RESEARCH ARTICLE

Analysis of Esophageal Cancer Time Trends in China, 1989-2008

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Abstract

National cancer incidence data were utilized to analyze trends in esophageal cancer incidence in China in order to provide basic information for making cancer control strategy. We retrieved and re-sorted valid esophageal cancer incidence data from National Central Cancer Registry Database over 20 years period from 1989 to 2008. Crude incidence and age-standardized incidence rates were calculated for analysis, with annual percent change estimated by Joinpoint software for long term trend analysis. The crude incidence rate of esophageal cancer was found to have remained relatively stable in both urban and rural areas over the 20 year period. Age standardized incidence rate (ASR) in cancer registration areas decreased from 39.5/100,000 in 1989 to 23.0/100,000 in 2008 in all areas (AAPC=-3.3%, 95% CI:-2.8~-3.7). The trend was no change in urban areas and 2.1% average annual decrease observed in rural aras. Before the year of 2000, esophageal cancer incidence rates significant decreased with 2.8% annually and then the rates kept stable. Over 20 years from 1989 to 2008, esophageal cancer age standardized incidence rate in cancer registration areas decreased with time. However, esophageal cancer is still a big issue and efforts for control should be continuously enhanced. Cancer registration is playing an important role in cancer control with the number of registries increasing and data quality improving in China.

Keywords: Esophageal Cancer - incidence - trend analysis - cancer registry - China

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Introduction

Esophageal cancer was the world's eighth most common incident cancer, with 481,645 new cases in 2008 and was the sixth most leading cause of cancer death, with 406,533 deaths (Jemal et al., 2011). The greatest burden of esophageal squamous cell carcinoma occurs in the "Asian Esophageal Cancer Belt", extending from northern Iran, east to China, and north to Russia (Glenn, 2001). Although the incidence of esophageal adenocarcinoma in Western countries has been rapidly increasing over the past few decades (Bosetti et al., 2008), the incidence of esophageal squamous cell carcinoma in the world seems to be relatively stable or slightly decreased (Devesa et al., 1998; He et al., 2008; Lepage et al., 2008) .

Approximately 53.8% and 51.9% of all esophageal cancers occurred and died in China. China's mortality rates have decreased somewhat over the past three decades with the improvement of its socio-economic status and lifestyle. According to the recent data from The Third National Death Sruvey (2004-2005), the mortality rate has declined by 33.6% and 41.6% compared with the second survey in 1990-1992 and the first survey in 1973-1975, respectively. However, esophageal cancer remains the fourth most common fatal cancer in both the urban and rural parts of China (Wei et al., 2010).

Cancer Registration is a process of continuing, systematic collection of data on the occurrence and characteristics of reportable malignant neoplasm with the purpose of helping to asses and controls the impact of cancer in the community. The National Cancer Registration Network collects information on cancer cases from population-based cancer registries in China each year since 1970s. The national center for cancer registries in China was established in 2002. Since 2008, the Ministry of Health has supported financially to the Registries in the form of central transfer payments. Till 2011, there were 195 local cancer registries, covering a population of 190 million (Li et al., 2009). The data quality was improved remarkably with the number of registries increasing. Till now, there isn't research result of esophageal cancer incidence trend in national level. Thus, analyzing trends on esophageal cancer incidence in China using National cancer incidence data will provide basic information for making cancer control strategy.

Materials and Methods

Source of the data

Data on population and cancer new cases in China during the period of 1989–2008 were obtained from official publications of the National Central Cancer Registy. Data from 10 cancer registries was included in the publications during 1989—1991. Then the number

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Table 1. Annual Population Coverage and Incident Cases of Esophageal Cancer in Chinese Cancer Registries, 1989—2008

Year	Number of	All		Urban		Rural	
	registries	Population	Incident cases	Population	Incident cases	Population	Incident cases
1989	10	20 356 468	3569	16 416 046	1857	3 940 422	1712
1990	10	20 969 190	3882	16 899 169	1952	4 070 021	1930
1991	10	21 097 356	3677	16 991 721	1833	4 105 635	1844
1992	11	21 957 795	3539	17 824 697	1791	4 133 098	1748
1993	11	21 571 576	3563	17 415 521	1816	4 156 055	1747
1994	11	21 431 753	3410	17 260 630	1702	4 171 123	1708
1995	11	21 434 742	3461	17 255 347	1745	4 179 395	1716
1996	11	21 446 433	3524	17 254 320	1710	4 192 113	1814
1997	11	21 560 482	3071	17 349 441	1595	4 211 041	1476
1998	20	30 597 756	6352	22 076 322	2995	8 521 434	3357
1999	20	30 742 521	6568	22 181 693	3153	8 560 828	3415
2000	23	35 933 101	6703	27 332 045	3365	8 601 056	3338
2001	23	36 476 211	6801	27 863 585	3418	8 612 626	3383
2002	23	36 721 179	6752	28 097 210	3463	8 623 969	3289
2003	33	50 636 241	9470	39 125 108	4171	11 511 133	5299
2004	35	56 979 172	11071	44 153 595	4895	12 825 577	6176
2005	34	53 780 183	10736	40 943 839	4518	12 836 344	6218
2006	35	61 635 451	11593	50 049 719	6151	11 585 732	5442
2007	39	60 376 657	12127	46 046 151	5486	14 330 506	6641
2008	41	66 138 784	13792	52 158 495	6997	13 980 289	6795
Total		711 843 051	133661	554 694 654	64613	157 148 397	69048

Table 2. Crude Incidence Rates of Esophageal Cancer in China from 1989—2008 (1/100 000)

Year	Both sexes			male			female		
	all areas	urban	rural	all areas	urban	rural	all areas	urban	rural
1989	35.03	11.31	43.45	42.21	14.90	51.91	27.58	7.55	34.70
1990	37.95	11.55	47.42	45.35	15.33	56.13	30.30	7.60	38.44
1991	35.72	10.79	44.91	42.78	14.69	53.14	28.39	6.71	36.38
1992	33.44	10.05	42.29	40.21	13.65	50.27	26.39	6.29	34.00
1993	33.19	10.43	42.04	40.37	13.97	50.63	25.73	6.75	33.11
1994	32.09	9.86	40.95	38.85	13.77	48.85	25.06	5.82	32.73
1995	32.07	10.11	41.06	37.39	13.43	47.19	26.55	6.68	34.68
1996	33.10	9.91	43.27	38.79	13.79	49.75	27.15	5.90	36.47
1997	26.80	9.19	35.05	32.58	12.93	41.79	20.80	5.33	28.05
1998	30.78	13.57	39.39	37.36	16.73	47.69	23.99	10.29	30.85
1999	30.96	14.21	39.89	38.29	18.46	48.86	23.41	9.81	30.66
2000	29.21	12.31	38.81	35.65	16.64	46.45	22.59	7.83	30.97
2001	29.11	12.27	39.28	35.92	16.40	47.72	22.09	7.95	30.63
2002	28.05	12.33	38.14	35.44	16.47	47.61	20.43	7.99	28.42
2003	31.69	10.66	46.03	40.18	15.24	57.17	23.10	5.93	34.81
2004	32.67	11.09	48.15	42.23	15.94	61.08	23.00	6.10	35.11
2005	32.36	11.03	48.44	41.61	16.26	60.72	23.00	5.63	36.10
2006	31.59	12.29	46.97	40.58	17.97	58.59	22.52	6.51	35.28
2007	30.54	11.91	46.34	39.74	17.47	58.62	21.21	6.24	33.91
2008	32.06	13.41	48.60	41.80	19.88	61.23	22.12	6.86	35.65

of cancer registries increased by year. Till 2008, there were 41 cancer registries' data published in the annual report. The number of cancer registries, the annual population coverage and incident cases of esophageal cancer from 1989—2008 were shown in Table 1. The quality of the data were checked by National Central Cancer Registry based on the "Guideline for Chinese Cancer Registration" and the quality requirement of "Cancer Incidence Five continents Volume ninth" which published by International Agency for Research on Cancer (IARC) and International Association of Cancer Registries (IACR) (Jensen et al., 1991; Bray et al., 2009) ICD10 (International Classification of Disease for Oncology, version 10) was used as criteria to classify cancer cases (Fritz, 2000). Population data was used as the cancer registries population coverage for the same period. Counties and county-level cities were defined as rural areas whereas prefecture-level cities, provincial capitals and municipalities were defined as urban areas.

Statistical Analysis

The esophageal cancer incidence database was retrieved from the National Central Cancer Registry database. For each gender, urban and rural esophageal cancer incidence rates were calculated. World Segi's population structure were used for age-standardized rates. Trends in crude and age-standardized cancer incidence rates were analyzed using Joinpoint regression, which

Table 3. Age Standardized Incidence Rates of Esophageal Cancer in China from 1989—2008 (1/100 000)

Year	Both sexes			male			female		
	all areas	urban	rural	all areas	urban	rural	all areas	urban	rural
1989	39.46	9.49	50.11	52.01	14.01	65.51	28.72	5.72	36.89
1990	42.95	9.55	54.93	56.21	14.37	71.22	31.95	5.69	41.37
1991	40.31	8.73	51.95	53.39	13.24	68.19	29.64	4.91	38.76
1992	37.52	7.71	48.81	49.16	11.41	63.45	27.58	4.45	36.33
1993	36.09	8.00	47.01	47.87	11.79	61.90	26.10	4.78	34.39
1994	34.92	7.72	45.77	45.86	11.87	59.41	25.60	4.17	34.15
1995	34.41	7.52	45.41	43.40	10.96	56.67	26.89	4.53	36.04
1996	35.28	6.96	47.69	44.55	10.63	59.42	27.18	3.83	37.42
1997	28.32	6.48	38.55	37.74	10.17	50.66	20.50	3.42	28.51
1998	28.35	9.87	37.59	36.64	13.06	48.44	20.79	6.99	27.69
1999	28.14	10.34	37.63	37.02	14.31	49.13	19.99	6.74	27.05
2000	25.86	9.13	35.36	33.35	13.30	44.74	18.90	5.39	26.57
2001	25.33	8.78	35.33	33.07	12.64	45.41	18.13	5.25	25.91
2002	24.24	8.71	34.21	32.05	12.53	44.57	17.04	5.24	24.61
2003	25.93	7.24	38.66	34.28	10.98	50.16	18.21	3.79	28.04
2004	24.89	7.59	37.30	33.36	11.55	49.00	16.77	3.89	26.01
2005	25.25	7.35	38.74	34.05	11.51	51.04	17.12	3.45	27.42
2006	24.67	8.23	37.77	33.32	12.74	49.72	16.75	4.02	26.90
2007	23.63	7.75	37.09	31.87	11.95	48.77	15.75	3.78	25.91
2008	22.95	8.30	35.94	31.21	13.02	47.33	15.10	3.91	25.02

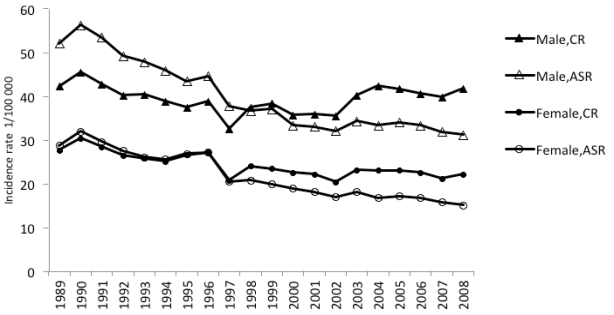

Figure 1. Time Trends of Esophageal Cancer Incidence in All Areas, 1989-2008

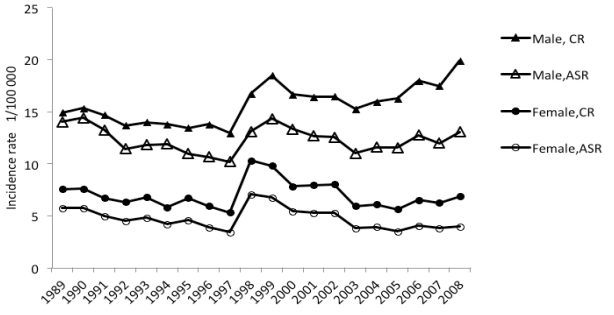

Figure 2. Time Trends of Esophageal Cancer Incidence in All Areas, 1989-2008

fitted up to two joined straight lines on alogarithmic scale to the trends in the annual rates. The trends of various periods were described by the annual percent change (APC). The average annual percent change (AAPC) was estimated as a geometric weighted average of the APCs in the period of 1999 to 2008 weighed by the length of internals. Joinpoint analyses were performed using the software which is called "Joinpoint Regression Program 3.5.2" from the Surveillance Research Program of the US National Cancer Institute (Kim et al., 2000).

Results

The crude incidence rates (CR) of esophageal cancer in both areas and both sexes was 35.03 per 100,000 in 1989 and was 32.06 per 100,000 in 2008 (42.21 per 100,000 and 41.80 per 100,000 in male; 27.58 per 100,000 and 22.12 per 100,000 in female). The CR in urban areas increased from 11.31 per 100,000 in 1989 to 13.41 per 100,000 in 2008 (14.90 per 100,000 to 19.88 per 100,000 in male and 7.55 per 100,000 to 6.86 per 100,000 in female). In rural areas, the CR was 43.45 per 100,000 in 1989 and was 48.60 per 100,000 in 2008 (51.91 per 100,000 and 61.23 per 100,000 in male; 34.70 per 100,000 and 35.65 per 100,000 in female) (Table 2, Figure 1-3).

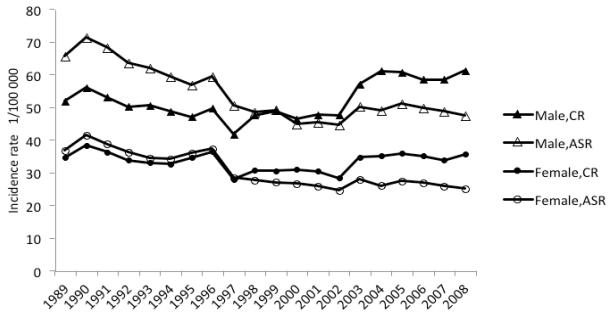

Figure 3. Time Trends of Esophageal Cancer Incidence in Rural Areas, 1989-2008

In all registry areas, the age standardized rates (ASR) decreased from 39.46 per 100,000 in 1989 to 22.95 per 100,000 in 2008 (52.01 per 100,000 to 31.21 per 100,000 in male and 28.72 per 100,000 to 15.10 per 100,000 in female). In urban areas, the ASR slightly decreased from 9.49 per 100,000 in 1989 to 8.30 per 100,000 in 2008 (14.01 per 100,000 in to 13.02 per 100,000 in male and 5.72 per 100,000 to 3.91 per 100,000 in female). In rural areas, the ASR decreased from 50.11 per 100,000 in 1989 to 35.94 per 100,000 in 2008 (65.51 to 47.33 per 100,000 in male and 36.89 per 100,000 to 25.02 per 100,000 in female) (Table 3, Figure 1-3).

Time trend analysis for cancer registry data shown the CR decreased 0.7% annually with 1.5% of decreasing in female and no change in male for allover registries. CR

Table 4. Joinpoint Analysis of Esophageal Cancer Crude Incidence

Area	Sex	Trend 1			Trend 2					
		Period	APC	95% CI	Period	APC	95% CI	Period	AAPC	95% CI
Total	Male	1989~1997	-2.8*	-4.2 ~-1.4	1997~2008	1.5*	0.6 ~2.5	1989-2008	-0.2	-0.8 ~0.4
	Female	1989~2001	-2.3*	-3.3 ~-1.2	2001~2008	0.2	-2.3 ~2.7	1989-2008	-1.5*	-2.0 ~-1.0
	Total	1989~1997	-2.8*	-4.2 ~-1.5	1997~2008	0.7	-0.2 ~1.6	1989-2008	-0.7*	-1.2 ~-0.1
Urban	Male	1989~1994	-1.9	-7.1 ~3.6	1994~2008	2.2*	1.0 ~3.3	1989-2008	1.4*	0.7 ~2.1
	Female	1989~2000	1.4	-2.3 ~5.2	2000~2008	-3.0	-8.6 ~3.0	1989-2008	-0.3	-1.7 ~1.1
	Total	1989~1992	-4.2	-19.0 ~13.4	1992~2008	1.3*	0.0 ~2.6	1989-2008	0.9	0.0 ~1.8
Rural	Male	1989~1997	-2.5*	-4.2 ~-0.8	1997~2008	3.1*	2.0 ~4.2	1989-2008	0.9*	0.1 ~1.6
	Female	1989~2000	-1.8*	-3.1 ~-0.4	2000~2008	2.4*	0.2 ~4.7	1989-2008	-0.2	-0.8 ~0.5
	Total	1989~1998	-2.1*	-3.7 ~-0.5	1998~2008	2.7*	1.3 ~4.2	1989-2008	0.5	-0.2 ~1.2

APC, annual percent change; AAPC, average annual percent change; *P<0.05

Table 5. Joinpoint Analysis of Esophageal Cancer Age-adjusted Incidence

Area	Sex	Trend 1			Trend 2					
		Period	APC	95% CI	Period	APC	95% CI	Period	AAPC	95% CI
Total	Male	1989~2001	-4.3*	-5.0 ~-3.6	2001~2008	-0.4	-2.1 ~1.3	1989-2008	-3.1*	-3.6 ~-2.6
	Female	1989~2002	-4.4*	-5.3 ~-3.4	2002~2008	-2.2	-5.3 ~1.0	1989-2008	-3.9*	-4.3 ~-3.4
	Total	1989~2001	-4.2*	-5.1 ~-3.4	2001~2008	-1.1	-3.0 ~0.8	1989-2008	-3.3*	-3.7 ~-2.8
Urban	Male	1989~1993	-5.6	-13.4 ~2.9	1993~2008	0.6	-0.6 ~1.7	1989-2008	-0.2	-1.0 ~0.5
	Female	1989~2000	0.4	-3.5 ~4.6	2000~2008	-4.4	-10.5 ~2.1	1989-2008	-1.5	-2.9 ~0.0
	Total	1989~1992	-6.8	-22.9 ~12.5	1992~2008	0.2	-1.3 ~1.6	1989-2008	-0.4	-1.4 ~0.5
Rural	Male	1989~2000	-3.9*	-4.8 ~-2.9	2000~2008	0.9	-0.7 ~2.4	1989-2008	-2.1*	-2.7 ~-1.4
	Female	1989~2001	-3.7*	-4.9 ~-2.4	2001~2008	0.0	-2.9 ~2.9	1989-2008	-2.5*	-3.1 ~-1.9
	Total	1989~2000	-3.7*	-4.7 ~-2.7	2000~2008	0.4	-1.3 ~2.2	1989-2008	-2.1*	-2.7 ~-1.5

APC, annual percent change; AAPC, average annual percent change; *P<0.05

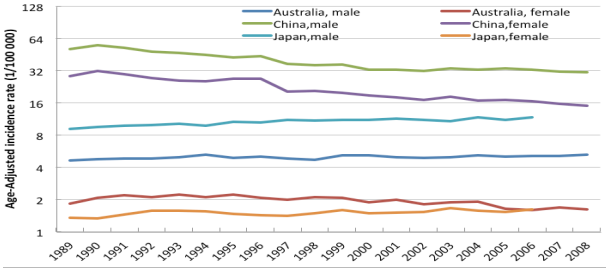

Figure 4. Time Trend Comparison of Esophageal Cancer Incidence Among China, Australia and Japan

among urban and rural men shown average 1.4% and 0.9% increase annually from 1989 to 2008. The trends kept stable for other groups. The trends in most of groups shown a decrease in first internal and an increase or stability in the rest of period (Table 4).

After adjusted by age, incidences decreased by 3.3% in 20 years (3.1% in men and 3.9% for women) in all areas. From 1989 to 2001, the average annual decrease of incidence was 4.2% with 4.3% in male in men period and 4.4% decease for women from 1989-2002. The trend in urban areas was no change for both men and women. In rural areas, ASR annually deceased by 2.1% with 2.1% in men and 2.5% in women. A quick decrease occurred in first 10 years and levelled off in last 10 years (Table 5).

Compared incidecne time trend on esphogeal cancer in China to that in Australia and Japan in the same period, the incidence rate is slightly increasing in Japan and stable in Australia when it is keeping decreasing in China (Figure 4).

Discussion

We used available population based cancer registration data over 20 years from 1989 to 2008 for trend analysis on incidence of esophageal cancer, stratefied by location (urban/rual) and sex. The crude incidence decreased in first 10 years in all areas and rural areas (stable in urban areas) and increased in recent 10 years both in urban and rural areas. The trends of age adjusted incidence rates had been falling down cross the 20 years in all areas and rural areas, with significant decreasing in first part of period but stable after. ASR in urban areas had no change through the period.

Esophageal cancer is one of the most common cancers and main cause of cancer death in China. According to recent statistics, esophageal cancer ranked sixth in common cancer incidence followed by lung cancer, stomach cancer, colorectal cancer, liver cancer and breast cancer. It the fouth leading causes of cancer deaths followed by lung cancer, stomach cancer and liver cancer. Esophageal cancer is a more mencasing public issue in rural than that in urban areas, which is still the most common cancer and the leading causes of cancer death in rural women and the second commonest cancer and fouth cancer death in men. National death surveys shown that esophageal mortality gradually decreased over 3 decades.

Esophageal cancer is the result of both effect of environmental factors and genetic susceptibility, and the way of living and behaving is one of the most important influencing factors. The risk factors of esophageal cancer in developed country are smoking, alcohol drinking and Barrett esophagitis (Freedman et al., 2007). However, the risk factors in developing country are nitrosamine, mold pollution, lack of vitamin,unhealthy lifestyles and smoking (Sun et al., 2010). For nearly 30 years, a great deal of cancer control work has been done in high risk areas in China. Such as: To improve the quality of the

drinking water by decreasing the pollution of nitrosamine. To administer the storage of agricultural products and advocate the people to expose grain and drinking water to the sunshine, not to eat the food with mold. Eating more vegetables and fruits, changing the bad lifestyle. Health education on essential knowledge of cancer prevention and control. Besides, more efforts have been put into screening and early detections to find the carcinoma in situ or intramucosal carcinoma especially esophageal epithelium dysplasia(EED). It is therefore very promising to detect patients with EED and treat the precancerous lesions before they transform into the irreversible malignant stage (Qiao et al., 2001). A national screening program using endoscopy with mucosal iodine staining and index biopsy combined with pathological examination for confirming and staging the disease has become available in 73 sites of 27 provinces of China. Through early detection and subsequent treatment, the 5-year survival rate of EC increased to 86% (Wang et al., 2004). Furthermore, obvious reductions in incidence and mortality rates of esophageal cancer were observed in several areas.

Our study is the first one to systematically explore the trend of the incidence for lung cancer from 1989 to 2008, with available population based cancer registration areas. However, the study has some limitations. Firstly, we pooled all valid data together without evaluating the representative as national level, especially, in the earier years, only 10 registries available. Secondly, we did not concern the uncertainty about data quality. Completeness and accuaracy could improve by time and incidence rate might change because of the impovement of quality. With the more registries established and quality improved, cancer registration data would provide more accuarate information.

The trend analysis is one of objectives that population based cancer registries provide giving the basic information for making cancer control policy and strategies.The use of the joinpoint method of analysis has allowed a detailed and accurate description of the pattern of cancer mortality in recent years, since it identifies the calendar years in which statistically significant changes in the trends occurred, and the annual percentage of change within the periods identified. This offers a clearer picture of the actual trends in mortality over long periods of time rather than data using only one trend statistic. The joinpoint regression and other similar methods have been applied to age-adjusted cancer mortality and incidence rates for different cancer sites by sex and race, and for truncated rates.

In conclusion, the increased esophageal cancer burden is mostly attributed to ageing population. The age-standardized incidence rate is slightly decreasing. The decreased trend in 1990s mainly because of nutrition and lifestyle improvement. However, we should pay attention to that incidence did not decreased in recent 10 years meaning prevention and control on esophageal cancer has not been working well. Esophageal cancer control including education health, intervention, screening and early diagnosis, should be continuously enhanced.

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