

# Cancer incidence and mortality in Henan province, 2012

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## Abstract

**Objective:** Population-based cancer registration data in 2012 from all available cancer registries in Henan province were collected by Henan Office for Cancer Research and Control. The numbers of new cancer cases and cancer deaths in Henan province with compiled cancer incidence and mortality rates were estimated.

**Methods:** In 2015, all registries' data in Henan province were qualified for the national cancer registry annual report in 2012. The pooled data were stratified by area (urban/rural), gender, age group (0, 1–4, 5–9, 10–14, ..., 85+) and cancer type. New cancer cases and deaths were estimated using age-specific rates and corresponding population of Henan province in 2012. The Chinese census data in 2000 and Segi's population were applied for age-standardized rates. All the rates were expressed per 100,000 person-years.

**Results:** Qualified 19 cancer registries (4 urban and 15 rural registries) covered 16,082,688 populations of Henan province in 2012. The percentage of cases with morphologically verified (MV%) and death certificate-only cases (DCO%) were 69.84% and 2.30%, respectively, and the mortality to incidence rate ratio (M/I) was 0.64. It was estimated that there were 248,510 new cancer cases and 158,630 cancer deaths in Henan province in 2012. The incidence rate was 266.17/100,000 (288.61/100,000 in males and 241.86/100,000 in females), the age-standardized incidence rates by Chinese standard population (ASIRC) and by world standard population (ASIRW) were 208.95/100,000 and 206.41/100,000 with the cumulative incidence rate (0–74 years old) of 24.30%. The crude incidence rate in urban areas was higher than that in rural areas. However, after adjusted by age, the cancer incidence rate in rural was higher than that in urban areas. The crude mortality of all cancers in Henan province was 169.90/100,000 (201.23/100,000 in males and 135.95/100,000 in females). The age-standardized mortality rates by Chinese standard population (ASMRC) and by world standard population (ASMRW) were 131.20/100,000 and 130.80/100,000, respectively. Among the patients aged 0–74 years, the cumulative mortality rate was 15.03%. The crude cancer mortality rate in urban areas was higher than that of rural areas. However, the age-standardized rate in rural areas was higher than that of urban areas. Cancers of lung, stomach, esophagus, liver, female breast, colorectum, cervix, brain, uterus and ovary were the most common cancers, accounting for about 82.80% of all cancer new cases. Lung cancer, stomach cancer, esophageal cancer, liver cancer, colorectal cancer, female breast cancer, brain cancer, leukemia, pancreatic cancer and cervix cancer were the leading causes of cancer deaths, accounting for about 88.50% of all cancer deaths. The burden between urban and rural, males and females were different.

**Conclusions:** Registration data of Henan province was qualified to provide basic information on population-based cancer incidence, mortality for cancer prevention and control. The upper digestive tract cancer burden in Henan province, especially for males in rural areas, was higher. The incidence rate of female breast cancer was higher in urban areas. Targeted prevention, early detection and treatment programs should be carried out by health department to control the cancer burden.

**Keywords:** Cancer registry; incidence; mortality; epidemiology; Henan province

Submitted Mar 05, 2016. Accepted for publication Mar 30, 2016.

doi: 10.21147/j.issn.1000-9604.2016.03.02

View this article at: <http://dx.doi.org/10.21147/j.issn.1000-9604.2016.03.02>

## Introduction

The National Central Cancer Registry (NCCR) of China estimated that there were 4,292,000 new cases of cancer diagnosed in 2015 in China (1). Henan province, the province with large population in China, is also facing heavy burden of cancer. With the national financial support, there were 6, 16, 16, 19, 20, 27 and 27 established registries from 2009 to 2015 respectively. Since 2012, Henan Office for Cancer Research and Control began publishing cancer registry annual report of Henan province. The cancer registration data are very useful in the prevention and control of cancer through estimating the local cancer incidence and mortality. In this paper, we provide a comprehensive overview of cancer incidence and mortality rates and estimate new cancer cases and cancer deaths in Henan province in 2012.

## Materials and methods

### Data source

Henan Office for Cancer Research and Control is in charge of population-based cancer registry in Henan province with responsibility of system establishment, training, data collection, evaluation and publication of annual report. The incidence cases were reported to cancer registries from local hospitals, community health service centers, the Basic Medical Insurances for Urban Residents and the New-Rural Cooperative Medical System. By June 1, 2015, 19 cancer registries in Henan province submitted 2012 data to Henan Office for Cancer Research and Control. All cancer cases were classified according to the International Classification of Diseases for Oncology, 3rd edition (ICD-O-3) and the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). Finally, all submitted data were pooled to form the database of Henan provincial registry system in 2012.

### Population of Henan province estimates

The population of Henan province in 2012 was estimated based on the fifth National Census data (2000) provided by the National Statistics Bureau of China, taking into account of the changes of age composition, gender ratio and the proportion of urban and rural transformation released by the National Bureau of Statistics (<http://data.stats.gov.cn/>). The population

of Henan province in 2012 was stratified by area (urban/rural), gender (male/female) and age groups (0–, 1–4, 5–84 by 5 years, 85+ years). The age-specific death probability was adjusted referring to the sixth National Census in 2010. Linear changes were assumed in each age group between the fifth and sixth Population Census.

### Quality control

Henan Office for Cancer Research and Control checked and evaluated the quality and comparability of submitted data based on “Guideline for Chinese Cancer Registration” and referring to relevant data quality criterion of “Cancer Incidence in Five Continents Volume IX” by International Agency for Research on Cancer/International Association of Cancer Registries (IARC/IACR) (2). The data included in the final analysis should meet the following criteria: the percentage of cases morphologically verified (MV%) was not lower than 66%; the percentage of death certificate-only cases (DCO%) was lower than 15%; the mortality to incidence ratio (M/I) was between 0.6 and 0.8; and the percentage of the diagnosis of unknown basis (UB%) was lower than 5%.

### Statistical analysis

Incidence and mortality rates were calculated by area, gender and age groups. The numbers of new cases and deaths were estimated using the 5-year age-specific cancer incidence/mortality rates and the corresponding populations. The Chinese population in 2000 and World Segi's population were used for age-standardized rates. The cumulative risk of developing or dying from cancer before 75 years of age (in the absence of competing causes of death) was calculated and presented as a percentage. Software including MS-Excel and IARCrgTools2.05 issued by IARC and IACR were used for data checking and evaluation (3). SAS software (SAS Institute Inc., Cary, USA) was used to calculate the incidence and mortality rates.

## Results

### Data quality

There were 19 registries in Henan province accepted by this analysis, including 4 cities and 15 counties and covering

16,082,688 of populations, including 8,283,111 males and 7,799,577 females, accounted for 17.1% of population of Henan province in end of 2012.

The overall indicators of MV%, DCO% and M/I ratio were

69.84%, 2.30% and 0.64, respectively. They were 69.47%, 1.80% and 0.63 in urban registries, compared to 69.92%, 2.41% and 0.64 in rural. The quality evaluation for major cancers is presented in *Table 1*.

**Table 1** Quality evaluation of cancer registration data in Henan province, 2012

Cancer	All areas			Urban			Rural		
	MV (%)	DCO (%)	M/I	MV (%)	DCO (%)	M/I	MV (%)	DCO (%)	M/I
Oral & pharyngx	55.00	2.37	0.32	56.52	0.00	0.20	54.51	3.13	0.36
Nasopharynx	61.65	0.97	0.45	56.10	0.00	0.29	63.03	1.21	0.50
Esophagus	84.28	2.26	0.69	81.72	2.57	0.72	84.67	2.21	0.69
Stomach	85.58	2.05	0.72	82.85	2.11	0.75	85.95	2.04	0.71
Colorectum	77.91	1.89	0.52	75.47	0.94	0.53	78.54	2.14	0.52
Liver	38.52	3.48	0.84	30.58	3.75	0.79	39.90	3.44	0.85
Gallbladder	52.35	2.25	0.61	54.03	4.03	0.68	51.78	1.64	0.58
Pancreas	48.12	5.12	0.78	56.62	2.21	0.74	45.56	6.00	0.79
Throat	52.15	3.35	0.59	69.57	0.00	0.59	50.00	3.76	0.59
Lung	60.82	2.79	0.78	64.40	1.43	0.89	60.02	3.10	0.75
Other organs in chest	41.18	0.98	0.39	42.42	0.00	0.52	40.58	1.45	0.33
Bone	37.89	2.37	0.52	37.04	1.85	0.39	38.04	2.45	0.55
Skin melanoma	100.00	0.00	0.38	100.00	0.00	0.44	100.00	0.00	0.37
Breast	91.03	1.29	0.34	83.84	1.58	0.28	93.14	1.21	0.37
Cervix	86.02	1.02	0.34	89.72	0.00	0.24	85.00	1.30	0.37
Uterus	86.95	0.94	0.28	82.86	1.43	0.22	88.10	0.81	0.30
Ovary	78.51	0.73	0.37	79.51	0.00	0.37	78.22	0.94	0.37
Prostate	57.87	2.98	0.55	72.50	1.25	0.47	50.32	3.87	0.59
Testis	61.54	0.00	0.24	40.00	0.00	0.50	66.67	0.00	0.17
Kidney	51.75	2.70	0.40	66.43	2.86	0.39	42.86	2.60	0.42
Bladder	64.44	1.41	0.43	71.54	0.77	0.45	61.92	1.64	0.43
Brain, CNS	29.74	3.11	0.53	45.27	1.35	0.31	26.93	3.43	0.57
Thyroid gland	67.88	1.45	0.15	71.53	0.73	0.06	66.67	1.69	0.18
Lymphoma	97.19	0.51	0.57	93.55	0.00	0.69	98.33	0.67	0.53
Leukemia	99.15	0.12	0.58	99.44	0.00	0.55	99.07	0.15	0.59
Total	69.84	2.30	0.64	69.47	1.80	0.63	69.92	2.41	0.64

MV%, percentage of morphological verification; DCO%, percentage of cancer cases identified with death certification only; M/I, mortality to incidence ratio; CNS, central nervous system.

### Incidence and mortality of overall cancers

#### Incidence

It was estimated that there were 248,510 new cases diagnosed as cancer in Henan province in 2012. The crude incidence rate of all cancers was 266.17/100,000 (288.61/100,000 in males and 241.86/100,000 in females). The age-standardized incidence

rates by Chinese standard population (ASIRC) and by world standard population (ASIRW) were 208.95/100,000 and 206.41/100,000, respectively. Among the cancer patients aged 0–74 years, the cumulative incidence rate was 24.30%. The crude incidence rate in urban areas was higher than that in rural areas. However, after adjusted by age, the cancer incidence rate in rural was higher than that in urban areas (Table 2).

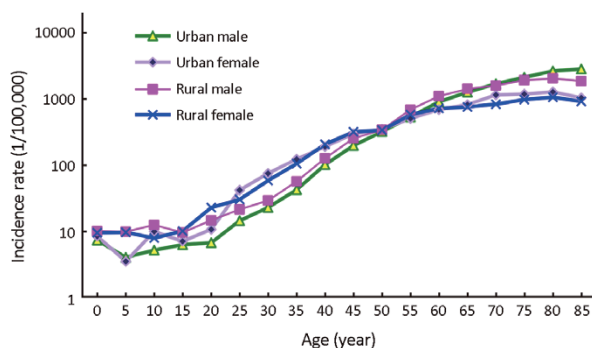
**Table 2** Cancer incidence in Henan province, 2012

Areas	Sex	Cases (hundred)	Crude incidence (1/10 <sup>5</sup> )	ASIRC (1/10 <sup>5</sup> )*	ASIRW (1/10 <sup>5</sup> )**	Cumulative rate 0–74 (%)
All areas	Both	2,485.1	266.17	208.95	206.41	24.30
	Male	1,401.4	288.61	235.50	235.69	28.14
	Female	1,083.8	241.86	185.57	180.41	20.49
Urban	Both	478.8	278.80	205.93	201.82	23.69
	Male	254.4	292.56	222.51	222.19	25.90
	Female	224.4	264.68	193.51	186.35	21.63
Rural	Both	2,006.3	263.33	209.67	207.55	24.45
	Male	1,147.0	287.75	238.58	238.97	28.67
	Female	859.4	236.54	183.50	178.87	20.21

\*, age-standardized incidence rate (China population, 2000); \*\*, age-standardized incidence rate (Segi's population).

#### Age-specific incidence rate

The age-specific incidence rate was relatively lower before 40 years old, then increased dramatically and peaked at age group of 80–84 years. The pattern was similar between urban and rural areas. Comparing the age-specific incidence rate between urban and rural areas, except age from 25–39 and 70+ years, urban areas had lower incidence rates than that in rural areas (Table 3, Figure 1).



**Figure 1** Age-specific cancer incidence rates in urban and rural areas in Henan province, 2012.

#### Mortality

It was estimated that there were 158,630 patients died from cancer in Henan province in 2012. The crude mortality of all cancers in Henan province was 169.90/100,000 (201.23/100,000 in males and 135.95/100,000 in females). The age-standardized mortality rates by Chinese standard population (ASMRC) and by world standard population (ASMRW) were 131.20/100,000 and 130.80/100,000, respectively. Among the patients aged 0–74 years, the cumulative mortality rate was 15.03%. The crude cancer mortality rate in urban areas was higher than that in rural areas. However, the age-standardized rate in rural areas was higher than that in urban areas (Table 4).

#### Age-specific mortality

The age-specific mortality rate was relatively lower before 45 years and then dramatically increased, reaching peak after 85 years. The pattern was similar between urban and rural areas. Comparing the age-specific mortality rate between urban and rural areas, in most age groups under 70 years old, urban areas had lower mortality rates than that in rural areas (Table 5, Figure 2).

**Table 3** Age-specific incidence rates of overall cancers in Henan province, 2012 (1/10<sup>5</sup>)

Age groups	All areas			Urban			Rural		
	Both	Male	Female	Both	Male	Female	Both	Male	Female
Total	266.17	288.61	241.86	278.80	292.56	264.68	263.33	287.75	236.54
0–	5.55	3.63	7.85	3.57	0.00	7.72	6.07	4.56	7.89
1–	10.23	10.70	9.67	8.80	8.87	8.71	10.52	11.06	9.86
5–	8.96	9.08	8.81	3.84	4.08	3.56	9.89	9.98	9.79
10–	10.11	11.50	8.34	7.44	5.25	10.05	10.62	12.66	8.00
15–	9.42	9.17	9.72	6.73	6.38	7.14	9.92	9.67	10.22
20–	17.19	13.63	21.12	8.77	6.80	10.83	18.74	14.84	23.08
25–	26.46	20.48	32.78	28.84	14.63	42.43	25.96	21.64	30.62
30–	44.92	28.24	62.68	50.25	23.19	75.64	43.58	29.42	59.15
35–	81.40	54.24	110.48	84.33	42.96	124.13	80.59	57.16	106.42
40–	162.13	122.86	204.79	147.14	102.94	192.38	166.01	127.82	208.12
45–	281.32	244.91	318.34	248.90	198.77	300.13	288.88	255.71	322.57
50–	343.13	342.44	343.81	337.91	324.19	351.93	344.50	347.34	341.72
55–	616.51	662.74	568.78	525.95	541.09	510.62	640.56	694.67	584.42
60–	899.48	1,077.30	720.60	803.53	911.76	698.45	921.74	1,114.86	725.85
65–	1,093.57	1,400.34	776.04	1,051.26	1,280.91	826.26	1,103.17	1,426.56	764.25
70–	1,256.47	1,621.24	902.92	1,424.27	1,709.78	1,164.74	1,216.09	1,600.78	837.43
75–	1,480.46	1,979.72	1,031.74	1,635.62	2,147.98	1,192.05	1,439.09	1,935.96	988.03
80–	1,574.99	2,190.06	1,110.93	1,916.49	2,679.16	1,285.38	1,493.46	2,065.53	1,071.32
85+	1,303.46	2,020.47	941.71	1,665.21	2,848.42	1,048.02	1,240.61	1,872.85	923.48

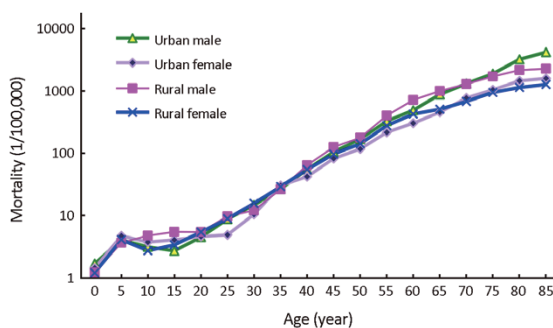
**Table 4** Cancer mortality in Henan province, 2012

Area	Sex	Deaths (hundred)	Mortality (1/10 <sup>5</sup> )	ASMRC (1/10 <sup>5</sup> )*	ASMRW (1/10 <sup>5</sup> )**	Cumulative rate 0–74 (%)
All areas	Both	1,586.3	169.90	131.20	130.80	15.03
	Male	977.1	201.23	165.43	165.67	18.91
	Female	609.2	135.95	99.69	99.00	11.14
Urban	Both	299.9	174.63	127.60	126.42	13.64
	Male	184.4	212.07	165.09	165.19	17.11
	Female	115.5	136.23	95.31	93.91	10.32
Rural	Both	1,286.4	168.83	132.18	132.07	15.36
	Male	792.7	198.86	165.63	166.09	19.33
	Female	493.7	135.89	100.85	100.36	11.34

\*, age-standardized mortality rate (China population, 2000); \*\*, age-standardized mortality rate (Segi's population).

**Table 5** Age-specific mortality of overall cancers in Henan province, 2012 (1/10<sup>5</sup>)

Age groups	All areas			Urban			Rural		
	Both	Male	Female	Both	Male	Female	Both	Male	Female
All	169.90	201.23	135.95	174.63	212.07	136.23	168.83	198.86	135.89
0–	2.48	3.19	1.62	7.20	6.75	7.72	1.24	2.28	1.12
1–	3.83	4.53	2.99	2.05	3.80	0.00	4.18	4.67	3.59
5–	3.96	3.75	4.22	4.39	4.08	4.75	3.88	3.69	4.12
10–	3.82	4.52	2.92	3.43	3.15	3.77	3.89	4.77	2.75
15–	4.37	5.08	3.52	3.36	2.73	4.08	4.56	5.50	3.41
20–	5.32	5.33	5.31	4.59	4.53	4.64	5.46	5.47	5.44
25–	8.91	9.59	8.18	6.81	8.78	4.93	9.35	9.75	8.91
30–	13.62	12.69	14.62	12.56	14.75	10.51	13.89	12.21	15.73
35–	28.03	26.67	29.49	28.68	26.85	30.43	27.85	26.62	29.21
40–	57.71	62.66	52.34	48.87	55.09	42.49	59.99	64.54	54.98
45–	108.51	122.16	94.63	94.40	105.73	82.82	111.80	126.01	97.37
50–	157.12	176.97	137.49	143.74	169.19	117.73	160.64	179.05	142.58
55–	328.23	388.42	266.08	273.29	327.90	217.98	342.82	404.31	279.02
60–	542.35	678.85	405.04	398.91	495.15	305.46	575.62	720.54	428.64
65–	743.47	977.70	501.03	669.30	882.75	460.16	760.31	998.54	510.63
70–	997.20	1,304.21	699.64	1,031.81	1,316.91	772.65	988.87	1,301.28	681.38
75–	1,343.00	1,752.75	974.72	1,446.61	1,905.89	1,049.00	1,315.37	1,712.93	954.47
80–	1,711.09	2,382.92	1,204.20	2,262.84	3,231.85	1,460.98	1,579.36	2,166.78	1,145.90
85+	1,742.25	2,574.66	1,322.28	2,493.46	4,221.77	1,591.93	1,611.73	2,280.97	1,276.04

**Figure 2** Age-specific cancer mortality in urban and rural areas in Henan province, 2012.

### *Incidence and mortality for major cancers*

#### **Cancer incidence for the 10 most common cancers**

Lung cancer was the most common cancer in all areas, followed by stomach cancer, esophageal cancer, liver cancer and female breast cancer, with estimated new cases of 47,820, 39,700, 36,840, 28,050 and 16,850 respectively. Lung cancer was the most frequently diagnosed cancers in males followed by

stomach cancer, esophageal cancer, liver cancer and colorectal cancer. Breast cancer was the most common cancers in female followed by lung cancer, esophageal cancer, stomach cancer and liver cancer (Table 6).

#### **Cancer death of the top 10 cancers**

Lung cancer was the leading cause of death in Henan province followed by stomach cancer, esophageal cancer, liver cancer and colorectal cancer with estimated deaths of 37,290, 28,390, 25,440, 23,650 and 8,450 respectively. In males, lung cancer was the leading cause followed by stomach cancer, liver cancer, esophageal cancer and colorectal cancer; while in females, lung cancer was still the leading cause followed by esophageal cancer, stomach cancer, liver cancer and breast cancer (Table 7).

#### **Cancer incidence of the 10 most common cancers in urban areas**

In urban areas, lung cancer was the most frequently diagnosed cancers, followed by esophageal cancer, stomach cancer, liver cancer and female breast cancer with the estimated new cases



**Table 6** Top 10 cancer incidence in Henan province, 2012

Rank	Site	Both sexes						Male						Female					
		Cases (hundred)	Incidence (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Cases (hundred)	Incidence (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Cases (hundred)	Incidence (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )				
		1	Lung	478.2	51.22	19.24	39.10	Lung	330.8	68.12	23.60	55.18	Breast	168.5	37.61	15.55	30.51		
2	Stomach	397.0	42.52	15.97	32.49	Stomach	271.6	55.93	19.38	44.94	Lung	147.5	32.91	13.61	24.07				
3	Esophagus	368.4	39.46	14.83	29.81	Esophagus	231.2	47.61	16.5	38.15	Esophagus	137.3	30.63	12.66	21.89				
4	Liver	280.5	30.04	11.29	23.26	Liver	200.5	41.29	14.31	33.51	Stomach	125.4	27.99	11.57	20.45				
5	Breast	168.5	37.61	6.78	30.51	Colorectum	89.1	18.36	6.36	15.08	Liver	80.0	17.86	7.38	13.11				
6	Colorectum	162.6	17.41	6.54	13.54	Brain, CNS	31.9	6.56	2.27	5.72	Colorectum	73.4	16.39	6.78	12.13				
7	Cervix	71.2	15.89	2.87	13.13	Leukemia	29.2	6.02	2.09	5.50	Cervix	71.2	15.89	6.57	13.13				
8	Brain, CNS	59.0	6.31	2.37	5.33	Bladder	24.4	5.03	1.74	4.18	Uterus	39.6	8.84	3.65	6.99				
9	Uterus	39.6	8.84	1.59	6.99	Pancreas	21.5	4.43	1.54	3.58	Ovary	32.9	7.35	3.04	6.14				
10	Ovary	32.9	7.35	1.32	6.14	Prostate	15.4	3.17	1.10	2.57	Brain, CNS	27.1	6.05	2.50	4.90				

\* , age-standardized incidence rate (China population, 2000); CNS, central nervous system.

**Table 7** Top 10 cancer mortality in Henan province, in 2012

Rank	Site	Both sexes						Male						Female					
		Deaths (hundred)	Mortality (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Deaths (hundred)	Mortality (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Deaths (hundred)	Mortality (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )				
		1	Lung	372.9	39.94	23.51	30.42	Lung	258.1	53.16	26.42	43.50	Lung	114.8	25.61	18.84	18.43		
2	Stomach	283.9	30.40	17.90	23.20	Stomach	195.2	40.20	19.98	32.84	Esophagus	96.5	21.53	15.84	15.25				
3	Esophagus	254.4	27.24	16.03	20.69	Liver	168.6	34.73	17.26	28.20	Stomach	88.7	19.79	14.56	14.18				
4	Liver	236.5	25.33	14.91	19.56	Esophagus	157.9	32.51	16.16	26.58	Liver	67.8	15.14	11.13	11.08				
5	Colorectum	84.5	9.05	5.33	6.93	Colorectum	47.9	9.85	4.90	8.08	Breast	58.1	12.97	9.54	9.94				
6	Breast	58.1	12.97	3.66	9.94	Leukemia	17.9	3.69	1.83	3.45	Colorectum	36.6	8.18	6.01	5.88				
7	Brain, CNS	31.0	3.32	1.95	2.77	Pancreas	17.3	3.57	1.77	2.90	Cervix	24.0	5.36	3.94	4.08				
8	Leukemia	29.7	3.18	1.87	2.89	Brain, CNS	17.0	3.51	1.74	3.08	Brain, CNS	13.9	3.11	2.29	2.44				
9	Pancreas	29.0	3.10	1.83	2.40	Bladder	10.7	2.20	1.09	1.84	Ovary	12.3	2.74	2.02	2.10				
10	Cervix	24.0	5.36	1.51	4.08	Gallbladder	9.2	1.88	0.94	1.58	Leukemia	11.8	2.62	1.93	2.32				

\* , age-standardized mortality rate (China population, 2000); CNS, central nervous system.

of 9,700, 5,350, 5,290, 4,520 and 4,210 respectively. The most common sites of cancer were lung, stomach, liver, esophagus and colorectum in males, while in females, cancers of breast, lung, esophagus, stomach and colorectum were the most common cancers (Table 8).

#### Cancer death of the top 10 cancers in urban areas

Lung cancer was the leading cause of cancer death in urban areas for both males and females with estimated number of deaths of 5,950 and 2,680, respectively. Other cancer types with high mortality in males were liver cancer, stomach cancer, esophageal cancer and colorectal cancer. In females, esophageal cancer was the second cause of cancer death, followed by stomach cancer, breast cancer and liver cancer (Table 9).

#### Cancer incidence of the 10 most common cancers in rural areas

Table 10 shows the 10 most common cancer incidence rates in rural areas. Lung cancer was the most frequently diagnosed cancers with estimated new cases of 38,130 and incidence rate of 50.04/100,000, followed by stomach cancer, esophageal cancer, liver cancer and female breast cancer. The most common sites of cancer in males were lung, stomach, esophagus, liver and colorectum, while in females they were breast cancer, lung cancer, esophageal cancer, stomach cancer and liver cancer.

#### Cancer death of the top 10 cancers in rural areas

Lung cancer was the leading cause of cancer death in rural areas for both males and females. The number of deaths on lung cancer in rural was 28,660 with mortality of 37.62/100,000. The other cancer types with high mortality were stomach cancer, liver cancer, esophageal cancer and colorectal cancer in males; esophageal cancer, stomach cancer, liver cancer and breast cancer in females (Table 11).

### Discussion

Population-based cancer registry in Henan province collects the information on cancer incidence cases and cancer deaths from covered population to monitor the cancer epidemics in local areas. The quality of the information was checked carefully by Henan Office for Cancer Research and Control. In 2015, all registries' data in Henan province were qualified for the national cancer registry annual report in 2012, covering 17.1% of population in Henan province at the end of 2012.

The incidence and mortality rate in Henan province were 266.17/100,000 and 169.90/100,000 in 2012, respectively.

Compared with the updated data in China (4), Henan province had higher incidence and mortality rate. Lung cancer was the most common cancer and the leading cause of death both in Henan province and in China. Cancers of upper digestive organ are still the more common cancers and cancer deaths in Henan province, accounting for 30.8% of all cancers. The age-standardized incidence rates of esophageal cancer and stomach cancer in Henan province were 91% and 43% higher than those in China respectively. In China, the 5 most common sites of cancer were lung cancer, stomach cancer, liver cancer, esophageal cancer and colorectal cancer in males, while in females, the breast cancer, lung cancer, colorectum cancer, stomach cancer and liver cancer were the 5 most common cancers. The spectrum of cancers between Henan province and China showed different ranks of esophageal cancer, especially in females.

The incidence rate of all cancers in males is around 19% higher than those in females and the mortality rate is around 48% higher. In top 10 cancers, the incidence rate of lung cancer, stomach cancer, esophageal cancer and liver cancer are more than 50% higher in males. The reasons for the higher rates in males may be related to modifiable lifestyle and environmental risk factors like smoking, alcohol and so on (5-9).

As shown in our data, the incidence rate, mortality rate and cancer ranks were quite similar between urban and rural areas in Henan province. However, the burden of upper digestive tract cancer was higher in rural areas than that in urban areas, while in contrast, the burden of female breast cancer was higher in urban areas than that in rural areas. The geographic disparities of these cancers are similar for males and females. This is in agreement with the previous study, showing that stomach cancer and esophageal cancer have a negative correlation with the economic level while female breast cancer has a positive correlation with the economic level (10-13).

### Conclusions

Registration data of Henan province was qualified to provide basic information of population-based cancer incidence, mortality for cancer prevention and control. The upper digestive tract cancer burden in Henan province, especially for males in rural areas, was high. The incidence rate of female breast cancer was higher in urban areas. Targeted prevention, early detection and treatment programs should be carried out by health department to control the cancer burden.

### Acknowledgements

We gratefully acknowledged the cooperation of all the



**Table 8** Top 10 cancer incidence in urban areas of Henan province, 2012

Rank	Site	Both sexes					Male					Female				
		Cases (hundred)	Incidence (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Cases (hundred)	Incidence (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Cases (hundred)	Incidence (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	
1	Lung	97.0	56.45	20.25	40.24	Lung	65.9	75.83	25.92	57.20	Breast	42.1	49.70	18.78	37.49	
2	Esophagus	53.5	31.13	11.16	22.41	Stomach	34.8	40.05	13.69	29.96	Lung	31.0	36.58	13.82	24.94	
3	Stomach	52.9	30.81	11.05	22.12	Liver	33.0	37.99	12.98	28.61	Esophagus	21.7	25.57	9.66	17.71	
4	Liver	45.2	26.34	9.45	19.11	Esophagus	31.8	36.54	12.49	27.76	Stomach	18.1	21.33	8.06	14.87	
5	Breast	42.1	49.70	8.80	37.49	Colorectum	19.7	22.66	7.75	17.27	Colorectum	16.8	19.85	7.50	13.70	
6	Colorectum	36.5	21.27	7.63	15.37	Bladder	7.0	8.02	2.74	6.11	Cervix	16.4	19.35	7.31	15.46	
7	Cervix	16.4	19.35	3.43	15.46	Leukemia	6.7	7.72	2.64	6.45	Liver	12.2	14.39	5.44	10.02	
8	Leukemia	11.8	6.89	2.47	5.65	Kidney	5.7	6.52	2.23	4.94	Uterus	9.6	11.32	4.28	8.43	
9	Uterus	9.6	11.32	2.00	8.43	Prostate	5.6	6.45	2.21	5.02	Ovary	8.1	9.58	3.62	7.60	
10	Ovary	8.1	9.58	1.70	7.60	Pancreas	5.4	6.21	2.12	4.69	Thyroid	6.7	7.90	2.98	6.19	

\* , age-standardized incidence rate (China population, 2000).

**Table 9** Top 10 cancer mortality in urban areas in Henan province, 2012

Rank	Site	Both sexes					Male					Female				
		Deaths (hundred)	Mortality (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Deaths (hundred)	Mortality (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Deaths (hundred)	Mortality (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	
1	Lung	86.3	50.25	28.78	35.51	Lung	59.5	68.45	32.28	51.80	Lung	26.8	31.59	23.19	21.23	
2	Stomach	39.6	23.04	13.19	16.98	Liver	26.6	30.55	14.40	23.02	Esophagus	15.7	18.46	13.55	12.88	
3	Esophagus	38.4	22.33	12.79	16.79	Stomach	25.3	29.12	13.73	23.11	Stomach	14.3	16.81	12.34	11.66	
4	Liver	35.7	20.80	11.91	14.97	Esophagus	22.7	26.11	12.31	21.44	Breast	11.6	13.69	10.05	9.91	
5	Colorectum	19.4	11.30	6.47	8.14	Colorectum	11.3	13.03	6.14	10.14	Liver	9.2	10.80	7.92	7.40	
6	Breast	11.6	13.69	3.87	9.91	Leukemia	4.5	5.18	2.44	4.46	Colorectum	8.1	9.52	6.99	6.39	
7	Pancreas	7.1	4.13	2.36	3.08	Pancreas	4.3	4.97	2.34	3.81	Cervix	3.9	4.64	3.40	3.47	
8	Leukemia	6.5	3.80	2.17	3.20	Bladder	3.2	3.68	1.74	2.70	Ovary	3.0	3.52	2.59	2.54	
9	Cervix	3.9	4.64	1.31	3.47	Gallbladder	3.0	3.40	1.60	2.62	Gallbladder	2.9	3.36	2.47	2.41	
10	Ovary	3.0	3.52	1.00	2.54	Lymphoma	2.8	3.26	1.54	2.41	Pancreas	2.8	3.26	2.40	2.45	

\* , age-standardized mortality rate (China population, 2000).

**Table 10** Top 10 cancer incidence in rural areas of Henan province, 2012

Rank	Site	Both sexes				Male				Female					
		Cases (hundred)	Incidence (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Cases (hundred)	Incidence (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Cases (hundred)	Incidence (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )
1	Lung	381.3	50.04	19.00	38.84	Lung	264.8	66.44	23.09	54.73	Breast	126.4	34.79	14.71	28.77
2	Stomach	344.1	45.16	17.15	35.03	Stomach	236.7	59.39	20.64	48.52	Lung	116.5	32.05	13.55	23.87
3	Esophagus	315.0	41.34	15.70	31.64	Esophagus	199.4	50.02	17.38	40.67	Esophagus	115.6	31.81	13.45	22.93
4	Liver	235.3	30.88	11.73	24.28	Liver	167.5	42.01	14.60	34.68	Stomach	107.3	29.54	12.49	21.85
5	Breast	126.4	34.79	6.30	28.77	Colorectum	69.4	17.42	6.05	14.57	Liver	67.8	18.66	7.89	13.90
6	Colorectum	126.0	16.54	6.28	13.10	Brain, CNS	26.7	6.71	2.33	5.99	Colorectum	56.6	15.58	6.59	11.74
7	Cervix	54.8	15.08	2.73	12.47	Leukemia	22.5	5.65	1.96	5.24	Cervix	54.8	15.08	6.38	12.47
8	Brain, CNS	49.1	6.45	2.45	5.52	Bladder	17.4	4.37	1.52	3.72	Uterus	30.0	8.26	3.49	6.61
9	Uterus	30.0	8.26	1.50	6.61	Pancreas	16.1	4.05	1.41	3.32	Ovary	24.8	6.82	2.89	5.76
10	Ovary	24.8	6.82	1.24	5.76	Bone	11.5	2.89	1.01	2.65	Brain, CNS	22.4	6.16	2.60	4.98

\* , age-standardized incidence rate (China population, 2000); CNS, central nervous system.

**Table 11** Top 10 cancer mortality in rural areas of Henan province, 2012

Rank	Site	Both sexes				Male				Female					
		Deaths (hundred)	Mortality (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Deaths (hundred)	Mortality (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )	Site	Deaths (hundred)	Mortality (1/10 <sup>5</sup> )	%	ASR* (1/10 <sup>5</sup> )
1	Lung	286.6	37.62	22.28	29.19	Lung	198.6	49.83	25.06	41.52	Lung	88.0	24.22	17.82	17.72
2	Stomach	244.3	32.06	18.99	24.76	Stomach	169.9	42.61	21.43	35.21	Esophagus	80.8	22.25	16.37	15.86
3	Esophagus	216.0	28.35	16.79	21.69	Liver	142.1	35.64	17.92	29.42	Stomach	74.4	20.49	15.08	14.85
4	Liver	200.8	26.35	15.61	20.66	Esophagus	135.2	33.91	17.05	27.88	Liver	58.7	16.15	11.88	11.97
5	Colorectum	65.1	8.54	5.06	6.66	Colorectum	36.5	9.16	4.61	7.62	Breast	46.5	12.80	9.42	9.93
6	Breast	46.5	12.80	3.61	9.93	Brain, CNS	15.0	3.76	1.89	3.33	Colorectum	28.6	7.86	5.79	5.76
7	Brain, CNS	27.9	3.67	2.17	3.09	Leukemia	13.4	3.36	1.69	3.20	Cervix	20.1	5.53	4.07	4.24
8	Leukemia	23.1	3.04	1.80	2.80	Pancreas	13.0	3.27	1.64	2.69	Brain, CNS	12.9	3.56	2.62	2.82
9	Pancreas	21.9	2.87	1.70	2.23	Bladder	7.5	1.87	0.94	1.63	Leukemia	9.7	2.68	1.97	2.38
10	Cervix	20.1	5.53	1.56	4.24	Bone	6.6	1.65	0.83	1.40	Ovary	9.3	2.56	1.88	1.99

\* , age-standardized mortality rate (China population, 2000); CNS, central nervous system.

population-based cancer registries in Henan province for data collection, sorting, verification and database creation.

### Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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**Cite this article as:** Liu S, Chen Q, Quan P, Zhang M, Zhang S, Guo L, Sun X, Wang C. Cancer incidence and mortality in Henan province, 2012. *Chin J Cancer Res* 2016;28(3):275-285. doi: 10.21147/j.issn.1000-9604.2016.03.02