

## RESEARCH ARTICLE

# Pancreatic Cancer Incidence and Mortality Patterns in China, 2009

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### Abstract

**Objective:** To estimate the incidence and mortality rates for pancreatic cancer in China. **Methods:** After checking and reviewing the cancer registry data in 2009 from 72 cancer registry centers, we divided cancer registry areas into urban and rural areas. Incidence/mortality rates, age-specific incidence/mortality rates, age-standardized incidence/mortality rates, proportions, and cumulative incidence/mortality rates for pancreatic cancer were calculated. **Results:** The total number of newly diagnosed pancreatic cancer cases and deaths in 2009 were 6,220 and 5,650, respectively. The crude incidence rate in all cancer registry areas was 7.28/100,000 (males 8.24, females 6.29). The age-standardized incidence rate by Chinese standard population (ASR) was 3.35/100,000, with ranking at 7th among all cancers. Pancreatic cancer incidence rate was 8.19/100,000 in urban areas whereas it was 5.41/100 000 in rural areas. Cancer mortality rate in all cancer registry areas was 6.61/100,000 (males 7.45; females 5.75), with ranking at 6th among all cancers, and 7.42/100 000 in urban but 4.94/100000 in rural areas. **Conclusions:** Pancreatic cancer incidence and mortality rates have shown a gradual increase in China. Owing to the difficulty of early diagnosis, identification of high-risk population and modification of risk factors are important to reduce the burden of pancreatic cancer.

**Keywords:** Pancreatic cancer - cancer registry - incidence - mortality - China

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### Introduction

Pancreatic cancer is one of the most dismal malignancies. Lack of highly sensitive and specific test and the early symptoms, it is difficult to early discovery, diagnosis and treatment. Unfavorable response to both chemotherapy and radiotherapy results in an exceptionally poor prognosis. Surgery is the most effective therapy to cure this disease, but the mean 5-year survival rate after resection is only 15%-25% (Gudjonsson, 2009; Tempero et al., 2010).

With an estimated 266 000 deaths in 2008, pancreatic cancer is the seventh leading cause of cancer deaths worldwide (GLOBOCAN, 2008). However, data are lacking on the incidence and mortality patterns in China. According to the latest available date from 72 cancer registries throughout China, pancreatic cancer ranks the seventh in cancer-related incidence and the sixth in mortality in 2009.

### Materials and Methods

#### Data source

Data source from 104 registries (46 in urban areas and 58 in rural areas) was submitted to National Central Cancer Registry. The coverage population was 109,476,347

(55,654,485 men and 53,821,862 women), accounting for 8.20% of the national population at the end of 2009.

#### Quality control

According to "Guideline of Chinese Cancer Registration (National Center for Cancer Registry, 2004)", we checked the data quality using the inclusion criteria in "Cancer Incidence in Five Continents Volume IX" (Curado et al., 1994), which was required by the International Agency for Cancer Registry (IACR) and the International Agency for Research on Cancer (IACR) (Parkin et al., 1994; Ferlay et al., 2005). We used software including MS-Excel, SAS, IARC Tools issued by the International Agency for Research on Cancer/the International Association of Cancer Registries (IARC/IACR) for data check and evaluation (Ferlay, 2006). The data were included in the present analysis if they met the following criteria: morphological verification (MV%) higher than 66%, percentage of cancer cases identified with death certification only (DCO%) less than 15%, and mortality to incidence ratio (M/I) between 0.6 and 0.8.

#### Statistical analysis

Cancer registry areas were divided into urban and rural areas. Incidence/mortality rates, age-specific incidence/mortality rates, age-standardized incidence/mortality rates,

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**Table 1. Pancreatic Cancer Incidence and Mortality, 2009**

Area	Gender	New cases	Deaths	M/I	MV%
All	Both sexes	6220	5650	0.91	37.96
	Male	3562	3220	0.90	39.14
	Female	2658	2430	0.91	36.38
Urban areas	Both sexes	4707	4268	0.91	38.39
	Male	2712	2444	0.90	39.97
	Female	1995	1824	0.91	36.24
Rural areas	Both sexes	1513	1382	0.91	36.62
	Male	850	776	0.91	36.47
	Female	663	606	0.91	36.80

**Table 2. Incidence Rates of Pancreatic Cancer in 2009 (1/10<sup>5</sup>)**

Area	Crude rate (1/10 <sup>5</sup> )	Proportion (%)	ASR China (1/10 <sup>5</sup> )	ASR world (1/10 <sup>5</sup> )	Cumulative rate 0-74(%)	Truncated rate 35-64 (1/10 <sup>5</sup> )
Gender						
All						
Both sexes	7.28	2.55	3.35	4.63	0.54	6.01
Male	8.24	2.59	4.01	5.53	0.65	7.35
Female	6.29	2.49	2.72	3.77	0.44	4.65
Urban areas						
Both sexes	8.19	2.70	3.59	4.96	0.57	6.36
Male	9.36	2.83	4.33	6.00	0.69	8.00
Female	7.00	2.53	2.88	4.00	0.46	4.72
Rural areas						
Both sexes	5.41	2.16	2.81	3.83	0.47	5.22
Male	5.97	2.04	3.26	4.43	0.56	5.91
Female	4.83	2.35	2.36	3.24	0.38	4.50

proportions, and cumulative incidence/mortality rates were calculated for pancreatic cancer. Age-standardized rates was calculated using the Chinese population (1982) (ASR China) and World Segi's population (ASR world). Using Jionpoint regression analysis calculate annual percent change of incidence and mortality rate.

## Results

### Data pooling and quality evaluation

The data from 72 registries were qualified and accepted for publication in the cancer registry annual report in 2012, including 31 urban areas and 41 rural areas (Table 1).The coverage population of all 72 cancer registries was 85 470 522 (43 231 554 men and 42 238 968 women). The total pancreatic cancer incident cases were 6220 (3562 for males and 2658 for females) and the deaths were 5650 (3220 for males and 2430 for females), respectively.

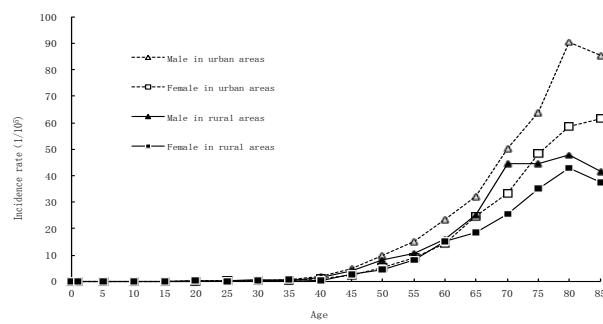
### Incidence rate

In 2009, the crude incidence rate of pancreatic cancer in the registry areas was 7.28 per 100 000 (8.24 per 100 000 for males and 6.29 per 100 000 for females), accounting for 2.55% of all cancers. The age-standardized rates were 3.35 per 100 000 and 4.63 per 100 000, respectively, after being standardized by the age structures of Chinese and the world populations. For patients aged 0-74 years, the cumulative incidence rate was 0.54%. In urban areas, the incidence rate was 8.19 per 100 1000 (9.36 per 100 000 for males and 7.00 for females), while in rural areas, it was 5.41 per 100 000 (5.97 per 100 000 for males and 4.83 per 100 000 for females) Standardized by the age structures of China and the world, in urban areas the age-standardized rates were 3.59

**Table 3. Incidence Rates of Pancreatic Cancer, 2003-2009**

Areas	2003	2004	2005	2006	2007	2008	2009
Gender							
ALL							
Both sexes	6.26	6.54	6.67	7.19	7.35	8.21	8.37 <sup>a</sup>
Male	6.83	7.29	7.40	7.74	8.00	9.01	9.48
Female	5.67	5.77	5.93	6.63	6.68	7.57	7.24
Urban Areas							
Both sexes	7.02	7.05	7.23	7.74	7.83	8.82	8.93
Male	7.60	7.88	8.08	8.31	8.37	9.66	10.18
Female	6.41	6.19	6.34	7.17	7.27	7.98	7.66
Rural Areas							
Both sexes	3.94	4.80	4.74	5.23	5.62	6.00	6.36
Male	4.43	5.26	4.98	5.71	6.65	6.50	6.97
Female	3.44	4.35	4.50	4.74	4.58	6.05	5.75

<sup>a</sup>From 2003 to 2009, annual percent change(APC) of incidence rates is 5.29

**Figure 1. Incidence Rates of Pancreatic Cancer in All Registration, 2009**

per 100 000 and 4.96 per 100 000. Both crude incidence rates and age-standardized incidence rates in urban areas were higher than those in rural areas (Table 2).

### Age-specific incidence rate

The age-specific incidence rate was low before 40 years old, and dramatically increased after then. The incidence rate among men was 90.42 per 100 000 and 47.86 per 100 000 in urban and rural areas. They reached a peak in the age group of 80- years. For women, the incidence rate reached a peak at the age group of 85-years, which were 61.60 per 100 000 in urban areas, whereas at the age group of 80-years which were 42.86 per 100 000 in rural areas.

For men, the age-specific incidence rate was similar before the age group of 40 years, but it was higher in the urban than that in rural areas aged 40 to 85 years old. It was higher in the urban than that in rural areas for females after the age group of 50- years (Figure 1).

### Incidence rates of pancreatic cancer from 2003 to 2009

About incidences of pancreatic cancer, there were fluctuations in the different regions and gender. But the percentage of incidence rate increased that the rate was from 6.26/10<sup>5</sup> in 2003 up to 8.37/10<sup>5</sup> in 2009. During the period 2003 to 2009, the incidence rate was 6.83/10<sup>5</sup> up to 9.48/10<sup>5</sup> in male and 5.67/10<sup>5</sup> up to 7.24/10<sup>5</sup> in female. In urban areas, the rate was 1.27 times higher in 2009 than that in 2003. Meanwhile, the incidence rate increased 1.61 times from 2003 to 2009 in rural areas (Table 3).

**Table 4. Mortality of Pancreatic Cancer in 2009 (1/10<sup>5</sup>)**

Area Gender	Crude rate (1/10 <sup>5</sup> )	Proportion (%)	ASR China (1/10 <sup>5</sup> )	ASR world (1/10 <sup>5</sup> )	Cumulative rate 0-74(%)	Truncated rate 35-64 (1/10 <sup>5</sup> )
All						
Both sexes	6.61	3.66	2.98	4.15	0.48	4.96
Male	7.45	3.32	3.59	4.98	0.57	6.17
Female	5.75	4.23	2.41	3.37	0.39	3.73
Urban areas						
Both sexes	7.42	4.08	3.19	4.44	0.51	5.21
Male	8.43	3.77	3.87	5.39	0.61	6.66
Female	6.40	4.58	2.54	3.55	0.41	3.75
Rural areas						
Both sexes	4.94	2.78	2.51	3.46	0.41	4.40
Male	5.45	2.41	2.93	4.00	0.48	5.09
Female	4.41	3.44	2.10	2.93	0.34	3.69

**Table 5. Mortality Rates of Pancreatic Cancer, 2003-2009**

Areas Gender	2003	2004	2005	2006	2007	2008	2009
ALL							
Both sexes	5.63	5.98	6.33	6.72	7.32	7.33	7.78 <sup>a</sup>
Male	6.06	6.60	7.00	7.28	7.78	7.94	8.70
Female	5.18	5.35	5.63	6.16	6.84	6.85	6.86
Urban Areas							
Both sexes	6.33	6.48	6.79	7.29	7.95	7.79	8.25
Male	6.78	7.14	7.55	7.98	8.31	8.34	9.30
Female	5.86	5.79	6.01	6.59	7.57	7.24	7.18
Rural Areas							
Both sexes	3.47	4.29	4.69	4.70	5.05	5.63	6.10
Male	3.82	4.74	5.08	4.77	5.84	6.40	6.51
Female	3.11	3.84	4.30	4.62	4.25	5.37	5.69

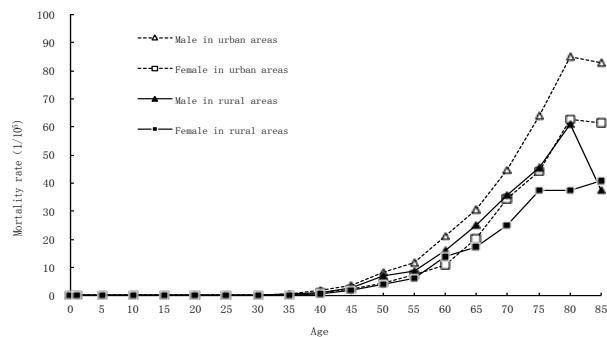
<sup>a</sup>From 2003 to 2009, APC of mortality rates is 5.53

### Mortality

The crude mortality rate of pancreatic cancer was 6.61 per 100 000 (7.45 per 100 000 in males and 5.75 per 100 000 in females). The China standardized rate was 2.98 per 100 000, compared with the world standardized rate of 4.15 per 100 000. The cumulative rate (0~74 years old) was 0.48%. The crude mortality rate of pancreatic cancer in urban areas was 7.42 per 100 000 (8.43 per 100 000 in males and 6.40 per 100 000 in females). The age-standardized mortality rates based on the Chinese standard population (ASR) and the world standard population (ASR) were 3.19 per 100 000 and 4.44 per 100 000, respectively. Among patients aged 0-74 years, the cumulative incidence rate was 0.48%. In rural areas, the crude mortality rate was 4.94 per 100 000 (5.45 per 100 000 in males and 4.41 per 100 000 in females). The ASMR was 2.51 per 100 000 and the ASMRW was 3.46 per 100 000. The cumulative mortality (0-74 years) was 0.48%. Urban areas had a higher mortality than rural areas did (Table 4).

### Age-specific mortality rate

The trend in the age-specific mortality rate in urban areas was similar to that in rural areas. The age-specific mortality rate was relatively low in the population younger than 40 years old. There was a dramatic increase in the mortality rate after 50 years old. The peak appeared at the age group of 80 years in males, and then decreased slightly after 85 years old. In urban areas, the age-specific



**Figure 2. Mortality Rates of Pancreatic Cancer in All Registration, 2009**

mortality rate reached a peak in the age group of 80- years, whereas it reached a peak at the age group of 85- years in rural areas.

The age-specific mortality rate among males was higher in urban areas than in rural areas in all age groups, except for the age group of 35-39 years. For females, it had the same trend except for the age groups of 20-24 and 60-64 years (Figure 2)

### Mortality rates of pancreatic cancer from 2003 to 2009

Between 2003 and 2007, the mortality rates of pancreatic cancer showed an approximately 1.4-fold increase; from 5.63/10<sup>5</sup> in 2003 to 7.78/10<sup>5</sup> in 2009. During the period 2003-2009, the incidence rates increased from 6.06/10<sup>5</sup> to 8.70/10<sup>5</sup> in males, and from 5.18/10<sup>5</sup> to 6.86/10<sup>5</sup> in females. The upward trend in mortality rates was observed in both urban areas and rural areas, and in both males and females (Table 5).

## Discussion

Pancreatic cancer is a relatively common malignant tumor. Because of insidious and rapid progressive nature of and a lack of an effective screening method for the malignancy, most patients are diagnosed at an advanced stage. Pancreatic cancer is almost uniformly fatal with a median survival of 6 months or less, and a 5-year survival of only 4% (Rulyak et al., 2004). Meanwhile, survival has changed little over the past 25 years despite increasing understanding of the pathogenesis of pancreatic cancer and improvements in clinical management.

The International Agency for Research on Cancer reported that 278684 new cases and 266669 deaths of this disease occurred worldwide in 2008. Pancreatic cancer was the thirteenth leading cause of cancer mortality and the seventh leading cause of incidence among both men and women. While, based on data from Chinese Cancer Registry Annual Report in 2012, pancreatic cancer incidence accounted for 2.55% of all malignant tumors, making it the seventh most common cancer. Furthermore, the mortality from pancreatic cancer accounted for 3.66% of all malignant tumors, which were ranked in the sixth place. Both in urban and rural areas, its incidence and mortality were ranked ninth and sixth, respectively.

Pancreatic cancer incidence and mortality rates have shown a gradual upward trend. Using Jointpoint regression analysis, Gu et al. (2011) reported that the standardized incidence rates among Shanghai residents had shown a

continuous increase from 3.38 to 6.29 per 100,000 during the period between 1973 and 2007. The incidence of male increase as an annual rate of 3.9% before 1982, and rising by 1.3% from 1982 to 2007, while it keeps increasing as an annual rate of 1.7% for women. Wang et al. (2005) indicated that the mortality rate from pancreatic cancer showed a gradual upward trend between 1991 to 2000 in China. The studies about pancreatic cancer of National Cancer Registration Center in 2009 report that incidence of pancreatic cancer was 7.28 per 100000, and mortality of pancreatic was 6.61 per 100000 in 2009, compared with the data of GLOBOCAN 2008, male incidence of pancreatic cancer in china (World standard rate 4.63 per 100000) was higher than average level of the world (4.3) and developing country (2.1), but lower than developed country (14.2), the trend of female was the same as the male. From 2003 to 2009, the APC incidence and mortality rates were 5.29 and 5.53 in China.

Previous studies had provided evidence in support of the associations of pancreatic cancer with genetic susceptibility, environmental factors, and medical condition. First, hereditary factors were estimated to be involved in approximately 10% of patients with pancreatic carcinoma. Patients with pancreatic cancer were cared for in a large kindred in China. The risk of this disease increased with the number of first-degree relatives who had pancreatic cancer. The OR was 4.6 (95%CI:0.5-16.4) (Greer et al., 2009). What is more, among environmental factors, smoking was an established risk factor. R. Talamini et al. (2010) reviewed that pancreatic cancer was associated to current smoking (OR = 1.68; 95% CI: 1.13-2.48), and the risk rose with increasing number of cigarettes/day (OR = 2.04; 95% CI: 1.14-3.66 for  $\geq 20$  cigarettes/day). No association emerged for former smokers (OR = 0.98; 95% CI: 0.66-1.45). They showed that there were linked between smoking and pancreatic cancer. Compared with developing countries, developed countries have a higher incidence and mortality rates of pancreatic cancer. According to data from the registration areas, the incidence rate was 51.4% higher in urban areas than that in rural areas, and it remained 27.8% higher after being age-standardized. The mortality was 50.2% higher in the urban than that in rural areas, and it remained 27.1% higher after being age-standardized. Westernized eating habits and people's living standards may brought out that results. Dieting with high oil, fat and low in fiber were contributed to pancreatic cancer. Concerning medical conditions, Muniraj et al. (2012) found that diabetes or impaired glucose tolerance is present in more than 2/3rd of pancreatic cancer patients. In particular, a positive relationship was observed between the incidence of type-II diabetes and late-onset diabetes and pancreatic cancer risk. Hu et al. (2011) demonstrated that the number of people with pancreatic cancer who had diabetes were significantly higher than other disease patients who had diabetes, with an odds ratio of 5.51. Long term hyperglycemia was a chronic stimulation of the pancreas, pancreatic cancer cells may lead to this situation. Studies from China and other countries reported mixed findings on the association between chronic pancreatitis and pancreatic cancer. The research found an effect of smoking, alcohol drinking group on the prognosis of patients with chronic pancreatitis. Klein et al. (2013) made an absolute risk model of pancreatic cancer to demonstrate that family history of

pancreatic cancer (OR: 1.60 [1.20-2.12]), current smoking (OR :2.20 [1.84-2.62]), heavy alcohol use (3 drinks/day) (OR: 1.45 [1.19-1.76]), obesity (body mass index .30 kg/m<sup>2</sup>) (OR: 1.26 [1.09-1.45]), diabetes > 3 years (nested case-control OR: 1.57 [1.13-2.18]).

Our research only cover 8.20% population in China. Maybe the data had some limitations. It was difficult to diagnose pancreatic cancer, MV% was lower than the overall. But all the data from registry areas met the quality requirements of national institute of standards.

In summary, pancreatic cancer incidence and mortality rates showed a gradual increase in China. Owing to the difficulty of early diagnosis, identification of high-risk population and modification of risk factors are important strategies to reduce the burden of pancreatic cancer. Our objective were to discover objective imaging findings that would identify which family members were destined to have pancreatic cancer so they could be offered pancreatectomy and avoid near certain death from the disease.

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