

An Analysis of Cancer Incidence in Tianjin from 2002 to 2011

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Abstract

Objective: To investigate the characteristics and trends of cancer incidence from 2002 to 2011 in the Tianjin area of China.

Methods: Based on the Tianjin Public Health Bureau statistics data from 2002 to 2011, the incidences of cancer were analyzed according to sex, age group, cancer site, and geographic region (Tianjin area versus overall China from 2003 to 2007).

Results: The crude incidence of cancer in Tianjin was 162.33 per 100,000 (men: 163.22 per 100,000; women: 161.43 per 100,000). Age-standardized incidences according to the Chinese standard population (Age-standardized rate (ASR) China) and the world standard population were 84.05 and 107.67 per 100,000, respectively. From 2002 to 2011, the incidence of cancer increased from year to year. Age-specific incidence reached a peak at 703.60 per 100,000 in the age group of 75–79 years old. Among group between 25 and 54 years old, the cancer incidence rate of the male group was significantly lower than that of the female group ($P < 0.05$); Among people aged over 60, the cancer incidence rate of the male group was significantly higher than that of the female group ($P < 0.05$). The most common cancer in Tianjin residents was lung cancer, followed by breast cancer, colorectal cancer, stomach cancer, and liver cancer. The five most common sites for cancer in men were lung, liver, stomach, colorectal, and bladder, while in women were breast, lung, colorectal, stomach, and cervix.

Conclusions: From 2002 to 2011, the incidence of cancer has been increasing. In view of the high incidence of lung and breast cancers in Tianjin, early screening focused on high-risk groups should be implemented to improve early diagnosis and treatment for these cancers.

Keywords: Cancer; Incidence; Epidemiology; Tianjin

Introduction

With modern industrialization, unprecedented social and environmental changes, aging populations, and westernized lifestyles, the incidence of cancer has significantly increased, and cancer has become a major threat to human health. Epidemiological studies published in the 2004–2005 Third National Review coroner sample survey showed that cancer ranked secondly only to the cardiovascular disease in cause of death for urban residents in China [1]. Although cancer is a major disease that presents a great burden to public health worldwide, the cancer incidence in different regions and ethnicities varies significantly. The cancer incidence in China (265.93 per 100,000) was significantly higher than the average incidence worldwide (187.6 per 100,000) and was twice as high as the average level in developing countries. Additionally, when adjusted to the standard population, the cancer incidence (187.7 per 100,000) in China was slightly higher than the worldwide average (181.6 per 100,000) and was 27% higher than that in developing countries [2].

According to cancer incidence trends surveys of thyroid cancer, breast cancer, prostate cancer, and esophageal cancer between 1981 and 2002 in the Tianjin area, the incidence of thyroid cancer increased year by year, exhibiting a total increase of 267% and an average annual

increase of 3.1%. The crude incidence of breast cancer was increased to 45.16 per 100,000 in 2000 from 18.51 per 100,000 in 1981. Crude and standardized incidence rates of prostate cancer rose from 1.04 and 1.35 per 100,000 in 1981 to 4.99 and 2.84 per 100,000 respectively in 2004. Additionally, crude and standardized incidence rates of esophageal cancer decreased by 2.22% and 5.18% in men, while 3.56% and 6.56% in women. However, limited information is available concerning the incidence rates of cancer in Tianjin for the more recent 10 years.

In this study, we analyzed changes in the epidemiological trends and distributions of cancers in the urban area of Tianjin between 2002 and 2011. The acquired information will be useful for establishing medical prevention methods and regular screening programs focused on population with a high risk of cancers.

Materials and Methods

Source of data

Tianjin Cancer Incidence 2002–2011 data from Tianjin Public Health Bureau statistics was used in this analysis. All subjects included in this database were Tianjin residents from January 2002 to December 2011, and cases were described in accordance with the International Classification of Diseases classification and coding of

cancer patients. Data from National Cancer Registry incidence 2003–2007 were also used [3].

Data collection and analysis

Tianjin Public Health Bureau statistics from 2002 to 2011 were reviewed, organized, and used to calculate crude, gender-specific, age-specific, and standardized incidence rates by Excel 2007. Age groups were divided by every 5 years interval. Chinese population standardized incidence rates were based on the 1982 Chinese population age structure, and the world population standardized incidence ratio was based on Segi's population age structure. Using SPSS 13.0 trend χ^2 test for standardized cancer incidence trends during 10 years; Pearson χ^2 test was used to compare the incidence of male and female annually. Test level $\alpha=0.05$.

Year	All			Male			Female			χ^2	P
	Incidence	ASR China ^a	ASR World ^b	Incidence	ASR China	ASR World	Incidence	ASR China	ASR World		
2002-2006	152.80	83.72	107.69	156.57	86.93	113.42	148.95	81.06	102.86	24.637	0.000
2007-2011	171.43	84.36	107.64	169.55	83.04	107.95	173.33	81.95	103.17	5.168	0.023

Table 1: The cancer incidence in Tianjin in 2002-2011 (1/105). ^aAge-standardized incidence rate (China population 1982), ^bAge-standardized incidence rate (Segi's population)

Age-specific incidence rates

As shown in Table 2, the cancer incidence trends in Tianjin from 2002 to 2011 were low in individuals aged 0–35 years. A slight increase occurred with aging; the incidence rate began to increase rapidly after the age of 40, rose dramatically after the age of 55. Age-specific incidence peaked at 703.60 per 100,000 in the age group of 75–79 years old and gradually decreased after the age of 80. Between different sexes, in the age range of 20–54 years old, cancer incidence in women was slightly higher than that in men (Figure 1).

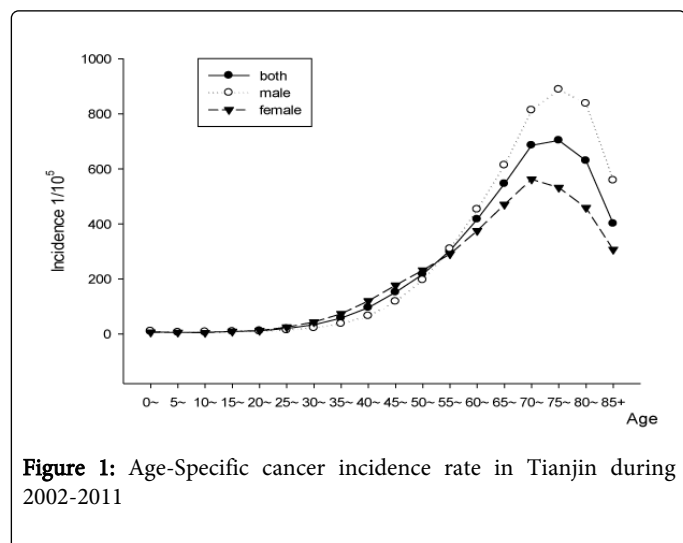


Figure 1: Age-Specific cancer incidence rate in Tianjin during 2002-2011

In contrast, in the age range of 55–85 years old, cancer incidence rates were slightly higher in men than in women, especially after 55 years of age when the cancer incidence in men increased significantly.

Results

Overall incidences

Between 2002 and 2011, the overall crude and age-adjusted incidences were 162.33 and 107.67 per 100,000, with similar incidences for men and women (men: 163.22 and 113.42 per 100,000; women: 161.43 and 102.86 per 100,000, respectively). Between 2002 and 2006, the crude incidence rate was higher in men than in women (156.67 versus 148.95 per 100,000). In contrast, between 2007 and 2011, the crude cancer incidence was slightly higher in women than in men (173.33 versus 169.55 per 100,000). The cancer incidence rate of the male group was significantly higher than that of the female group between 2002-2006 as well as 2007-2011 (χ^2 trend=24.637, 5.168, respectively; $P=0.000, 0.023$, respectively) (Table 1).

The cancer incidence in men peaked at 888.71 per 100,000 in the age group of 75–79 years old, while in woman it peaked at 562.48 per 100,000 in the age group of 70–74 years old. In the older age groups, the cancer incidence gradually decreased (Table 2). Among group between 25 and 54 years old the cancer incidence rate of the male group was significantly lower than that of the female group ($P<0.05$); Among people aged over 60, the cancer incidence rate of the male group was significantly higher than that of the female group ($P<0.05$).

Age group	All	Male	Female	χ^2	P
Total	162.33	163.22	161.43	0.471	0.493
0-4	8.21	10.25	6.05	2.911	0.088
5-9	5.50	6.12	5.57	0.300	0.862
10-14	6.48	7.60	4.77	2.052	0.152
15-19	8.94	8.96	8.87	1.041	0.950
20-24	11.54	10.02	12.41	0.865	0.352
25-29	19.83	13.53	24.73	10.188	0.001
30-34	33.77	22.03	43.41	22.381	0.001
35-39	57.61	37.25	73.12	50.368	0.000
40-44	95.67	65.68	119.80	72.829	0.000
45-49	151.44	117.83	177.02	45.000	0.000
50-54	216.73	196.14	231.84	10.280	0.001
55-59	303.00	309.35	290.35	1.991	0.158

60-64	417.10	453.04	375.30	16.660	0.000
65-69	546.11	613.37	470.61	31.195	0.000
70-74	685.66	813.39	562.48	61.372	0.000
75-79	703.60	888.71	532.20	83.694	0.000
80-84	629.69	837.56	459.11	54.758	0.000
85+	401.46	558.65	306.91	18.330	0.000

Table 2: Age-specific cancer incidence of all cancers in Tianjin in 2002-2011 (1/10⁵)

Changes in cancer incidence

Figure 2 reflects the increasing crude cancer incidence trends by year in Tianjin. The overall crude incidence increased from 146.87 per 100,000 in 2002 to 207.15 per 100,000 in 2011. In men, the incidence of cancer rose from 153.58 to 205.64 per 100,000, while in women it increased from 140.02 to 208.67 per 100,000 from 2002 to 2011, respectively. Slight decreases in incidences were observed in 3 out of the 10 years (2003, 2007 and 2010).

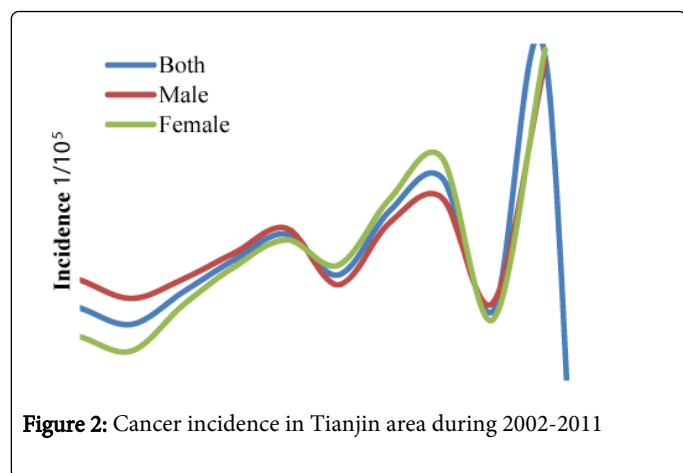


Figure 2: Cancer incidence in Tianjin area during 2002-2011

Changes in cancer types with high incidence

Figure 3 displays the 10 cancer types with highest incidences during the time period from 2002 to 2011. The most common cancer in Tianjin residents in 2002-2011 was lung cancer, accounting for 24.3% of all new cancer cases. This was followed by breast cancer (11.75%), colorectal cancer (8.82%), stomach cancer (7.52%), and liver cancer (7.29%). In men, cancers of the lung, liver, stomach, colorectal, and bladder accounted for about 76.28% of all newly diagnosed cancers. In women, the leading cancer sites were the breast, lung, colorectal, stomach, and cervix. Breast cancer alone accounts for 23.69% of all new cancer cases in women (Figures 3-5).

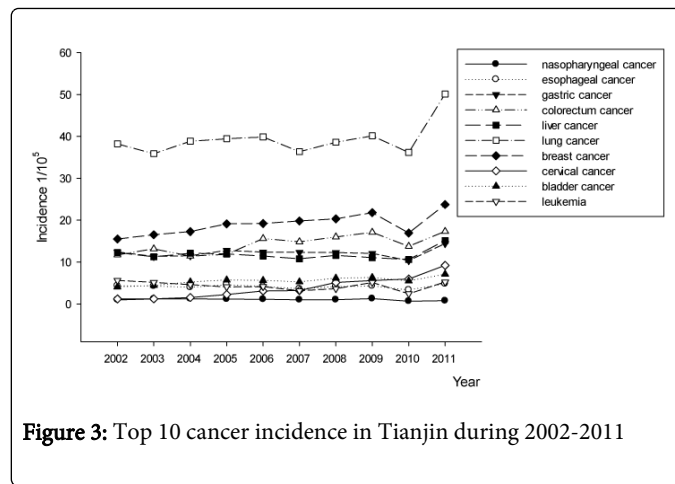


Figure 3: Top 10 cancer incidence in Tianjin during 2002-2011

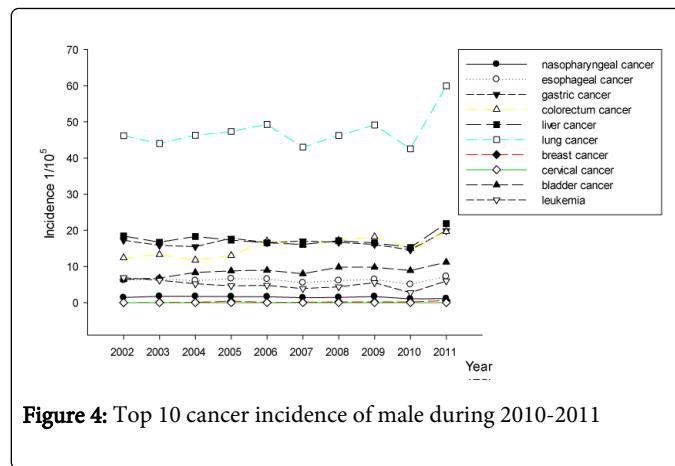


Figure 4: Top 10 cancer incidence of male during 2010-2011

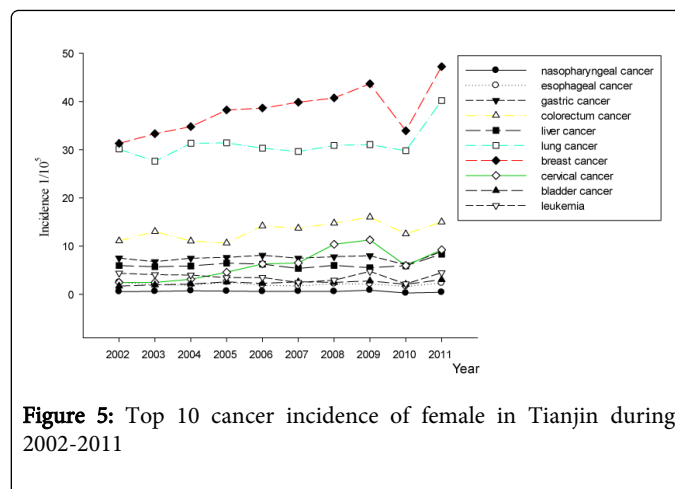


Figure 5: Top 10 cancer incidence of female in Tianjin during 2002-2011

Rank	Male			Female			All		
	Site	Incidence (1/10 ⁵)	%	Site	Incidence (1/10 ⁵)	%	Site	Incidence (1/10 ⁵)	%
1	Lung	47.47	29.08	Breast	38.25	23.69	Lung	39.44	24.30

2	Liver	17.42	10.67	Lung	31.28	19.38	Breast	19.08	11.75
3	Stomach	16.73	10.25	Colorectum	13.22	8.19	Colorectum	14.32	8.82
4	Colorectum	15.41	9.44	Stomach	7.58	4.70	Stomach	12.20	7.52
5	Bladder	8.72	5.34	Cervical	6.29	3.90	Liver	11.83	7.29
6	Esophagus	6.22	3.81	Liver	6.15	3.81	Bladder	5.57	3.43
7	Leukemia	5.01	3.07	Leukemia	3.61	2.24	Leukemia	4.31	2.66
8	Nasopharyngeal	1.48	0.91	Bladder	2.36	1.46	Esophagus	4.16	2.56
9	Breast	0.20	0.12	Esophagus	2.07	1.28	Cervical	3.92	2.42
10	Cervical	—	—	Nasopharyngeal	0.59	0.37	Nasopharyngeal	1.04	0.64
	Top 10	118.46	72.48	Top 10	111.40	69.01	Top 10	115.85	71.41

Table 3: Top 10 cancer incidence and composition in Tianjin in 2002-2011

Between 2007–2011 and 2002–2006, the 10 leading cancers in Tianjin remained stable; lung cancer continued to be the most common cancer, followed by breast cancer, colorectal cancer, and liver cancer. Compared with 2002-2006, the overall incidences of the leading 3 cancers during 2007-2011 increased. In men, Lung cancer increased from 46.66 to 48.25 per 100,000, and colorectal cancer increased from 13.52 to 17.21 per 100,000. In women, the incidence of breast cancer rose from 35.28 to 41.09 per 100,000, while that of lung cancer increased from 30.16 to 32.34 per 100,000 and that of cervical cancer increased from 3.80 to 8.67 per 100,000. In women, cervical cancer ranked from the seventh to the fourth cancer types due to its more than 2-fold increase of incidence in the recent 5 years (Table 3).

Discussion

Cancer is a serious threat to human health and social economic development as well as a heavy burden to health resources.

In our study, the crude incidence rate of cancer in the Tianjin area was 162.33 per 100,000 (men: 163.22 per 100,000; women: 161.43 per 100,000). Age-standardized incidence rates by Chinese standard population (ASR China) and by world standard population were 84.05 and 107.67 per 100,000 from 2002 to 2011. In contrast, the crude incidence rate of cancer in China from 2003 to 2007 was 265.93 per 100,000 (men: 293.99 per 100,000; women: 237.19 per 100,000). Age-standardized incidence rates by Chinese and world standard populations were 144.25 and 187.66 per 100,000, respectively [2]. The incidence of cancer in Tianjin from 2002 to 2011 was less than the national average data from 2003 to 2007. Our survey revealed lower incidence rates than national reports, which may be due to the small sample size in some areas and statistical errors resulting from incomplete registration. Difference in research methods might partly explain the higher incidence in national reports, since different choice of database as well as the age's group and national data which covered several high cancer incidence provinces might influence the results. It is also probably related to a better health conditions in Tianjin compared to many other areas. The improvements in living standards, health care promotion, and self-awareness for disease prevention as well as some dietary habits characteristic of Tianjin residents such as drinking milk, avoiding eating spicy and preserved foods, and eating

fresh seafood instead of pickled food might play some roles in the relatively low cancer incidence in Tianjin. The overall cancer incidence in Tianjin in 2010 was lower than those of previous years, so as the incidences of leading cancers, such as lung cancer, breast cancer, colorectal cancer, and liver cancer.

We found the incidence slightly increased with aging, especially for people older than 55 years. Age-specific incidence peaked at 703.60 per 100,000 in the age group of 75-79 years old and gradually decreased in the older groups (≥ 80 years old). This trend was similar to that observed from 1981 to 2000 in Tianjin [4], but was slightly different from that of the national cancer incidence from 2003 to 2007 [2], which peaked in the age group of 80-84 years old. This suggested that survival of the aged population (over 80 years) had improved in Tianjin. The fact that the cancer incidence in the 55-years-old group rapidly increased was believed to be related to the rising incidence of cancers in certain sites, such as the lung, breast, colorectal, and thyroid. A survey of the prevalence of thyroid cancer in Tianjin showed that the cancer incidence in women reached 2 peaks: one at 45 years old and one at 65 years old. Cancer incidence in men reached a peak at 60 years old [5]. The age of onset of colorectal cancer in Tianjin was 61.99 years old (61.3 years in men, 62.66 years in women). Onset age between 54 and 78 years accounted for 65% of the total incidence [6].

The most common cancer in Tianjin residents in 2002-2011 was lung cancer, followed by breast cancer, colorectal cancer, stomach cancer and liver cancer. In contrast, in 2003-2007 the top 5 leading cancer sites in China were the lung, colorectal, stomach, breast, and liver [2]. Although the top 5 cancer sites were the same in Tianjin as in China, the order of incidence was slightly different, with breast cancer having a particularly high incidence in Tianjin. Lung, liver, stomach, colorectal, and bladder were the top 5 most common cancer sites in men in Tianjin, while in nationwide scale the most common sites of cancer were different, with lung, stomach, liver, colorectal, and esophagus as the most common cancer sites in men. In particular, men in Tianjin exhibited lower incidences of gastric cancer and esophageal cancer than men in China. In women, cancers of the breast, lung, colorectal, and stomach were the top 4 leading cancers in both Tianjin and China. The fifth leading site of cancer was the cervix in Tianjin

and the liver in China for women. Thus, it should be noticed that women in Tianjin had a particularly high incidence of cervical cancer, especially young women in the age group of 15-44 years.

The incidence of lung cancer incidence in Tianjin increased significantly might be related to several reasons such as air pollution, high smoking rate, etc. A smoking survey of Tianjin residents showed that the current smoking rate was 26.8%, and 12.9% of Tianjin residents were engaged in severe smoking [7]. These numbers were higher than the 2002 national urban population smoking rates of 25.0% and 10.6% [8]. In Tianjin residents, the smoking rate for men was 55.6%, and for women was 7.8% [7], both of which were higher than the 2002 national survey level (3.08%) [8]. The average age of initial tobacco use was 21.63 years old, and the average cigarette consumption was 15.26 per day [7]. Smoking accounts for 80% of the worldwide lung cancer burden in men and at least 50% of the burden in women. Approximately 87% of lung cancer cases are attributed to tobacco exposure; the relative risk of lung cancer in smokers is 24 times of that in non-smokers [9]. Additionally, lung cancer among non-smokers is significantly associated with exposure to second-hand smoking of more than 20 cigarettes daily, adulthood second-hand smoke exposure, gender female, and second-hand smoke exposure in the workplace [10]. According to a survey in 2007 in Tianjin [11], 79.17% of non-smokers were exposed to second-hand smoke, which is much higher than the nationwide rate of 51.19% in 2002.

Air pollution is another factor that has a significant influence on the incidence of lung cancer in a population. A study by the American Cancer Society found that when fine particulate matter (PM_{2.5}) was increased by an annual average concentration of 10 µg/m³, the population's lung cancer mortality rate rose by 8% [12]. Atmospheric particulate matter (PM) pollution in Tianjin was hazardous, with 70% of days in a whole year having PM as the primary pollutant [13]. Tianjin was also polluted by fire and motor vehicle contaminants. PM₁₀ pollution reached a peak during spring and autumn, and a second peak in winter [14]. Atmospheric PM_{2.5} pollution in winter was serious [15]. The annual average concentration of atmospheric PM between 1984 and 1988 was significantly related to lung cancer incidence 12 years later [16]. Sulphur dioxide (SO₂) pollution comes mainly from burning coal and is another major air pollutant and the secondary carcinogen. The Grey Tianjin study found that the annual average concentration of SO₂ between 1996 and 2000 was associated with lung cancer incidence 13 years later [16].

The incidence of breast cancer was increased by 25% in Tianjin during 2002-2011. The risk factors for breast cancer among Tianjin women can be broadly summarized as follows: energy imbalance including high consumption of meat, fish, and dairy products, passive smoking, family history of cancer, late age at marriage and less breastfeeding [17]. Compared with other cities, breast cancer caused by family genetic factors was more prominent in Tianjin [18]. Family history was one of the most well-established risk factor for breast cancer. Early age at menarche, with an average age decreased from 12.91 years in 1985 to 12.61 years in 2005 [19], together with a later average age at natural menopause (48.72 years old), allow mammary epithelial cells be exposed to endogenous estrogens and progesterone for a longer period [20]. Protective factors for breast cancer include more than one full-term pregnancy and breastfeeding. However, in urban cities, women only have 1 child and often do not breastfeed for a prolonged period. In addition, the incidence of breast cancer was increased with the rising smoking and alcohol consumption, as well as excess nutrient intake and greater BMI index in recent years.

China still suffers a great disease burden for esophageal cancer; however, the incidence of esophageal cancer in different regions varies significantly. During the period from 2002 to 2011, Tianjin had a relatively lower incidence of esophageal cancer. Over the past few decades, a number of risk factors for esophageal squamous cell carcinoma have been identified. These factors include tobacco smoking, alcohol drinking, dietary and micronutrient deficiency, high temperature of beverage and food consumption, poverty, fast food eating habits, and polycyclic aromatic hydrocarbon (PAH) exposure [21]. In contrast, drinking green tea and consuming more fresh fruit and vegetables may be protective factors. Increases in the use of refrigerators have led to substantial reductions in the consumption of smoked, salted, and pickled foods and increases in fresh food intake. Tianjin residents preferred drinking green tea daily and tend to consume less spicy or pickled foods. Tea is rich in polyphenols and has antioxidant and cancer-preventive effects that are especially protective for women [22].

We have to point out that there are potential limitations in our study. The accuracy of observed incidence rates may be influenced by several factors including the incompleteness of registration, changes in disease classification, and advances in diagnostic technology. Difference in statistical analysis might partly explain the lower incidence in our survey than previous report, since small sample size in some areas and statistical errors resulting from incomplete registration by the Tianjin Public Health Bureau might exist. Changes in the coding system from ICD to ICD-O may have resulted in loss of specificity in some reported cases. The great advance in diagnostic technology is perhaps a significantly important variable in the study because better diagnostic technology leads to more early detection of cancer, which may increase the number of cancer cases over the study period.

Conclusion

Living conditions in China have been through and continue to undergo tremendous changes in recent years. Consistent with these changes, lifestyle in Chinese urban area is modernized and tends to be more westernized. Individuals have adopted more cancer-causing behaviours such as smoking, eating fast food and alcohol consumption, all of which appear to have negative effects on individual health. A significant proportion of the worldwide burden of cancer could be partly relieved through the application of existing cancer prevention methods and by implementing programs for tobacco control, vaccination (for liver and cervical cancers), and early detection and treatment. Public health campaigns to promote physical activity and healthier dietary patterns for residence will also play a role. There is now an alarming increasing trend in the incidence of several cancer types, especially noticeable in the developed countries. Therefore, it is likely that China will also have a further increase in the overall cancer incidence in the coming decades. A comprehensive and timely survey of the cancer incidence in Tianjin is necessary to further monitor such trends, and will lead to the development and implementation of an effective primary prevention program.

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