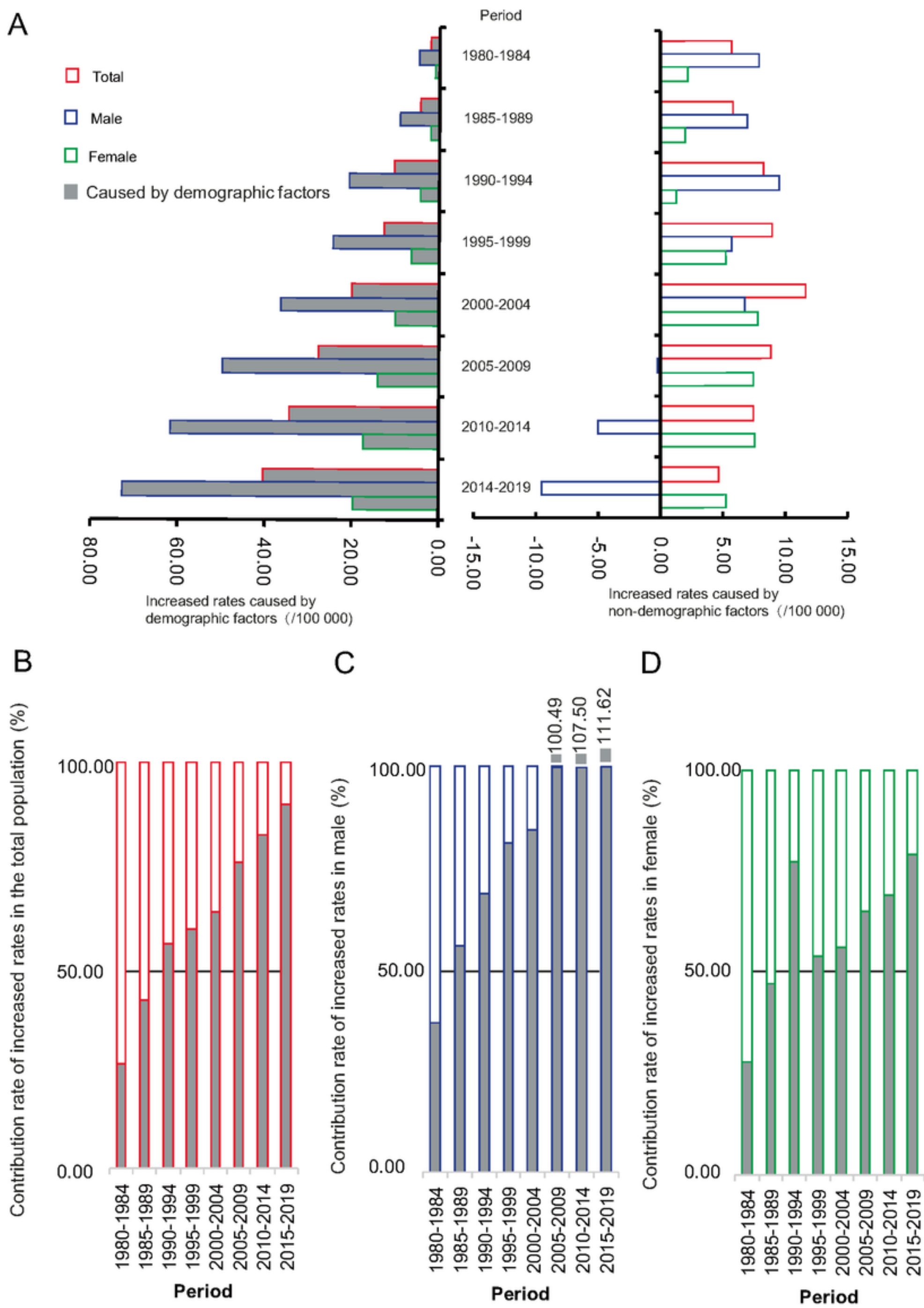

Figure 2

The trends of increased rates in CMR caused by non-demographic and demographic factors are shown in Figure 2. Based on the CMR of lung cancer in 1973-1979, no statistically significant trend was found caused by non-demographic factors in the total population, with an APC of 0.17% (95% CI =-11.34%-13.16%, P =0.97) from 1980 to 2019but a significant upward trend was also observed in the increased rate caused by demographic factors [APC (95% CI) = 51.70% (35.48%- 69.88%), P < 0.001]. In males, the increased rate caused by non-demographic factors decreased by 32.96% (95% CI = -51.68%- -6.99%, P = 0.02) during 1980-2019, and the rate caused by demographic factors increased by 46.42% (95% CI = 32.23%-62.03%, P < 0.001). In females, the increased rate caused by non-demographic factors showed an upward trend with an APC of 24.24% (95% CI = 2.60%-50.44%, P

= 0.03), and the rate caused by demographic factors also increased [APC (95% CI) = 55.63% (38.54%-74.83%), P < 0.001] (Table 3). Figure 2B-D shown the proportion of increased values of CMR caused by non-demographic and demographic factors. From 1985 to 2019, demographic factors played a decisive role in the contribution rate of CMR compared to 1973-1979.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFigureS1.pdf
- SupplementaryFigureS2.pdf
- Supplementary.docx