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ORIGINAL RESEARCH

Trend Analysis of Lung Cancer Incidence and Mortality in Xiamen (2011-2020)

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Objective: To analyze the trends of lung cancer incidence and mortality in Xiamen from 2011 to 2020 and provide some clues for the lung cancer prevention and control.

Methods: The data was obtained from the Xiamen City Cancer Register in Fujian Province, China. The data was updated on Sep 30, 2023. The codes of C33-C34 were used to identify the lung cancer. The newly diagnosed lung cancer patients during the period of 2011–2020 in Xiamen City were included in the evaluation of incidence and mortality and Cox analysis.

Results: A total of 11408 lung cancer patients were enrolled. The crude incidence rate was 52.78 per 100000 and the age-standardized incidence rate (ASIWR) was 40.67 per 100000 from 2011 to 2020. Both the crude incidence rate of lung cancer (AAPC =5.92, *P* value <0.001) and ASIWR (AAPC = 4.93, *P* value <0.001) showed increasing trends. The crude incidence rate in female increased 4.90 times faster as that in male (AAPC: 12.34/2.52). The crude mortality rate and the age-standardized mortality rate (ASMWR) were 37.25 per 100000 and 28.30 per100000. The 5-year age-standardized relative survival rate (ARS) was 18.62% (95% CI: 17.63–19.67%). The 5-year ARS was higher in women than men (26.35% vs 15.28%) and higher in urban than rural areas (21.44% vs 11.96%). Patients with lower education levels had significantly lower ARS than those with higher education (14.66% vs 31.53%). The 5-year ARS improved notably from 2016–2020 compared to 2011–2015 (22.23% vs 13.21%). Farmers had the lowest ARS among occupations [13.34% (95% CI:11.93–14.92%)]. There were all increasing trends in 1-year, 3-year, 5-year, and 10-year ARS rates between 2011 and 2020 (all *P* values of AAPC<0.05).

Conclusion: Lung cancer incidence in Xiamen increased, while mortality decreased with improved survival. Developing more perfect need to consider the differences in the social environment and other factors.

Keywords: lung cancer, incidence, mortality, trend, survival analyze

Introduction

Lung cancer is a highly aggressive and widespread cancer that poses a severe threat to people's health and safety.[1] Lung cancer was the cancer with the highest incidence and mortality in 2022, responsible for almost 2.5 million new cases and 1.8 million deaths.[2] According to the 2023 Cancer Report in the United States, Lung cancer ranked second in new cases of cancer in the United States. Despite improvements in the survival rate of lung cancer patients, it remains the leading cause of cancer-related deaths and poses the greatest threat to people's health.[3] Lung cancer also has a high incidence and mortality in developed countries like Japan, South Korea and Europe.[1,4] In China, Lung cancer has long been the leading cause of cancer death and the first incidence in males. In 2022, lung cancer surpassed breast cancer as the most diagnosed cancer among women in China, and it ranked first in the ranking of cancer incidence and mortality among both men and women in Chinese population.[5] Due to economic development and an increasing aging population, the disease burden caused by lung cancer is projected to rise, making the prevention and control of the disease a challenging situation.

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The incidence and mortality of lung cancer may vary depending on the level of economic development and the living habits of people in different provinces and cities in China.[6] Therefore, it is essential to implement lung cancer prevention and control measures according to the specific situation of each province and city. Xiamen is a city located on the east coast of Fujian Province, China. The city has a mild and rainy climate and a relatively developed economy. This study aims to analyze the trend of lung cancer incidence and mortality in Xiamen from 2011 to 2020. The findings of this study will provide evidence for the prevention and control of lung cancer in Xiamen. It will also provide some clues for the prevention and control of lung cancer in other cities along the east coast of China.

Materials and Methods

Study Population and Data Collection

All patients of lung cancer newly diagnosed during the period of 2011–2020 in Xiamen city were included in the evaluation of incidence and mortality and Cox analysis. The period survival analysis also included alive patients of lung cancer diagnosed before 2011. The codes of C33-C34 were used to identify the lung cancer in terms of the tenth version of International Classification of Diseases (ICD-10). The case data was obtained from Xiamen City Cancer Register in Fujian Province, China. The population-based Xiamen City Cancer Register was established in 2009 and covered all census registers of the whole city including four urban districts and two rural districts from 2010. The survival status of patients was followed up with both passive and active methods by Registry staff each year. The data in our study was updated on Sep 30, 2023. Registry staff anonymized the records before we received them.

The evaluation criteria for data quality included the percentage of cases diagnosed based on death certification only (DCO%), the proportion of morphological verification (MV%), and the mortality-to-incidence ratio (M/I). The DCO%, MV%, and M/I of lung cancer in this study were 2.53% (289/11,408), 74.50% (8499/11,408), and 70.58% (8052/11,408), meeting all quality specification. The study was approved by the ethics committee of Xiamen City Center for Disease Control and Prevention (XJK/LLSC (2023)004).

Statistical Analysis

The Segi's population were used to calculate age standardized rates (ASR) of incidence and mortality. Period analysis was used to deal with the censored data. Survival rate in this study was assessed with observed survival rate, relative survival rate, and age-standardized relative survival rate (ARS). Abridged life tables were smoothed to complete life tables using the Elandt-Johnson model. OS was estimated using the life table method. *RS* was calculated as the ratio of the OS and the expected survival from the general population on basis of the Ederer II method. ARS was calculated with the standard weights according to the International Cancer Survival Standards (ICCS): 7% for 0–44 years, 12% for 45–54 years, 23% for 55–64 years, 29% for 65–74 years, and 29% for 75–99 years. The Cox regression analysis was used to evaluate the risk factors associating with lung cancer. The analyzed factors included age, gender, suburb, marital status, occupation, culture, diagnosis year. The trends of incidence or mortality rate or survival time year by year was appraised by the annual percent changes (APC) in time segments and the average annual percent changes (AAPC) across the entire study period using join point regression analysis program (version 5.0.2). The other analyses were performed using SAS version 9.4. A significance level of $P< 0.05$ was considered for all statistical tests.

Results

Incidence Trends in Different Gender and Different Suburb

A total of 11408 cases of lung cancer were registered between 1st January 2011 and 31st December 2020, with a crude incidence rate of 52.78 per 100000 population and an age-standardized incidence rate (ASIWR) of 40.67 per 100000 population. There was a higher incidence rate in male compared to female (ASIWR 56.89 per 100000 versus 26.08 per 100000), and a higher incidence rate in urban residents compared to rural residents (ASIWR 42.89 per 100000 versus 36.17 per 100000). There were increasing trends in both crude incidence rate of lung cancer (AAPC =5.92, 95%confidence interval [CI] [3.57, 8.32], *P* value <0.001) and ASIWR (AAPC = 4.93, 95% CI [3.24, 6.66], *P* value <0.001). The AAPCs of crude incidence rate and ASIWR all had significant increase trends in male, female, urban, and rural (showed in Table 1 and Figure 1). The crude incidence rate of lung cancer in female increased 4.90 times faster as that in male (AAPC: 12.34/2.52).

Table 1 The Incidence and Mortality and 5-Year Survival Rate in Different Gender and Suburb in Xiamen City from 2011 to 2020

variable	Incidence			Mortality			5-year Survival Rate		
	N	CR	ASR	N	CR	ASR	OS (95% CI)	RS (95% CI)	ARS (95% CI)
Year:									
2011	758	41.74	33.88	608	33.48	27.08	11.46(6.07–18.74)	12.78 (6.77–20.90)	9.71(5.39–17.50)
2012	813	43.11	34.36	602	31.92	25.93	12.78(7.86–18.95)	14.51 (8.92–21.52)	14.61(10.60–20.13)
2013	840	42.95	34.25	692	35.38	27.38	12.58(10.05–15.40)	14.08(11.25–17.24)	13.89(11.19–17.23)
2014	955	47.43	36.92	843	41.87	32.56	12.02(9.75–14.55)	13.45(10.91–16.28)	12.34 (9.96–15.28)
2015	1076	51.61	38.91	867	41.59	31.18	11.37(9.13–13.87)	12.76(10.25–15.57)	13.85(11.20–17.11)
2016	1099	51.19	38.63	857	39.92	29.91	13.59(11.22–16.19)	15.19(12.54–18.10)	16.00(13.16–19.46)
2017	1158	52.35	39.88	908	41.05	30.81	15.76(13.25–18.47)	17.50(14.71–20.50)	17.49(14.87–20.57)
2018	1280	55.05	42.52	905	38.92	29.69	16.09(13.59–18.77)	17.66(14.93–20.61)	16.41(13.97–19.28)
2019	1603	64.17	48.96	909	36.39	26.85	24.61(21.59–27.73)	26.70(23.43–30.09)	24.79(21.83–28.14)
2020	1826	68.23	50.91	861	32.17	23.17	34.19(30.88–37.53)	36.75(33.19–40.33)	33.42(30.30–36.86)
Gender:									
Male	7544	70.39	56.89	5891	54.97	44.16	13.92(12.94–14.92)	15.63(14.53–16.76)	15.28(14.18–16.47)
Female	3864	35.46	26.08	2161	19.83	14.00	26.06(24.01–28.16)	27.97(25.77–30.21)	26.35(24.31–28.57)
Suburb:									
Urban	8134	55.34	42.89	5512	37.50	28.55	19.98(18.80–21.19)	22.06(20.76–23.40)	21.44(20.18–22.78)
Rural	3864	35.46	36.17	2540	36.72	27.90	12.40(11.02–13.88)	13.59(12.07–15.20)	11.96(10.60–13.49)
Total	11408	52.78	40.67	8052	37.25	28.30	17.67(16.74–18.63)	19.50(18.47–20.55)	18.62(17.63–19.67)
AAPC (95% CI):									
Male	-	2.52*(1.75, 3.31)	1.50*(0.92, 2.09)	-	−0.73(−3.94, 2.57)	−1.86(−4.86, 1.24)	-	-	13.48*(7.17, 20.15)
Female	-	12.34*(8.77, 16.03)	12.21*(8.3, 16.26)	-	3.07#(−0.21, 6.46)	1.89#(−1.57, 5.47)	-	-	4.66(−5.65, 16.08)
Urban	-	4.63*(3.07, 6.21)	4.38*(2.34, 6.46)	-	−0.34#(−3.14, 2.54)	−1.49#(−4.49, 1.60)	-	-	14.34*(1.92, 28.26)
Rural	-	7.15*(5.03, 9.33)	5.71*(3.74, 7.73)	-	3.21*(1.20, 5.26)	0.70(−4.81, 6.53)	-	-	8.59*(2.14, 15.45)
Total	-	5.92*(3.57, 8.32)	4.93*(3.24, 6.66)	-	0.82#(−2.40, 4.14)	−1.30(−4.64, 2.16)	-	-	12.86*(3.43, 23.15)

Notes:*t* test was used to test whether the prevalence slope of AAPC/APC was zero.**P* values <0.05, the others *P* values of AAPC>0.05; # From 2011 to 2015, the APCs (annual percentage changes) of crude mortality rate in female, urban, total residents were 13.38 (95% CI:5.55–21.78, *P*=0.006), 9.37 (95% CI:2.69–16.48, *P*=0.015), 7.94 (95% CI:0.47–15.95, *P*=0.041), respectively. The APC of ASR in female was 11.03 (95% CI:2.87–19.85, *P*=0.017) from 2011 to 2015. The APCs of CR and ASR in urban were −7.48 (95% CI:[−11.51,-3.26], *P*=0.006), and −7.63 (95% CI[−11.98,-3.05], *P*=0.008) from 2015 to 2020. The other *P* values of APC among AAPC without * note > 0.05.

Abbreviations: CR, crude rate; ASR, age-standardized rate by world standard population (Segi's population); CI, confidence interval. OS, observed survival rate; RS, relative survival rate; ARS, age-standardized relative survival. AAPC, average annual percent change; CI, confidence interval.

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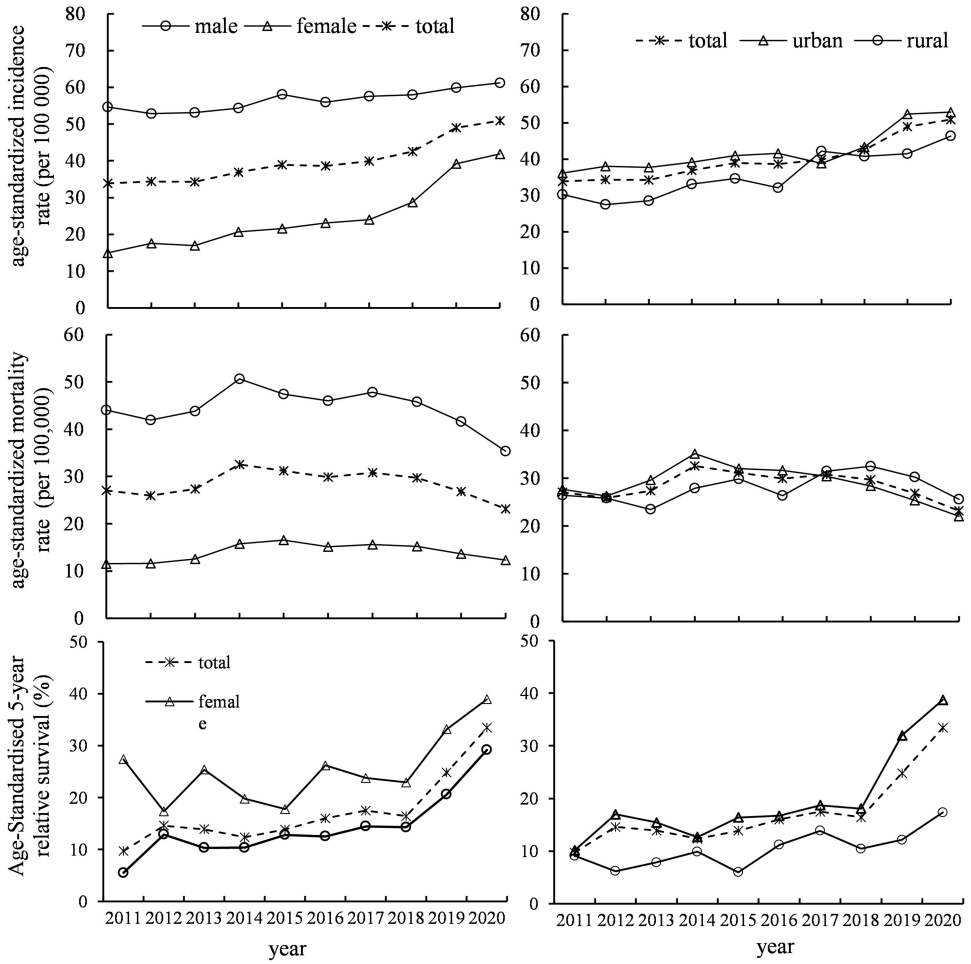

Figure 1 The age-standardized incidence, mortality, relative survival rates as time increase.

Mortality Trends in Different Gender and Different Suburb

Following up the patients until the end of Sep 30, 2023, there were 8052 dead patients with lung cancer including 7552 cases died of cancer and 500 cases not died of cancer. The crude mortality rate and the age-standardized mortality rate (ASMWR) were 37.25 per 100000 and 28.30 per 100000. There was a higher mortality rate in male compared to female (ASMWR 44.16 per 100000 versus 14.00 per 100000). The mortality rate in urban residents was similar to that in rural residents (ASMWR 28.55 per 100000 versus 27.90 per 100000).

The AAPCs of crude mortality rate and ASMWR were all not statistically significant in total residents and in different gender and in different suburb except the crude mortality rate in rural residents (AAPC =3.21, 95% CI [1.20, 5.26], *P* value =0.006). The crude mortality rate in total residents increased by 7.94% per year (APC= 7.94 (95% CI:0.47–15.95, *P* value=0.041) from 2011 to 2015. The APCs of crude mortality rate and ASMWR in female were 13.38 (95% CI:5.55–21.78, *P* value=0.006) and 11.03 (95% CI:2.87–19.85, *P* value=0.017) from 2011 to 2015. In urban, the crude mortality rate in urban increased by 9.37% per year (APC=9.37, 95% CI: [2.69,16.48], *P* value=0.015) from 2011–2015 but decreased by 7.48% per year (APC=−7.48, 95% CI: [−11.51, −3.26], *P* value=0.006) from 2015–2020. The ASMWR in urban also decreased year by year (APC=−7.63, 95% CI [−11.98, −3.05], *P* value=0.008) from 2015 to 2020.

The Survival Rate for Lung Cancer in Xiamen

As shown in Table 1, the 5-year observed survival rate, relative survival rate, and age-standardized relative survival rate (ARS) in Xiamen residents with lung cancer were 17.67% [95% CI: 16.74–18.63%], 19.50% (95% CI: 18.47–20.55%), and 18.62% (95% CI: 17.63–19.67%), respectively. The 5-year ARS rate in female [26.35% (95% CI: 24.31–28.57%)]

was 1.72 times as that in male [15.28% (95% CI:14.18–16.47%)]. The 5-year ARS rate in urban [21.44% (95% CI:20.18–22.78%)] was higher than that in rural [11.96% (95% CI:10.60–13.49%)]. Farmers with lung cancer had the lowest 5-year ARS [13.34% (95% CI:11.93–14.92%)] in different occupation. The 5-year ARS of those lung patients with Junior high school or below culture level [14.66% (95% CI:13.59–15.82%)] was only half that of those with higher education. The *RS* rate decreased with age. The rate in 0–44 years old patients was 2.08 times than that in above 75 years old [29.91% versus 9.71%]. The *RS* in female was always higher than that in male with all age groups. Figure 2 also showed that the ARS in urban was higher than that in rural in all survival time.

The 5-year ARS was much higher between 2016 and 2020 [22.23%(95% CI:20.89–23.67%)] comparing to that between 2011 and 2015 [13.21%(95% CI:11.85–14.74%). Table 2 showed that there were all increasing trends in 1-year, 3-year, 5-year, and 10-year ARS rates between 2011 and 2020 (all *P* values of AAPC>0.05). The AAPC increased with the survival time. 10-year ARS increased 4.05 times than 1-year ARS (AAPC:20.65/4.09). The 5-year ARS increased by 12.86% per year (AAPC =12.86, 95% CI [3.43, 23.15], *P* value =0.007). The AAPC of 5-year ARS had increase trends in male (AAPC =13.48, 95% CI [7.17, 20.15], *P* value =0.001) but without statistically significant trend in female (AAPC =4.66, 95% CI [−5.65, 16.08], *P* value >0.05). There were both increasing trend of the 5-year ARS in urban patients (AAPC =14.34, 95% CI [1.92, 28.26], *P* value =0.02) and in rural patients (AAPC =8.59, 95% CI: [2.14, 15.45], *P* value =0.01).

Results of Multivariate Cox Regression Analysis

There were overall 10753 cases in Cox analysis without 289 DCO cases and 369 cases with multisite tumor. Seven variables (age, gender, suburb, marital status, occupation, culture, diagnosis year), all had statistically significant by multivariate Cox analysis. There was higher dead risk of lung cancer in male than that in female (Hazard Ratio [HR]=1.610 [1.528–1.695],

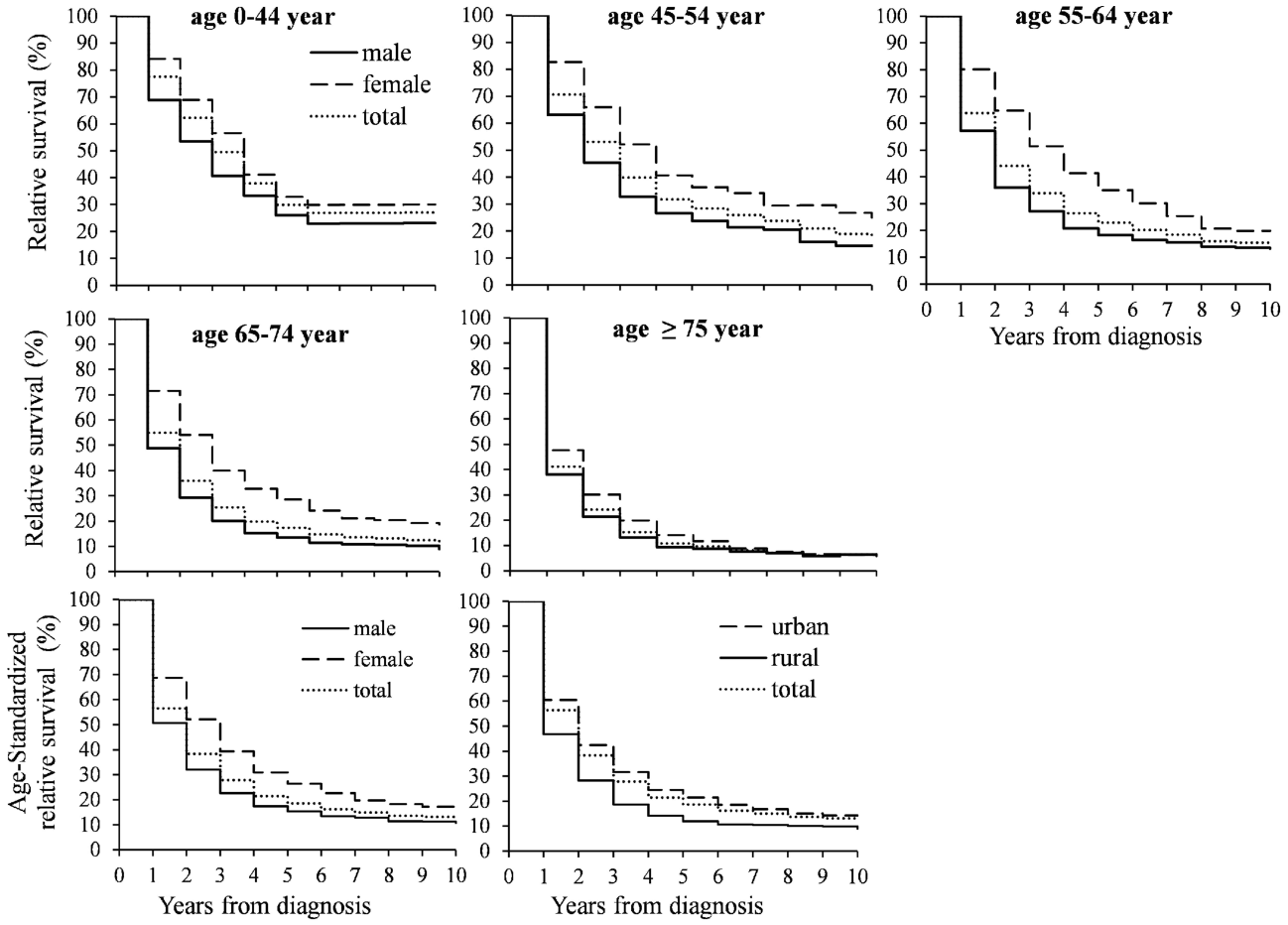

Figure 2 The relative survival rate and 5-year age-standardized relative survival rate in different age group, gender, and suburb as the survival year increase.

Table 2 The Age-Standardized Relative Survival Rates of Lung Cancer in Different Year in Xiamen City from 2011 to 2020

Survival year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	AAPC*(95% CI)
1	45.69	52.69	50.01	48.78	50.97	54.67	53.44	57.94	63.81	68.52	4.09(1.40, 6.86)
3	19.19	25.03	21.03	19.50	22.40	22.30	24.89	27.64	35.62	44.65	8.81(3.05, 14.88)
5	9.71	14.61	13.89	12.34	13.85	16.00	17.49	16.41	24.79	33.42	12.86(3.43, 23.15)
10	3.40	5.33	4.10	9.29	6.30	7.06	11.47	11.04	16.77	23.11	20.65(13.77, 27.94)

Notes:*t* test was used to test whether the prevalence slope of AAPC/APC was zero.*all *P* values <0.05.
Abbreviations: AAPC, average annual percent change; CI, confidence interval.

P<0.001). The death risk of lung cancer patients with 0–44 years old was lower than those with above 55-year-old age groups (HR=1.287[1.130–1.465] for 55–64 years old, HR=1.674[1.464–1.913] for 65–74 years old, HR=2.838[2.480, 3.247] for above 75 years old (all *P*<0.05). Lung cancer patients living in rural areas had a higher risk of death than those living in urban (HR=1.155[1.093–1.220], *P*<0.001). The death risk of farmer, retiree, and worker with lung cancer was 1.523 times (HR=1.523 [1.348, 1.722], *P*<0.001), 1.440 times (HR=1.440 [1.277, 1.623], *P*<0.001), and 1.419 times (HR=1.419 [1.240, 1.624], *P*<0.001) as that of officer, respectively. Compared to lung patients with High school, Higher Vocational school, or technical school culture level, the risk of death was higher in those with Junior high school or below culture level (HR=1.490 [1.392,1.595], *P*<0.001). The death risk of lung cancer in patients diagnosed between 2011 and 2015 was 1.468 times as those diagnosed between 2016 and 2020 (HR=1.468[1.401,1.537], *P*<0.001) (Table 3).

Table 3 Results of Multivariate Cox Regression Analysis

Variables	Total (n=10753,%)	5-Year ARS	Hazard Ratio	95% CI of HR	*P*-value
Age (years old):					
0–44	645(6.00)	29.91(24.22–35.80)*	1.000		
45–54	1591(14.80)	28.40(25.38–31.50)*	1.108	0.971–1.265	0.1283
55–64	2964(27.56)	22.92(20.91–24.99)*	1.287	1.130–1.465	0.0001
65–74	3052(28.38)	17.37(15.61–19.20)*	1.674	1.464–1.913	<0.0001
75+	2501(23.26)	9.71(8.10–11.50)*	2.838	2.480–3.247	<0.0001
Sex:					
Female	3637(33.82)	26.35(24.31–28.57)	1.000		
Male	7116(66.18)	15.28(14.18–16.47)	1.610	1.528–1.695	<0.0001
Suburb:					
Urban	7623(70.89)	21.44(20.18–22.78)	1.000		
Rural	3130(29.11)	11.96(10.60–13.49)	1.155	1.093–1.220	<0.0001
Marital status:					
Married	8359(77.74)	19.00(17.84–20.23)	1.000		
Single	166(1.54)	19.97(12.62–31.62)	1.054	0.868–1.279	0.5973
Separated, divorced, widowed	1510(14.04)	32.59(28.82–36.85)	0.928	0.867–0.994	0.0332
Unknown	718(6.68)	3.87(2.79–5.36)	1.582	1.455–1.721	<0.0001
Education level:					
High school, higher vocational school, or technical school	1894(17.61)	29.21(26.42–32.31)	1.000		
Junior high school or below	7542(70.14)	14.66(13.59–15.82)	1.490	1.392–1.595	<0.0001
College or above	1046(9.73)	31.53(27.63–35.99)	1.049	0.950–1.159	0.3425
Unknown	271(2.52)	9.45(7.01–12.73)	0.845	0.696–1.026	0.0884
Occupation:					
Officer	1059(9.85)	18.94(16.67–21.52)	1.000		
Farmer	4284(39.84)	13.34(11.93–14.92)	1.523	1.348–1.722	<0.0001
Retiree	3806(35.39)	21.32(19.37–23.47)	1.440	1.277–1.623	<0.0001
Worker	882(8.20)	23.93(20.33–28.18)	1.419	1.240–1.624	<0.0001
Other	722(6.71)	5.58(4.45–7.00)	1.998	1.739–2.295	<0.0001
Year of Diagnose:					
2016–2020	6631(61.67)	22.23(20.89–23.67)	1.000		
2011–2015	4122(38.33)	13.21(11.85–14.74)	1.468	1.401–1.537	<0.0001

Notes: These variables were all included in the multivariate Cox regression analysis without single factor analysis. *5-year relative survival time.
Abbreviations: ARS, age-standardized relative survival rate; CI, confidence interval. HR, hazard ratio.

Discussion

The incidence and mortality rates of lung cancer are the highest among all malignant tumors in Xiamen, making it the most common type of cancer in the area.[7] The study analyzed the incidence and mortality of lung cancer in Xiamen from 2011 to 2020 using the Xiamen cancer registration system. The results revealed that the age-standardized incidence rates of lung cancer in the female, male, urban, rural, and overall population of Xiamen have been gradually increasing over time. The ASIWR of lung cancer in Xiamen was 40.67 per 100,000 between 2011 and 2020. This rate is lower than the incidence rate in the United States from 2015 to 2019, which was 56.3 per 100,000.[8] However, it is higher than the overall incidence rate of lung cancer in 185 countries in 2020, which was 22.4 per 100,000.[9] In 2020, the ASIWR of lung cancer in Xiamen was 50.91 per 100,000. This rate is higher than the overall national level in 2020 and 2022 (34.8 and 40.78 per 100,000, respectively).[5] However, it is slightly lower than Haining city in Zhejiang province (69.57 per 100,000).[10] In comparison to other provinces, the rate in Xiamen was higher than Shandong (48.1 per 100,000)[11] and similar to Henan province (50.74 per 100,000).[12] The result revealed a relatively high incidence of lung cancer in Xiamen, highlighting the imperative to enhance efforts in the prevention and control of this disease.

The incidence of lung cancer in Xiamen was higher in urban areas and more common in males, consistent with national trends and other cities.[6,13–15] In Xiamen, the crude incidence rate of lung cancer was found to be approximately two times higher in males as compared to females. However, it is noteworthy that the increase rate of the crude incidence rate of lung cancer in females was significantly higher than that in males. The increase rate was found to be 4.9 times higher than that in males. With the development of the economy and the improvement of people's living standards, the rate of lung cancer in Xiamen has been influenced by various factors. These factors may not only be related to the high smoking rate but also higher adherence to the Western dietary pattern and environmental pollution (such as traffic and cooking).[16–20] In addition, the aging of the population, active physical examination, and the use of advanced equipment may contribute to an increase in lung cancer incidence. As the population continues to age and life expectancy increases, the social burden of lung cancer in Xiamen is expected to continue increasing. Therefore, it is important to further explore the reasons for the increase of lung cancer incidence in Xiamen residents, especially women, and to adjust the prevention and control strategies.

Our study showed that the crude mortality rate of lung cancer in Xiamen was 32.17 per 100,000 in 2020, and the ASMWR was 23.17 per 100,000. This was lower than the national ASMWR of lung cancer in 2022 (26.66 per 100,000),[5] but higher than the global death rate in 2020 (18.0 per 100,000).[9] The 5-year ARS of lung cancer patients in Xiamen in 2020 was 33.42%, which was higher than the 5-year ARS (25.4%) in Fujian province from 2019 to 2021.[21] Since 2015, the mortality rate of lung cancer in Xiamen has shown a downward trend. From 2011 to 2020, the 1-, 3-, 5-, and 10-year ARS of lung cancer in Xiamen have shown an upward trend, indicating significant improvements in the survival status of lung cancer patients. The Chinese government began to introduce the Cancer Screening, Early Diagnosis, and Early Treatment (SEDET) program in rural areas in 2005 and has since gradually expanded to urban areas, including lung cancer, which has made good progress.[22] The government's increased investment in public health resources and improvements in early detection rates bring hope to poor and high-risk groups, improving their survival status. In addition, advanced diagnostic equipment and improved treatment methods have also greatly enhanced the survival rate of lung cancer patients.[23]

The mortality rate of male lung cancer patients in Xiamen was significantly higher than that of female patients. The 5-year ARS of female lung cancer patients in Xiamen was 1.72 times higher than that of male patients. These indicated that the survival status of female lung cancer patients in Xiamen was better than that of male patients. Women generally have more active lifestyles than men, including less smoking, more fruit consumption, and less eating out. Furthermore, a significantly higher proportion of women than men have been moderately physically active after the age of 50 years.[24]

Our study showed that 5-year ARS of newly diagnosed lung cancer patients from 2016 to 2020 was higher than that of newly diagnosed patients from 2011 to 2015. This suggests that the efforts made in the prevention and control of lung cancer in Xiamen have had a positive impact. However, variations in the extent of improvement were observed across different demographic groups, with elderly individuals, those with lower levels of education, farmers, and rural residents experiencing comparatively fewer benefits from advanced diagnostic and treatment options. As with other cancers, the survival rate in lung cancer decreases progressively with increasing age.[25] Older adults tend to have coexisting diseases and poorer overall health. This may result in more severe side effects, which may lead clinicians to choose more cautious

treatment options or prescribe shorter treatment durations.[26,27] Residents with low educational levels, those engaged in farming or who live in rural areas tend to have relatively low socioeconomic status (SES).[28] This has a negative impact on the choice of lung cancer treatment options and the continuity of treatment, thus affecting the prognosis of lung cancer patients.[29] In addition, the smoking rate is higher in people with low SES, and 50–83% of lung cancer patients choose to continue smoking after diagnosis, which affects the quality of life and survival of patients.[30] Evidence suggests that smoking accelerates lung cancer progression and metastasis, with both direct and secondhand smoke implicated in promoting tumor initiation, invasion, and metastasis.[31] Moreover, for farmers, exposure to harmful environmental factors such as pesticides can also contribute to the initiation and metastasis of lung cancer.[32] Although China has strengthened cancer screening, early diagnosis, and treatment in rural areas, the high cost of lung cancer treatment (including non-treatment costs such as loss of work) may reduce the enthusiasm for screening and delay treatment among people with low SES. Therefore, the prevention and control of lung cancer are closely related to social and environmental factors. Xiamen municipal government should consider the differences across populations and formulate targeted prevention and control measures to help Xiamen residents obtain high-quality preventive health care and treatment services.

Our study analyzed the trend of incidence and mortality of lung cancer in Xiamen from 2011 to 2020 and explored the effect of age, gender, suburb, marital status, occupation, culture, and diagnosis year on the survival rate of lung cancer. This study provides a valuable reference for the precise prevention and control of lung cancer in Xiamen and southeast coastal cities of China. The data of this study came from the Xiamen Cancer Registry. Although the staff used both passive and active follow-up methods each year to ensure the accuracy of the data, statistical bias was inevitable like other studies. It may overestimate the survival rate. Additionally, this study was based on population-based surveillance data and lacked detailed exposure information, such as smoking status. In the future, we plan to collect more specific data on smoking, surgical treatment, radiotherapy, and chemotherapy to conduct more comprehensive survival analyses.

Conclusion

The incidence of lung cancer in Xiamen was relatively high and showed an increasing trend from 2011 to 2020. The incidence of lung cancer in women has increased significantly, and the social burden of lung cancer in Xiamen may continue to increase. The mortality of lung cancer in Xiamen showed a downward trend, and the 5-year ARS continued to improve. The prevention and control of lung cancer in Xiamen had achieved certain effects. Males, residents with low education levels, rural residents, and the elderly are the key groups for prevention and control. The prevention and control of lung cancer in Xiamen need to consider the differences in the social environment and other factors to develop more perfect prevention and control measures.

Data Sharing Statement

The datasets generated and/or analyzed during the current study are contained within the Xiamen City Center for Disease Control and Prevention Office, but are not publicly available due to confidentiality, security, and ownership matters. They may be available from the corresponding author upon reasonable request.

Ethical Approval and Consent to Participate

The study was approved by the ethics committee of Xiamen City Center for Disease Control and Prevention (XJK/LLSC (2023)004). The need of informed consent was waived by the ethics committee of Xiamen City Center due to retrospective and anonymous study design. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 helsinki declaration and its later amendments or comparable ethical standards.

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Disclosure

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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