

## ORIGINAL ARTICLE

**Lung cancer incidence and mortality in China, 2008**

Hongmei Zeng, Rongshou Zheng, Siwei Zhang, Jie He &amp; Wanqing Chen

National Office for Cancer Prevention and Control &amp; National Cancer Center, Beijing, China

**Keywords**

cancer epidemiology; cancer screening; lung cancer.

**Correspondence**

Wanqing Chen, National Office for Cancer Prevention and Control &amp; National Cancer Center, Beijing 100021, China.

Tel: +86 10 8778 7039

Fax: +86 10 67718227

Email: chenwq@cicams.ac.cn

Received: 20 June 2012;

accepted 26 June 2012.

doi: 10.1111/j.1759-7714.2012.00160.x

**Abstract****Background:** To provide cancer statistics to health planners, researchers, and the public, we reported the incidence and mortality data of lung cancer in 2008 in Chinese registration areas by age, sex, and geographic area.**Methods:** In 2011, 56 population-based cancer registries reported the lung cancer incidence and mortality data of 2008 to the Chinese National Central Cancer Registry. Forty-one registries' data met the national criteria. The crude incidence and mortality rates of lung cancer were calculated by age, gender, and area. Age-standardized rates were calculated using the Chinese and World populations.**Results:** The crude incidence rate for lung cancer was 54.75/100 000 (73.12/100 000 for male and 36.08/100 000 for female; 57.96/100 000 in urban and 42.80/100 000 in rural). Age-standardized rates by China population (CASR) and World population (WASR) for incidence were 24.98/100 000 and 34.07/100 000, respectively. The crude mortality rate for lung cancer was 46.07/100 000 (62.47/100 000 for male and 29.39/100 000 for female; 48.76/100 000 in urban and 36.03/100 000 in rural). The CASR and WASR for mortality were 20.09/100 000 and 27.68/100 000, respectively. Both for incidence and mortality, the rates for lung cancer were higher in males than in females, and in urban areas than in rural areas. The overall age-specific incidence and mortality rates showed that both rates were relatively low up to 35 years of age, but dramatically increased from such age, reaching a peak with subjects of 80–84 years old.**Conclusion:** The burden of lung cancer remains high in China, especially for males in urban areas. Effective intervention, such as smoking control, should be enhanced in the future.**Introduction**

Lung cancer has been the first leading cancer diagnosed and reported cause of cancer death in China for many years.<sup>1</sup> Recent reports also exhibit an increasing trend of the lung cancer burden.<sup>2</sup> Lung cancer is particularly prevalent in civil cities and in males. Cigarette smoking is an established risk factor of the disease. Accurate population-based statistics of lung cancer form the basis for policy makers and researchers for effective cancer prevention and control.

Population-based cancer registries play an important part in collecting and providing cancer data. In China, the first population-based cancer registry was created in 1958.<sup>3</sup> However, the development of cancer registries was limited in the 20<sup>th</sup> century. In 2002, the National Central Cancer Registry (NCCR) of China was established, acting as a federal bureau for systematic management of cancer surveillance.

The population-based registries from local areas around China routinely collect data on patient demographics, primary tumor site, and tumor morphology. Based on the increasing demand for updated cancer information, NCCR has published annual cancer statistics since 2006. In the present study, we reported the incidence and mortality of lung cancer in 41 Chinese population-base cancer registries of 2008, overall and by age group, sex, and geographic area. The updated results from this study will provide important policy suggestions and practical implications.

**Material and methods****Data source**

The NCCR of China was responsible for cancer data collection, evaluation, and publication from population-based

cancer registries. All new cancer cases diagnosed in 2008 were reported to cancer registries from all hospitals, community health centers, and the other departments, including centers of township medical insurance and the new-type Rural Cooperative Medical System. The death record database was linked and matched with the cancer registration database for identifying cancer deaths and supplementing missed cases.

Until 15 June 2011, there were 56 cancer registries (in 26 cities and 30 counties) from 19 provinces reporting cancer registration data to NCCR. The overall population coverage was 82 433 497, accounting for 6.21% of the whole population. The cancer registries coded cancer site and histology by the International Classification of Diseases (ICD) for Oncology, third edition, and ICD-10. Invasive cases of lung cancer (C33-C34) were drawn and analyzed from the overall cancer database. Demographic information was provided by national statistics bureau.

### Quality control

Based on “Guideline of Chinese Cancer Registration” and the standard of data inclusion in “Cancer Incidence in Five Continents Volume IX,” cancer registration data was evaluated by the quality indicators of proportion of morphological verification (MV%), percentage of cancer cases identified with death certification only (DCO%), and mortality to incidence ratio (M/I).<sup>4–6</sup> The detailed standard for data inclusion has been shown previously.<sup>7</sup> Generally, data with DCO% less than 20%, an overall MV% of more than 55%, and M/I between 0.55–0.95, were considered acceptable.

### Statistical analysis

Crude incidence and mortality rates of lung cancer were prepared by sex, area, and for 19 age groups (0–, 1–4, 5–9, . . . 80–84, 85+ years). Age-standardized rates were calculated using the Chinese population (1982) and World Segi’s population. The cumulative risk of developing or dying from cancer before the age of 75 years (in the absence of competing causes of death), was calculated as a percentage. Software including MS-FoxPro, MS-Excel, and IARC-crgTools issued by IARC and IACR, were used for data checkup. SAS software was used to calculate the incidence and mortality rates.

### Results

A total of 41 population-based cancer registries with qualified cancer statistics were included in the study. The population covered by these cancer registries was 66 138 784, including 33 340 597 males and 32 798 187 females, accounting for 4.98% of the whole population. Among them, 19 registries

were from urban areas, including 52 158 495 of the population. Twenty-two registries were from rural areas, including 13 980 289 of the population. The MV%, DCO%, and M/I ratio for the national pooled data were 50.84%, 3.45%, and 0.84, respectively. In urban areas, the MV%, DCO%, and M/I ratio were 54.37%, 3.87%, and 0.84, respectively. In rural areas, they were 32.96%, 1.34%, and 0.84%. There were 36 213 new cases diagnosed with lung cancer in 2008. Of these, 24 378 were males and 11 835 were females. The number of overall cancer deaths was 30 469, including 20 828 males and 9641 females. The detailed information for population, incidence, and death as a result of lung cancer in each cancer registry is shown in Table 1.

### Incidence

The crude incidence rate for lung cancer was 54.75/100 000 in 2008, accounting for 18.30% of overall new cancer cases. The age-standardized rates by China (CASR) population and by World population (WASR) were 24.98/100 000, and 34.07/100 000, respectively. Among patients aged 0–74, the cumulative incidence rate was 4.13%.

Lung cancer occurred more often in men than in women. For males, the crude incidence rate was 73.12/100 000, whereas the CASR and WASR were 35.02/100 000, and 48.18/100 000, respectively. For females, the crude incidence rate was 36.08/100 000, whereas the CASR and WASR were 13.49/100 000, and 15.66/100 000. The crude incidence rate in urban areas was 57.96/100 000 and it was higher than that in rural areas (42.80/100 000). After age standardization, incidence rate in urban areas (34.80/100 000 for WASR) was still higher than that in rural areas (30.79/100 000 for WASR) (Table 2).

Age-specific incidence rates of lung cancer for both gender and area were compared (Fig 1). Overall, the age-specific incidence rate was relatively low in subjects up to 35 years of age. However, the rate dramatically increased for patients over the age of 35, reaching a peak for subjects of 80–84 years old (379.77/100 000). For males, subjects in the age group of 85 years or older had the highest age-specific rates, whereas for females, subjects in the age group of 80–84 years old had the highest rates. Lung cancer among males generally had a higher age-specific incidence rate than females, except for subjects in younger age groups (<30 years old). Similarly, the age-standardized lung cancer rates in urban areas were generally higher than those in rural areas, except for subjects in younger age groups (Table 3).

### Mortality

The crude mortality rate for lung cancer in 2008 was 46.07/100 000, accounting for 24.95% of cancer deaths during 2008. The CASR and WASR for mortality were 20.09/100 000

**Table 1** Population, incidence of new cases, and deaths of lung cancer in cancer registries in 2008

Registry	Urban = 1 Rural = 2	Population			New cancer cases			Cancer death		
		Both	Male	Female	Both	Male	Female	Both	Male	Female
Beijing	1	7 513 532	3 796 097	3 717 435	4461	2748	1713	3741	2316	1425
Shexian	2	393 068	204 175	188 893	89	64	25	57	37	20
Cixian	2	629 362	320 489	308 873	246	165	81	199	131	68
Yangcheng	2	382 667	193 237	189 430	72	54	18	57	33	24
Shenyang	1	3 486 819	1 724 993	1 761 826	2752	1664	1088	2523	1543	980
Dalian	1	2 286 743	1 145 030	1 141 713	1760	1127	633	1412	931	481
Anshan	1	1 474 115	734 861	739 254	1070	683	387	991	617	374
Benxi	1	958 034	477 602	480 432	597	341	256	511	318	193
Dandong	1	754 604	373 054	381 550	478	295	183	405	251	154
Haerbin-daoli	1	703 798	343 577	360 221	441	261	180	313	190	123
Haerbin-nangang	1	1 037 786	519 913	517 873	539	335	204	583	361	222
Shanghai	1	6 167 941	3 087 207	3 080 734	3845	2579	1266	3428	2346	1082
Suzhou	1	6 287 735	3 105 480	3 182 255	3562	2579	983	2660	1965	695
Qidong	2	1 116 272	550 234	566 038	787	573	214	692	511	181
Haimen	2	1 019 352	465 991	553 361	795	563	232	678	505	173
Lianyungang	1	808 784	412 365	396 419	315	226	89	284	190	94
Huai'an-Chuzhou	1	1 187 430	612 067	575 363	313	220	93	249	189	60
Jinhu	2	363 983	183 173	180 810	134	87	47	81	52	29
shenyang	2	964 852	493 646	471 206	443	303	140	405	267	138
Jianhu	2	805 234	410 247	394 987	258	179	79	245	168	77
Dafeng	2	724 502	363 491	361 011	426	288	138	383	256	127
Yangzhong	2	273 434	135 115	138 319	92	58	34	81	63	18
Taixing	2	1 197 000	650 429	546 571	286	215	71	307	221	86
Hangzhou	1	6 737 379	3 408 365	3 329 014	3538	2446	1092	3274	2366	908
Jiaxing	1	505 149	252 057	253 092	291	195	96	218	155	63
Jiashan	2	381 688	189 660	192 028	272	212	60	239	176	63
Haining	2	652 028	322 373	329 655	302	226	76	292	219	73
Ma'anshan	1	627 561	321 347	306 214	333	264	69	282	217	65
Tongling	1	411 795	211 367	200 428	181	122	59	177	126	51
Changle	2	670 256	352 984	317 272	172	114	58	138	90	48
Linqu	2	802 520	409 307	393 213	448	297	151	326	223	103
Feicheng	2	734 828	358 310	376 518	377	250	127	240	171	69
Linzhou	2	1 022 559	522 617	499 942	165	100	65	129	80	49
Wuhan	1	4 833 008	2 493 854	2 339 154	2517	1854	663	1892	1413	479
Guangzhou	1	3 926 921	1 997 570	1 929 351	2386	1636	750	1827	1292	535
Sihui	2	410 893	210 919	199 974	159	119	40	116	87	29
Zhongshan	2	1 457 901	728 359	729 542	604	400	204	477	326	151
Fusui	2	438 342	232 800	205 542	84	71	13	69	55	14
Yanting	2	607 497	314 950	292 547	220	175	45	186	148	38
Gejiu	2	389 952	196 206	193 746	156	133	23	117	103	14
Wuwei	1	991 460	515 079	476 381	247	157	90	185	120	65
Total		66 138 784	33 340 597	32 798 187	36 213	24 378	11 835	30 469	20 828	9641

and 27.68/100 000, respectively. Among patients aged 0–74, the cumulative rate was 3.25%.

The mortality rate of lung cancer was much higher in males than in females. For males, the crude rate, CASR and WASR were 62.47/100 000, 28.96/100 000, and 40.16/100 000. For females, the crude rate, CASR and WASR were 29.39/100 000, 11.91/100 000, and 16.42/100 000. In urban areas, the crude rate, CASR and WASR were 48.76/100 000,

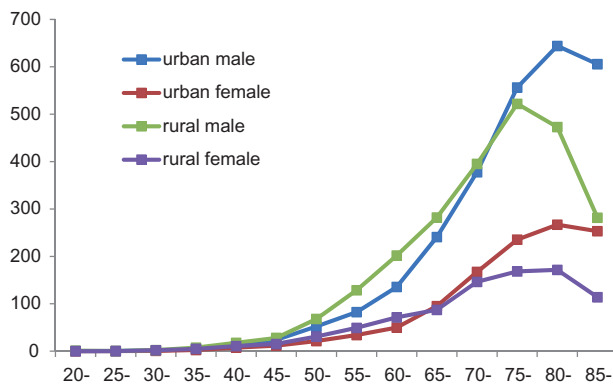
20.33/100 000, and 28.09/100 000. In rural areas, they were 36.03/100 000, 18.85/100 000, and 25.65/100 000, lower than those in urban areas (Table 4).

Age-specific mortality rates by gender and area are shown in Table 5. The trend for lung cancer mortality in different age groups was similar to the trend of lung cancer incidence. Both for males and females, in urban and in rural areas, the mortality reached a peak for subjects of 80–84 years old (Fig 2).

**Table 2** Lung cancer incidence by sex and area in registration areas in 2008

Area	Sex	New cases	Incidence rate (1/10 <sup>5</sup> )	CASR <sup>a</sup> (1/10 <sup>5</sup> )	WASR <sup>b</sup> (1/10 <sup>5</sup> )	Cumulative rate (0–74), %
All areas	Both	36 213	54.75	24.98	34.07	4.13
	Male	24 378	73.12	35.02	48.18	5.77
	Female	11 835	36.08	15.66	21.22	2.56
Urban	Both	30 230	57.96	25.44	34.80	4.19
	Male	20 132	76.66	35.28	48.72	5.79
	Female	10 098	38.99	16.33	22.19	2.67
Rural	Both	5983	42.80	22.96	30.79	3.86
	Male	4246	59.97	33.77	45.48	5.67
	Female	1737	25.17	12.76	17.07	2.10

CASR, China population; WASR, World population

**Figure 1** Age-specific incidence rate of lung cancer in cancer registration areas in 2008 (1/10<sup>5</sup>).

## Discussion

This study provides updated incidence and mortality rates of lung cancer in 2008 in China, based on 41 population-based cancer registries' data. The crude incidence and mortality rate of lung cancer in registration areas were 54.75/100 000, and 46.07/100 000, respectively. The age-standardized incidence and mortality rates by World population were 34.07/100 000, and 27.68/100 000, respectively. Lung cancer occurred more often in males than in females, and in urban areas than in rural areas. The most recent cancer statistics may provide basic information for cancer prevention and control.

Lung cancer retains its status as the leading cause of cancer death, as well as the most commonly diagnosed cancer, in

**Table 3** Age-specific incidence rates of lung cancer in cancer registration areas in 2008 (1/10<sup>5</sup>)

Age group	All areas			Urban			Rural		
	Both	Male	Female	Both	Male	Female	Both	Male	Female
all	54.75	73.12	36.08	57.96	76.66	38.99	42.80	59.97	25.17
0–	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1–	0.16	0.20	0.11	0.22	0.27	0.15	0.00	0.00	0.00
5–	0.66	0.52	0.82	0.92	0.73	1.14	0.00	0.00	0.00
10–	0.03	0.00	0.06	0.00	0.00	0.00	0.09	0.00	0.20
15–	0.09	0.18	0.00	0.03	0.06	0.00	0.30	0.57	0.00
20–	0.39	0.52	0.26	0.34	0.41	0.27	0.62	1.02	0.21
25–	0.86	0.82	0.89	1.00	0.94	1.07	0.28	0.36	0.19
30–	2.35	2.33	2.36	2.39	2.35	2.43	2.21	2.28	2.14
35–	5.98	6.93	5.02	5.88	6.74	5.02	6.30	7.59	5.00
40–	14.03	16.20	11.80	13.97	15.81	12.09	14.25	17.69	10.71
45–	25.83	31.82	19.62	26.80	32.70	20.66	21.79	28.11	15.32
50–	53.69	74.06	32.78	54.51	75.38	33.17	49.85	68.02	30.99
55–	89.44	124.55	54.11	89.40	123.64	55.17	89.60	128.60	49.23
60–	130.96	187.57	75.23	129.31	183.88	76.15	137.55	201.91	71.47
65–	202.78	295.02	115.64	207.58	298.52	122.81	184.34	282.01	87.25
70–	298.08	413.57	193.38	305.34	417.54	203.59	264.61	395.24	146.33
75–	372.06	541.44	224.50	381.06	545.28	236.32	327.89	521.91	168.34
80–	379.77	566.08	237.05	397.70	584.22	251.57	294.39	472.99	171.62
85–	364.62	598.15	224.83	406.14	660.72	250.02	172.26	281.56	113.91

**Table 4** Cancer mortality of lung cancer in cancer registration areas in 2008

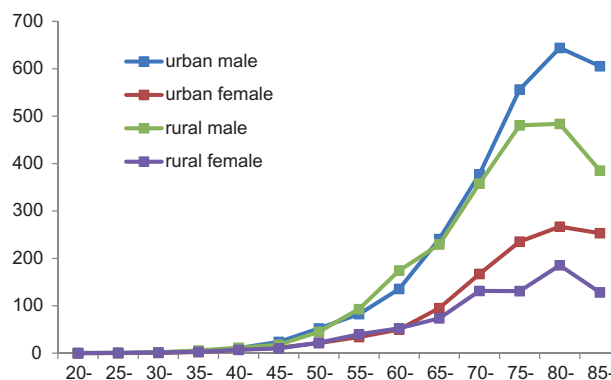
Area	Sex	Deaths	Mortality rate (1/10 <sup>5</sup> )	CASR (1/10 <sup>5</sup> )	WASR (1/10 <sup>5</sup> )	Cumulative rate 0–74 (%)
All areas	Both	30 469	46.07	20.09	27.68	3.25
	Male	20 828	62.47	28.96	40.16	4.66
	Female	9641	29.39	11.91	16.42	1.91
Urban	Both	25 432	48.76	20.33	28.09	3.26
	Male	17 232	65.62	29.09	40.43	4.65
	Female	8200	31.66	12.27	16.98	1.96
Rural	Both	5037	36.03	18.85	25.65	3.18
	Male	3596	50.79	28.10	38.52	4.69
	Female	1441	20.88	10.26	13.89	1.71

CASR, China population; WASR, World population

**Table 5** Age-specific mortality of lung cancer in cancer registration areas in 2008 (1/10<sup>5</sup>)

Age group	All areas			Urban			Rural		
	Both	Male	Female	Both	Male	Female	Both	Male	Female
all	46.07	62.47	29.39	48.76	65.62	31.66	36.03	50.79	20.88
0–	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1–	0.05	0.10	0.00	0.00	0.00	0.00	0.21	0.39	0.00
5–	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10–	0.03	0.00	0.06	0.00	0.00	0.00	0.09	0.00	0.20
15–	0.02	0.05	0.00	0.03	0.06	0.00	0.00	0.00	0.00
20–	0.21	0.38	0.04	0.19	0.33	0.04	0.31	0.61	0.00
25–	0.51	0.65	0.37	0.48	0.63	0.33	0.65	0.73	0.56
30–	1.35	1.74	0.96	1.23	1.72	0.74	1.72	1.79	1.65
35–	3.53	4.40	2.65	3.29	3.97	2.60	4.36	5.89	2.81
40–	9.15	10.83	7.42	9.08	10.63	7.50	9.39	11.57	7.14
45–	17.15	22.64	11.46	17.92	23.82	11.77	13.95	17.66	10.15
50–	36.51	51.00	21.65	37.09	52.28	21.55	33.84	45.15	22.11
55–	59.90	84.43	35.23	58.33	82.48	34.19	67.00	93.06	40.03
60–	96.67	143.65	50.42	92.25	135.70	49.91	114.32	174.53	52.50
65–	162.55	238.49	90.81	165.46	240.88	95.16	151.37	229.60	73.60
70–	262.35	374.24	160.91	267.41	377.78	167.32	239.01	357.90	131.36
75–	369.34	543.96	217.21	385.75	556.40	235.34	288.82	480.64	131.08
80–	410.80	617.91	252.15	432.60	644.03	266.95	307.02	483.84	185.48
85–	357.11	569.29	230.10	387.22	605.66	253.25	217.64	385.30	128.15

China in 2008. Compared to the cancer incidence and mortality of 2003–2007 in China, we found the crude rates of lung cancer in 2008 were higher than those of 2003–2007.<sup>7</sup> After age standardization, the incidence and mortality rates were relatively stable. The aging population in China is a major cause for the increasing burden of lung cancer. The observed variations in lung cancer rates across regions or between males and females may largely reflect differences in the tobacco epidemic and air pollution. Tobacco smoking is an identified risk factor for the disease. It accounts for 80% of the worldwide lung cancer burden in males and 50% of the burden in females. Effective smoking control has been shown to reduce lung cancer incidence in the US since 1999.<sup>8</sup> China has the largest smoking population, but still does not have

**Figure 2** Age-specific mortality of lung cancer in cancer registration areas in 2008 (1/10<sup>5</sup>).

nationwide intervention on smoking control. Promising results have been reported that screening with the use of a low-dose helical computed tomography (CT) scan might reduce mortality from lung cancer.<sup>9</sup> It is expected that through primary and secondary prevention, the prevalence of the disease may be controlled in the future.

NCCR is the authoritative source of information on cancer incidence and mortality in China. NCCR collects and publishes these statistics from population-based registries. The population coverage is increasing year by year. Since 2008, the Ministry of Health introduced more cancer registries and provided specific funding to support the development of cancer surveillance. By the end of 2011, there were 195 cancer registries around China, covering 14% of the whole population. Notably, the new cancer registries take at least five years to ensure data quality and reliability.

## Conclusion

The data provided here is the most up-to-date data on incidence and mortality, reflecting the only available population-based information on lung cancer in China. In our study, urban population coverage comprised a majority of the overall population, therefore, the representativeness of the data needs to be explained with caution.<sup>10</sup> The Chinese government is still making efforts to improve the quality of the cancer registration data, especially in rural areas. The accuracy and representativeness of the population-based cancer statistics is expected to improve in the future.

## Acknowledgments

We wish to acknowledge all staff from local cancer registries for their great contribution in providing cancer registration data.

## Disclosure

No authors report any conflict of interest.

## References

- 1 Chen Z. *The Third National Death Cause Survey Report*. Chinese Academy of Medical Sciences & Peking Union Medical College Press, Beijing 2008.
- 2 Chen W, Zhang S, Zou X. Evaluation on the incidence, mortality and tendency of lung cancer in China. *Thoracic Cancer* 2010; **1**: 35–40.
- 3 Zhang S, Cheng W, Wang L. The 30 years of cancer registration in China. *China Cancer* 2009; **18**: 256–9.
- 4 Curado MP, Edwards B, Shin HR (eds) *et al. Cancer Incidence in Five Continents, Vol.IX*. IARC Scientific Publications No. 160, Lyon 2007.
- 5 Parkin DM, Chen VW, Ferlay J, Galceran J, Storm HH, Whelan SL. *Comparability and Quality Control in Cancer Registration*. IARC Technical Report No.19, Lyon, 1994.
- 6 Felay J, Burkhard C, Whelan S, Parkin DM. *Check and Conversion Programs for Cancer Registries*. IARC Technical Report No.42, Lyon, 2005.
- 7 Zhao P, Chen W, Kong L. *Chinese Cancer Incidence and Mortality 2003-2007*. Military Medical Science Press, Beijing 2011.
- 8 Kort EJ, Paneth N, Vande Woude GF. The decline in U.S. cancer mortality in people born since 1925. *Cancer Res* 2009; **69**: 6500–5.
- 9 National Lung Screening Trial Research Team, Aberle DR, Adams AM, *et al.* Reduced lung-cancer mortality with low-dose computed tomographic screening. *N Engl J Med* 2011; **365**: 395–409.
- 10 Li G, Chen W. Representativeness of population-based cancer registration in China—comparison of urban and rural areas. *Asian Pac J Cancer Prev* 2009; **10**: 559–564.