

Cancer Incidence and Trend Analysis in Shahroud, Iran, 2000 – 2010

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Abstract

Background: Cancer is the third leading cause of death in Iran, and its trend is increasing in recent years. National reports state that cancer registries in Shahroud district had 204% coverage in 2008. This study investigated cancer situation in Shahroud with complete details between 2000–2010.

Methods: Data was obtained from national cancer registry software and analyzed after removing the repeated records. World standard population and direct standardization method was used to calculate Age Standardized incidence Rates (ASRs). Annual percentage changes calculated using Jointpoint software and Poisson regression model was performed to calculate cancer incidence trends.

Results: A total of 2240 cancer cases were identified, 1234 (55.1%) in man and 1006 (44.9%) in woman. The mean age was 61.6 years (Confidence Interval, CI 95%: 60.9– 62.3). ASRs of total cancers was 95.4 (CI 95%: 89.2–101.6) per 100,000; this rate was 114.8 (CI 95%: 107.9–121.6) for men and 105.2 (CI 95%: 100.6 –109.8) for women. The average annual increase in ASR was 12.4%, which could not be attributed only to improve reporting. Gastric cancer is the most common cancer in men, and breast cancer is most common in women.

Conclusion: Cancer incidence rate has increased significantly in Shahroud in recent years. A portion of this increase can be attributed to increased incidence of cancers, especially cancers of colorectal, gastric, breast, and skin.

Keywords: Epidemiology; Incidence; Iran; Neoplasm

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Introduction

Every year, 7.6 million people around the world die of cancer and about 70% of these deaths happen in low and middle income countries. However, 30% of cancer cases are related to behavioral and nutritional risk factors such as tobacco use and are preventable. Five main cancers causing human death include lung, stomach, liver, colon, and breast cancers [1]. World population growth, increasing percentages of the elderly population, and annual increases of cancer cases are three main reasons that may cause all countries, from developed to developing, to face higher incidences and burden of cancer in future. It is estimated that by year 2030, the number of new cancer cases and that of deaths by cancer will reach 26.4 million people and 17 million people, respectively [2].

In 2008, 12.4 million new cancer cases were recognized in the world. In this year in the Eastern Mediterranean Region, 467,000 new cancer cases were identified. Lung and bladder cancers were the

most prevalent cancers among the men living in that region, whereas breast and, as a distant second, cervical cancer, were the most prevalent cancers among women [2].

In Iran, cancer is the third cause of human death, and more than 30,000 people die of cancer every year [3]. With the rising percentage of the elderly population, improvement in life expectancy, advancement of technology, changes in people's lifestyle, and other risk factors of cancer, it is predicted that the number of cancer deaths in Iran will reach 62,000 people by 2020 [3]. Therefore, it is necessary to decrease the burden of cancer by means of effective interventions. The first step in a cancer control program is to create an accurate cancer registry system. In 1984 in Iran, the registration and mandatory reporting law of cancers was legislated at the Islamic Consultative Assembly (the parliament) of Iran [3]. The status of cancer registry improves each year. Since 2008 and in addition to pathology-based cancer registry,

population-based cancer registry has also been added gradually. These works resulted in 74,076 registries of cancer cases (92, which is 8% of what was expected) in 2008 [3]. In the annual report of cancer registry for 2008, the coverage of cancer registry in Shahroud district was 204%. Therefore, it was a prerequisite to study the cancer status in this district in detail. In addition to the reports of cancer registry from 2000 to 2010 in Shahroud, this study provides the trend analysis of cancer incidence in order to have a better description of cancer status in Shahroud district.

Materials and Methods

All pathological reports in cancer registry software were investigated for correct ICD-0 coding. Duplicate reports were removed with respect to information on sex, age, and place of residence. From 2000 to 2007, the cancer registry software registered the information regionally. Hence, it was not possible to find cancer cases in each region discovered in other cities of the country. To solve this problem, all patients who were residents of Shahroud were extracted from the database of the Iranian center for disease control. If the cancer case resided in Shahroud for at least 10 years, then he/she were added to the studied database. Since 2008, detected cases of cancer in the other provinces were added to the total cases for each city by a new software. Although the registered cancers in 2010 in our final database lacked the information of other provinces, the cancer registry program changed to a community-based program and cancer cases were registered along with pathological centers of death registration programs, methadone receivers for treating malignancy, among others since 2008. The registered cases of two software programs were put into an Excel file and the duplicates were removed again.

During the study period, the population of Shahroud did not change dramatically. For example, based on the national censuses, the population of Shahroud district was reported as 224,825 in 2006 and 23,8830 in 2011. Moreover, accurate census, especially in the urban areas was not available annually, and population estimation in 18 age groups based on population growth in censuses did not give accurate results. Therefore, the results of the 2006 census, which lay in the middle of the study period, was used for all study years in order to calculate crude and standardized incidence rates. The crude and standardized rates were calculated per 100,000 populations. According to this census the Shahroud population was 234,825 people,

including 114,542 (48.8%) women and 120,283 (51.2%) men. The calculation of the ASR was done by using STATA software and through the direct standardization method based on world standard population modified by Doll *et al.* in 1966 [4]. Confidence intervals of 95% were calculated for standardized rates. The ASR was calculated for common cancers in different sex and age groups.

Jointpoint software was used to calculate the Annual Percentage Change (APC) and the average change during the study period [5]. The trend analysis of cancer cases was done by using the Poisson Regression model.

Results

From 2000 to 2010, a total of 2240 patients with cancer were identified in Shahroud district, which included 1234 (55.1%) men and 1006 (44.9%) women and a sex ratio of 1.23 (123 male patients for every 100 female patients). The average age of the patients was 61.6 years (CI 95%: 60.9–62.3), with 59.4 years (CI 95%: 58.4–60.5) for women and 63.3 (CI 95%: 62.4–64.2) for men. The average age difference between men and women was statistically significant ($P < 0.001$). During the study period, the mean age of the patients did not change in all patients ($P = 0.566$), with $P = 0.321$ in women and $P = 0.404$ in men.

Table 1 shows the crude and standardized incidence rate of cancers based on age and sex. Since the cancer registry program changed to population-based cancer registry 2008 onwards, in Table 1, the cancer cases discovered in pathological centers have been shown in parenthesis. In general, from 988 patients with cancer registered from 2008 to 2010, 352 patients (35.6%) were discovered through methods other than pathological reports. Therefore, only about 64% of the cancer cases could be discovered from pathological centers. The number of reported cancers increased from 2000 to 2010 and this trend was statistically significant ($P < 0.001$). This increase was significant even by removing the cases that were clinically discovered from 2008 to 2010 ($P = 0.007$).

During the study period, the highest incidence rate belonged to 2008. Standardized incidence rates were always higher than crude incidence rates (Table 1). It should be noted that, during the years 2000 and 2001, 18 and 19 discovered cases lacked information on patient's age, respectively. Therefore, these cases were not included in calculating the standardized rate, as a result, crude and standardized rates were close to each other during these years. It should also be noted that, in 2010, the

Table 1. Crude Incidence Rate (CIR) and Age Standardized incidence Rate (ASR) of cancers, per 100,000 population, according to sex and year, Shahrud, Iran

Year	Sex	n	CIR	ASR	CI 95% for ASR
2000	Female	45	39.3	34.5	22.8 – 46.1
	Male	45	37.4	35.4	23.5 – 47.4
	Total	90	38.3	35.0	26.7 – 43.4
2001	Female	68	59.4	59.8	44.2 – 75.3
	Male	92	76.5	81.7	63.4 – 99.9
	Total	160	68.1	70.8	58.8 – 82.7
2002	Female	71	62.0	72.3	55.0 – 89.6
	Male	86	71.5	85.2	55.0 – 103.9
	Total	157	66.9	79.0	66.2 – 91.7
2003	Female	68	59.4	71.5	54.2 – 88.9
	Male	81	67.3	74.2	57.1 – 91.2
	Total	149	63.5	73.2	61.0 – 85.3
2004	Female	87	76.0	82.7	64.7 – 100.6
	Male	105	87.3	101.8	81.6 – 122.1
	Total	192	81.8	92.5	79.0 – 106.1
2005	Female	74	64.6	73.2	56.1 – 90.4
	Male	76	63.2	74.3	57.0 – 91.6
	Total	150	63.9	73.8	61.6 – 86.0
2006	Female	73	63.7	70.1	53.4 – 86.8
	Male	93	77.3	87.1	68.5 – 105.7
	Total	166	70.7	78.4	66.0 – 90.9
2007	Female	72	62.9	73.4	56.0 – 90.8
	Male	116	96.4	113.2	91.8 – 134.7
	Total	188	80.1	93.7	79.8 – 107.5
2008	Female	185 (117)	161.5 (102.1)	185.4 (118.7)	158.0 (96.7) – 212.8 (140.7)
	Male	229 (149)	190.4 (123.9)	229.9 (151.9)	199.2 (126.7) – 260.7 (177.1)
	Total	414 (266)	176.3 (113.3)	207.7 (135.4)	187.1(118.7) – 228.3 (152.2)
2009	Female	147 (97)	128.3 (84.7)	148.8 (98.3)	124.1 (78.2) – 173.4 (118.4)
	Male	160 (109)	133.0 (98.1)	152.1 (113.6)	127.6 (92.3) – 176.7 (134.8)
	Total	307 (206)	130.7 (91.6)	150.8 (106.2)	133.4 (91.6) – 168.2 (120.8)
2010	Female	116 (78)	101.0 (68.1)	116.7 (78.7)	95.0 (60.9) – 138.4 (96.6)
	Male	151 (86)	125.5 (71.5)	147.9 (84.5)	123.6 (66.1) – 172.2 (103.0)
	Total	267 (164)	113.5 (69.8)	132.4 (81.8)	116.1 (68.9) – 148.7 (94.6)
Total (2000 – 2010)	Female	1006	83.9	95.4	89.2 – 101.6
	Male	1234	98.9	114.8	107.9 – 121.6
	Total	2240	91.6	105.2	100.6 – 109.8

studied dataset lacked registered cases of other provinces. The analysis of the rates during the study period revealed that incidence rates in men were always higher than in women; however, this difference was not statistically significant ($P = 0.591$).

The APC of the standardized incidence rate was equal to 12.4% (CI 95%: 5.2–20.1), which was statistically significant. Figure 1 shows the trend in standardized incidence rate of cancers and the percentage change during the study period by age. Figure 2 shows the percentage change for consecutive years.

There was also a significant increase in the incidence of cancer cases in the Poisson Regression

model as the incidence rate ratio of cancer was equal to 1.11 (CI 95%: 1.10–1.13) ($P < 0.001$). Therefore the crude number of cancers increased 11% by each year during the study period.

The study of cancer incidence rate in 18 age groups and for registered cancer cases during 2001 to 2010 (the cases of the year 2000 were not calculated due to undercounts and not registering the age for 18 people) showed that cancer incidence rate increased by age (Figure 3). Moreover, between the ages of 40 and 54 years, cancer incidence rate in women was slightly higher and, for ages above 55 year, it was significantly higher in men. Further details have been displayed in Figure 3.

Table 2. Crude Incidence Rate (CIR) and Age Standardized incidence Rate (ASR), per 100,000 population, according to cancer site and sex in Shahroud, Iran; 2001 – 2010

Topography (C-code)	Total		Male		Female	
	CIR	ASR (CI 95%)	CIR	ASR (CI 95%)	CIR	ASR (CI 95%)
Skin (C44)	15.33	18.20 (16.27 – 20.14)	17.46	21.02 (18.08 – 23.96)	13.1	15.40 (12.87 – 17.94)
Stomach (C16)	13.46	15.52 (13.75 – 17.30)	17.96	21.24 (18.30 – 24.18)	8.73	9.76 (7.78 – 11.73)
Esophagus (C15)	9.24	10.70 (9.22 – 12.19)	8.73	9.96 (7.95 – 11.97)	9.78	11.39 (9.22 – 13.57)
Breast (C50)	7.28	8.50 (7.20 – 9.81)	0.33	0.38 (0.01 – 0.75)	14.58	16.50 (13.95 – 19.06)
Bladder (C67)	5.28	6.26 (5.12 – 7.40)	7.65	9.39 (7.40 – 11.38)	2.79	3.16 (2.03 – 4.29)
Colon (C18)	5.2	6.25 (5.11 – 7.40)	4.91	5.80 (4.27 – 7.33)	5.5	6.41 (4.78 – 8.04)
Prostate (C61)	4.64	9.71 (7.79 – 11.64)	9.06	9.71 (7.79 – 11.64)	N/A	-
Unknown primary site (C80)	4.3	5.00 (3.99 – 6.01)	3.82	4.36 (3.05 – 5.68)	4.8	5.46 (3.97 – 6.95)
Brain (C71)	2.77	3.80 (2.83 – 4.77)	3.16	3.65 (2.46 – 4.85)	2.36	2.79 (1.70 – 3.88)
Blood (C42)	2.43	3.41 (2.46 – 4.37)	2.41	2.80 (1.72 – 3.87)	2.44	2.85 (1.76 – 3.94)
Bronchus and Lung (C43)	2.13	2.53 (1.77 – 3.28)	2.49	2.71 (1.70 – 3.72)	1.75	1.92 (1.06 – 2.79)
Rectum (C20)	1.92	2.33 (1.60 – 3.05)	2.33	2.59 (1.58 – 3.60)	1.48	1.74 (0.90 – 2.58)
Larynx (C32)	1.66	3.54 (2.37 – 4.71)	2.83	3.77 (2.48 – 5.06)	0.44	0.58 (0.07 – 1.10)
Lymph nodes (C77)	1.58	2.37 (1.52 – 3.22)	2.33	2.26 (1.34 – 3.17)	0.79	0.83 (0.23 – 1.42)
Testis (C62)	1.28	2.18 (1.36 – 3.00)	2.49	2.18 (1.36 – 3.00)	N/A	-
Liver and intrahepatic bile ducts (C22)	1.23	1.61 (0.97 – 2.26)	1.33	1.58 (0.78 – 2.38)	1.13	1.15 (0.49 – 1.80)
Ovary (C56)	1.11	2.27 (1.35 – 3.19)	N/A	-	2.27	2.27 (1.35 – 3.19)
Pancreas (C25)	1.02	1.58 (0.92 – 2.24)	0.91	1.12 (0.43 – 1.80)	1.13	1.49 (0.68 – 2.31)
Thyroid (C73)	1.02	1.42 (0.83 – 2.01)	0.67	0.86 (0.25 – 1.46)	1.4	1.38 (0.69 – 2.07)
Connective, subcutaneous and other soft tissues (C49)	0.77	1.46 (0.73 – 2.18)	0.58	0.60 (0.13 – 1.06)	0.96	1.06 (0.40 – 1.72)
Cervix (C53)	0.77	1.80 (0.95 – 2.65)	N/A	-	1.57	1.80 (0.95 – 2.65)
Other and ill defined sites (C76)	0.68	1.25 (0.60 – 1.89)	0.75	0.96 (0.32 – 1.60)	0.61	0.74 (0.19 – 1.29)
Gallbladder (C23)	0.64	0.89 (0.40 – 1.37)	0.42	0.46 (0.05 – 0.86)	0.87	0.89 (0.32 – 1.45)
Corpus uteri (C54)	0.51	1.20 (0.51 – 1.88)	N/A	-	1.05	1.20 (0.51 – 1.88)
Kidney (C64)	0.47	0.94 (0.34 – 1.55)	0.67	0.79 (0.21 – 1.37)	0.26	0.30 (0.00 – 0.64)

From 2001 to 2010, cancer of skin, stomach, esophageal, and breast were the most prevalent cancers (Table 2). In men, three prevalent cancers were stomach, skin, and esophageal cancers. In women, three prevalent cancers were breast, skin, and esophageal cancers. During this 10-year period, the standardized incidence rates of stomach, skin, bladder, throat, larynx, and lymphatic cancers in men were higher than in women.

Most cancers had the highest incidence rates between the ages of 60 and 69 years. At younger ages, breast, cervical, and testicular cancers had the highest incidence rate (Table 3).

Further details on prevalent cancers and their morphological status during study period (from 2000 to 2010) are as follows:

Stomach Cancer (C16)

The mean age of the patients was 67.6 years (CI 95%: 66.2–68.9). The mean age between the two genders was not different ($P = 0.297$). Total 68.04% of the patients were male and 31.6% were female. The dominant morphology in 79.0% of the patients was adenocarcinoma (ICD-0 code: 8140.3) and it was found in 82.7% females and 77.3% males. The other most prevalent morphology was carcinoma undifferentiated (ICD-0 code: 8020.3),

Table 3. Age standardized incidence rate of common cancers per 100,000 population, according to sex and age groups, Shahroud, Iran; 2001 – 2010

Age group (Year)	Skin (C44)			Stomach (C16)			Esophagus (C15)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
0 – 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 – 9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10 – 14	0.00	0.09	0.05	0.00	0.00	0.00	0.00	0.00	0.00
15 – 19	0.06	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
20 – 24	0.00	0.05	0.02	0.04	0.00	0.02	0.00	0.00	0.00
25 – 29	0.14	0.07	0.10	0.00	0.07	0.03	0.07	0.00	0.03
30 – 34	0.14	0.00	0.07	0.28	0.00	0.14	0.00	0.00	0.00
35 – 39	0.70	0.23	0.47	0.39	0.08	0.23	0.23	0.23	0.23
40 – 44	0.80	0.35	0.57	0.36	0.00	0.18	0.27	0.26	0.26
45 – 49	1.15	0.58	0.87	0.67	0.29	0.48	0.19	0.00	0.10
50 – 54	1.48	1.55	1.51	1.37	0.31	0.84	0.53	1.34	0.94
55 – 59	2.50	1.91	2.20	1.55	1.35	1.45	0.48	0.68	0.58
60 – 64	3.75	2.22	2.97	3.20	1.70	2.43	1.25	2.49	1.89
65 – 69	3.52	3.22	3.38	4.70	1.61	3.18	2.61	2.28	2.45
70 – 74	2.54	2.15	2.34	4.10	1.76	2.93	1.85	1.86	1.86
75 – 79	2.09	1.25	1.69	2.67	1.17	1.95	0.94	1.41	1.16
80 – 84	1.01	0.67	0.85	1.01	1.07	1.04	0.86	0.62	0.74
>=85	1.14	1.04	1.09	0.91	0.35	0.63	0.68	0.23	0.46
Total	21.02	15.40	18.20	21.24	9.76	15.52	9.96	11.39	10.70

Table 3. Continue ...

Age group (Year)	Bladder			Colorectal (C18 – C21)			Prostate	Breast	Testis	Ovary	Cervix
	Male	Female	Total	Male	Female	Total	Male	Female	Male	Female	Female
0 – 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 – 9	0.00	0.13	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10 – 14	0.00	0.00	0.00	0.18	0.00	0.09	0.00	0.00	0.00	0.09	0.00
15 – 19	0.00	0.06	0.03	0.00	0.00	0.00	0.00	0.05	0.06	0.12	0.00
20 – 24	0.00	0.00	0.00	0.08	0.00	0.05	0.00	0.35	0.29	0.15	0.00
25 – 29	0.21	0.07	0.14	0.00	0.00	0.00	0.00	0.71	0.27	0.00	0.07
30 – 34	0.14	0.07	0.11	0.00	0.07	0.04	0.00	1.00	0.49	0.21	0.14
35 – 39	0.23	0.00	0.12	0.23	0.08	0.16	0.00	2.79	0.23	0.31	0.00
40 – 44	0.00	0.00	0.00	0.62	0.26	0.44	0.48	2.41	0.18	0.09	0.17
45 – 49	0.57	0.19	0.38	0.77	1.25	1.01	0.00	0.13	0.10	0.10	0.29
50 – 54	0.85	0.10	0.47	0.85	0.93	0.89	0.11	3.00	0.21	0.21	0.21
55 – 59	0.71	0.34	0.52	0.71	1.46	1.10	0.48	1.80	0.12	0.11	0.11
60 – 64	2.22	0.39	1.28	2.09	1.18	1.62	0.70	2.09	0.00	0.13	0.26
65 – 69	1.70	0.54	1.13	0.91	1.21	1.06	1.96	1.61	0.13	0.54	0.27
70 – 74	1.27	0.49	0.88	1.07	0.78	0.93	1.46	0.39	0.10	0.10	0.20
75 – 79	0.79	0.55	0.67	0.86	0.70	0.79	1.73	0.16	0.00	0.00	0.08
80 – 84	0.35	0.11	0.24	0.55	0.28	0.43	1.21	0.00	0.00	0.11	0.00
>=85	0.34	0.12	0.23	0.46	0.35	0.40	1.59	0.00	0.00	0.00	0.00
Total	9.39	3.16	6.26	9.40	8.56	8.98	9.71	16.50	2.18	2.27	1.57

which was found in 5.2% of the patients (in 5.8% females and 4.9% males). The incidence difference in types of the morphology of this cancer was not significant between the two genders ($P = 0.671$). Incidence risk ratio for this cancer was 1.08 which means the crude number of cancer increased 8% by each year during the study period (Table 4).

Esophageal Cancer (C15)

The mean age of the patients was 67.5 (CI 95%: 65.9 – 69.0). The mean age between the two genders was not different ($P=0.139$). Total 48.3% of the patients were male and 51.7% of them were female. The dominant morphology in 85.9% of the patients was squamous cell carcinoma (ICD-0 code:

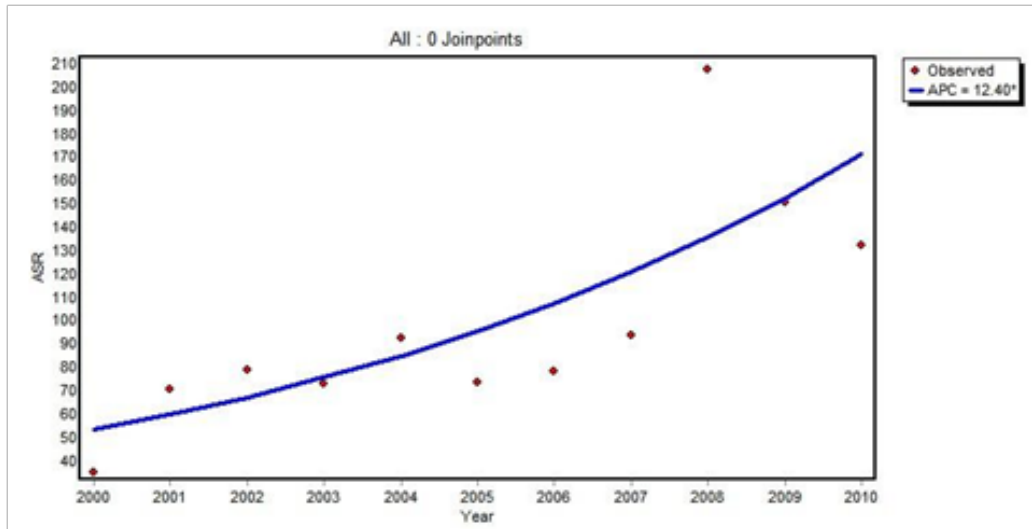


Figure 1. Trend of age standardized rate of cancers in Shahroud, Iran; 2000 - 2010

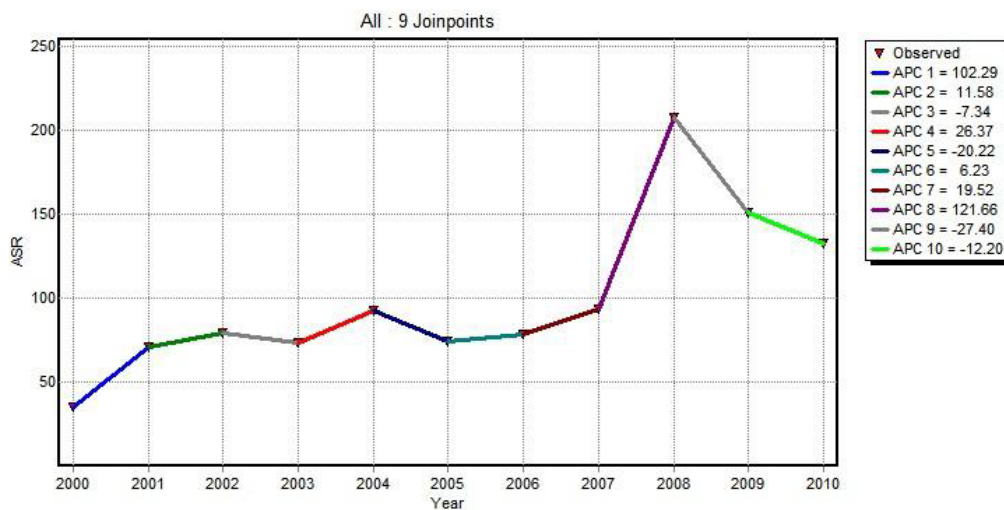


Figure 2. Annual Percent Changes (APC) of cancers in Shahroud, Iran; 2000 - 2010

8070.3) and it was found in 89.3% of females and 82.3% of males. The other most prevalent morphology was adenocarcinoma (ICD-0 code: 8140.3), which was found in 5.1% of the patients (1.7% of the females and 8.9% of the males). The incidence difference in types of the morphology of this cancer was significant between two genders ($P=0.036$). During the study period, the trend of this cancer remained unchanged in both genders (Table 4).

Skin Cancer (C44)

The mean age of the patients was 64.3 (CI 95%: 62.9 – 65.8). The mean age between the two

genders was not different ($P=0.973$). Total 58.3% of the patients were male and 41.7% of them were female. The dominant morphology in 63.3% of the patients was basal cell carcinoma (ICD-0 code: 8090.3) and it was found in 67.1% of the females and 77.3% of males. The other most prevalent morphology was squamous cell carcinoma (ICD-0 code: 8070.3), which was found in 23.5% of the patients (17.7% of the females and 27.6% of the males). The incidence difference in types of the morphology of this cancer was significant between two genders ($P=0.006$). During the study period, the trend of this cancer incidence increased in males and remained unchanged in females (Table 4).

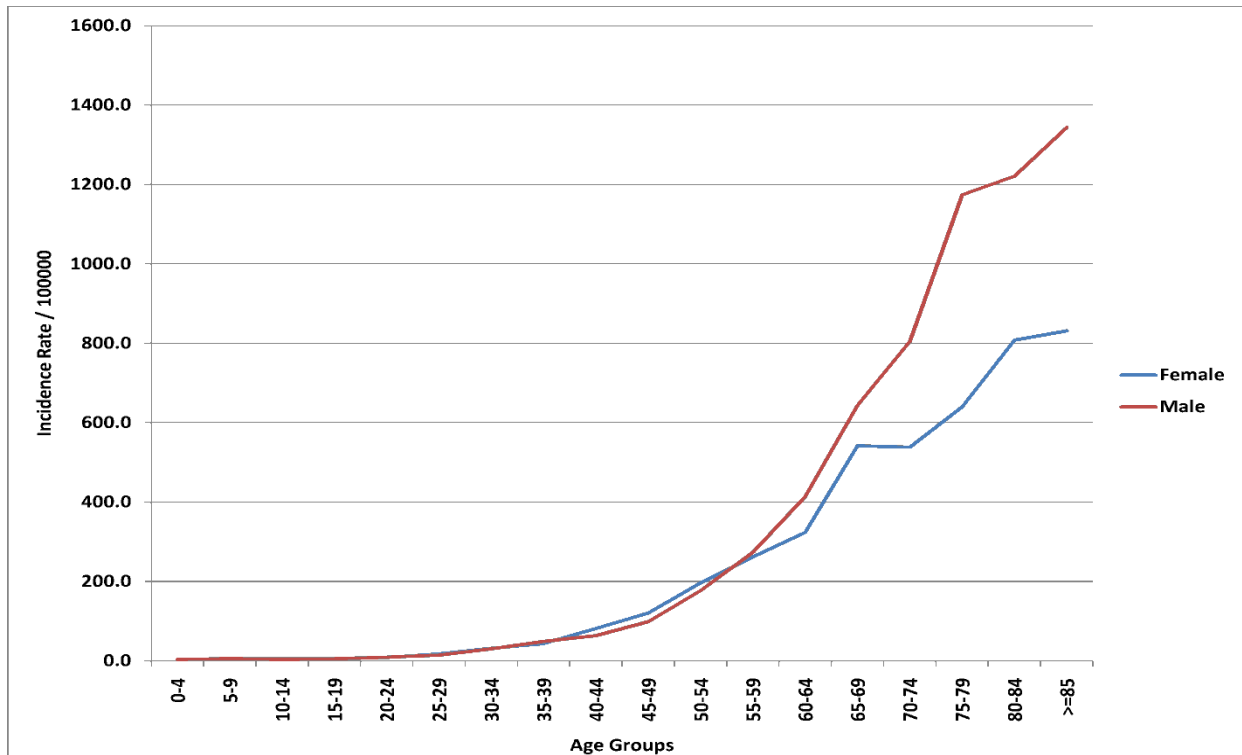


Figure 3. Crude incidence rate of cancers according to sex and age groups, Shahroud, Iran; 2001 - 2010

Prostate Cancer (C61)

The mean age of the patients was 74.2 (CI 95%: 72.2 – 76.6). The dominant morphology in 81.8% of the patients was adenocarcinoma (ICD-0 code: 8140.3). The other most prevalent morphologies were carcinoma (ICD-0 code: 8010.3), which was found in 11% of the patients and adenocarcinoma in adenomatous polyp (ICD-0 code: 8210.3) in 4.6% of the patients. Incidence risk ratio for this cancer was 1.13 which means the crude number of cancer increased 13% by each year during the study period (Table 4).

Bladder Cancer (C67)

The mean age of the patients was 63.2 (CI 95%: 60.5 – 66.0). The mean age between the two genders was not different ($P=0.587$). Total 72.5% of the patients were male and 27.5% of them were female. The dominant morphology in 66.4% of the patients was transitional cell carcinoma (ICD-0 code: 8120.3) and it was found in 58.3% of females and 69.5% of males. The other most prevalent morphology was papillary transitional cell carcinoma (ICD-0 code: 8130.3), which was found in 32.1% of the patients (38.9% of the females and 29.5% of the males). The incidence difference in types of the

morphology of this cancer was not significant between two genders ($P=0.242$). Incidence risk ratio for this cancer was 1.09 which means the crude number of cancer increased 9% by each year during the study period (Table 4).

Breast Cancer (C50)

During the study period only 4 men with breast cancer recognized, therefore breast cancer investigated only in women. The mean age of the patients was 49.4 (CI 95%: 47.6 – 51.1). The dominant morphology in 90.2% of the females was infiltrating duct carcinoma (ICD-0 code: 8500.3). The other most prevalent morphologies were Neoplasm malignant (ICD-0 code: 8000/3), which was found in 1.7%, Carcinoma, NOS (ICD-0 code: 8010.3) in 1.2%, and medullary carcinoma, NOS (ICD-0 code: 8510.3) in 1.2% of female patients. Incidence risk ratio for this cancer was 1.17 which means the crude number of cancer increased 17% by each year during the study period (Table 4).

Colorectal Cancer (C18-C21)

The mean age of the patients was 61.8 (CI 95%: 59.6 – 64.0). The mean age between the two genders was not different ($P=0.961$). Total 53.3% of the patients were male and 46.7% of them were

Table 4. Trend analysis of common cancers in Shahroud, Iran; 2000 - 2010

Cancer Site	Incidence Risk Ratio (CI 95%)*		
	Male	Female	Total
Stomach	1.05 (1.01 – 1.09)	1.14 (1.07 – 1.22)	1.08 (1.04 – 1.11)
Esophagus	1.02 (0.96 – 1.08)	1.01 (0.95 – 1.07)	1.02 (0.98 – 1.06)
Skin	1.06 (1.01 – 1.10)	1.01 (0.96 – 1.06)	1.04 (1.00 – 1.07)
Breast	-	1.17 (1.11 – 1.23)	1.17 (1.11 – 1.23)
Prostate	1.13 (1.06 – 1.20)	-	1.13 (1.06 – 1.20)
Bladder	1.02 (0.92 – 1.13)	1.11 (1.04 – 1.19)	1.09 (1.03 – 1.15)
Colorectal	1.20 (1.12 – 1.29)	1.12 (1.05 – 1.20)	1.16 (1.11 – 1.22)

* Calculated in Poisson regression model

female. The dominant morphology in 86.8% of the patients was adenocarcinoma (ICD-0 code: 8140.3) and it was found in 89.4% of females and 84.5% of males. The other most prevalent morphology was mucin-producing adenocarcinoma (ICD-0 code: 8481.3), which was found in 4.4% of the patients (4.7% of the females and 4.1% of the males). The incidence difference in types of the morphology of this cancer was not significant between two genders ($P=0.061$). Incidence risk ratio for this cancer was 1.16 which means the crude number of cancer increased 16% by each year during the study period (Table 4).

Discussion

The results of this study showed that, during the period 2000 through 2010, the trend of cancer incidence in Shahroud district was increasing; on an average, it grew by 12.4% annually. A considerable amount of this growth was definitely related to the improvement of the registry and reporting system, especially as of 2008 onwards, when the method of cancer registry changed from pathology-based to population-based. Moreover, low incidence rate of cancer in 2000 was not due to the fact that few cancer cases occurred, but rather owing to the incomplete registration of cancer cases at the beginning of the cancer registry program. On the other hand, the data for 2010 were incomplete up to this moment of the study (discovered cases in other provinces were not included), making up for the undercount in 2000 to some extent so that we can consider that 12.4% trend was correct during the whole period. Iranian national reports of cancer registry showed that the Average Annual Percentage Change (AAPC) for standardized incidence rate was 9.6% in males and 10.6% in females during 2003 to 2008 [3,6-10]. In Shahroud and during the same years, these numbers were 24.7% and 28.3%, which indicated that cancer incidence in Shahroud was higher than in the whole country mainly due to the improvement of the reporting system. In this comparison, it should be noted that the year 2008 in

Shahroud and even in the national statistics was an exception. In this year, by considering the expected crude incidence rate of cancer as 113 per 100,000 people, Shahroud had 204% reporting coverage, ranked second one in the country [3]. In addition to the improvement of reporting and increasing rate of cancers, the cause of this sudden increase in incidence rate can be attributed to changing the cancer registry to community-based approach.

It should be noted that in some cancers such as esophageal and skin cancers in women and bladder cancer in men, there was no increase in the incidence of cancer cases during the study period (Table 4). Therefore, if the reason for the increasing trend in cancer incidence in Shahroud was only the improvement of reporting, then there should have been an increase in these cancers cases as well, unless the incidence of these cancers is decreasing and the improvement of reporting causes the annual incidence rate of these cancers to remain unchanged. Since no intervention programs to prevent these cancers have been carried out in the country or in the region, this hypothesis cannot be true. In other words, the dramatic increase in the incidence of breast, colorectal, prostate, and stomach cancers in women (Table 4) with the improvement of reporting in all kinds of cancers, resulted in the increasing trend in cancer incidences in Shahroud.

The prevalent cancers during the study period included skin, stomach, esophageal, and breast cancers. Esophageal cancer has a lower rank in national reports and colorectal cancer takes the fourth place instead. Table 2 shows that esophageal cancer is the third common cancer among both men and women. Although the incidence rate of this kind of cancer is not as much as in the northern provinces and in the provinces located in the esophageal cancer belt [3,11-13], it is higher than in many parts of the country [3,14,15], and, unlike in other studies [16,17], the trend of this cancer in Shahroud has not decreased during the recent years. In fact, adenocarcinoma type of esophageal cancer is increasing, especially in developed countries [18].

Unlike the provinces with high prevalence in Iran that has >90% of esophageal cancer of squamous cell type [19], in Shahroud and especially among men, the percentage of adenocarcinoma of esophagus is considerable. Moreover, the constancy of the incidence rate in esophageal cancer could be attributed to the relative increase in adenocarcinoma of esophagus. Therefore, it is necessary to pay special attention to the risk factors of adenocarcinoma-type esophageal cancer such as gastroesophageal reflux and infection with *Helicobacter pylori* as well as other risk factors for squamous cell carcinoma of esophagus.

In this study, stomach cancer was the most prevalent cancer among men and the fourth cancer among women. Since another study conducted in other cities of the Semnan province, except for Shahroud, during 1997 to 2001 showed that stomach cancer with ASR equal to 27 was the most prevalent cancer [20], it can be stated that this cancer, which similar to other study [17], had an increasing trend and needs special attention. Therefore, this kind of cancer is considered as a priority not only in Shahroud but also in the whole Semnan province. However, in GLOBOCAN 2008, the standardized incidence rate of stomach cancer in Iran was reported to be 15.6 [21], which was more than that calculated in Shahroud.

This study showed that breast cancer in women with ASR equal to 16.50 was the most prevalent cancer in women. Its standardized incidence rate was even higher than that of skin cancer and had the most increasing trend (Table 4). However, the calculated ASR was less than GLOBOCAN 2008 (18.4). In other provinces of Iran, breast cancer takes the first place among cancers in women [13,14,20]. It seems that women's lifestyle and urbanization have led Shahroud toward the provinces with high prevalence of breast cancer such as Tehran, Mazandaran, Gilan, East Azarbaijan, Isfahan, and Khuzestan. If this status does not change, the increasing trend of breast cancer, which is seen in other studies [17,22], will continue.

In this study, colorectal cancer had the highest increase among all patients. This status resembles the results of other studies conducted inside and outside Iran [16,17,22]. On the other hand, the standardized incidence rate of these cancers (8.89) is higher than that in the GLOBOCAN 2008 report (7.6). Therefore, while doing further studies on this form of cancer, it is necessary to design and perform the required interventions immediately in all cities of the province of Semnan.

One of the remarkable finding of this study is the low incidence rate of lung cancer; in fact, this cancer takes the eleventh place among the prevalent cancers in Shahroud. This is contrary to global statistics [2,21] and some studies conducted in Iran [17], in which lung cancer among men takes the third place. Lower rate of tobacco use in this city is one of the reasons for this status. Considering that most lung cancer cases are discovered from death registration systems rather than from pathology centers, it can be predicted that in the coming years and with the continuation of the population-based cancer registry, the incidence rate of lung cancer will also rise.

In this study, the mean age of the patients with cancer was 61.6 years, which was higher than that in the other parts of Iran [13,23]. This could be due to the fact that Shahroud, with 8.9% elderly population (>60 years old) in 2006, is among the cities with a high proportion of the elderly (in 2006, 7.3% of the population in the whole country were >60 years).

There was no significant difference in the mean age of the patients during the study period, while the percentage of elderly population increased from 2000 to 2010. Therefore, it can be mentioned that in some cancers such as breast cancer, the mean age decreases and, in some other cancers, as mentioned earlier, it increases with age. These two statuses caused the mean age of the patients to remain unchanged during the study period.

Some of the strengths of this study include analyzing the cancer cases during an 11-year period with trend analysis, appropriate statistical tests, accuracy in providing databases with accurate coding, and minimum missing data in terms of sex and age. On the other hand, the reports of cancer cases were pathology-based from 2000 to 2007 and discovered cases were fewer than expected, which is considered as a limitation in the real estimation of incidence rate of cancers. The other limitation of this study is using the population of the census in 2006 for all of the study years. Obviously, if the population statistics in 18 sex and age groups were available for all years, the incidence rates could be calculated with more accuracy.

In summary, it can be said that the trend of cancer incidence from 2000 to 2010 was associated with impressive increase, wherein some of this increase can be attributed to more occurrences of cancers, especially colorectal, stomach, breast, and skin cancers.

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Conflict of Interest

None declared.

Authors' Contribution

Mansooreh Fateh drafted the manuscript and contributed in the conceptualization of the paper and was involved in data collection supervision and statistical analyses. Mohammad Hassan Emamian contributed in preparation of the study design and conceptualized and conducted all statistical analyses and critically revised the manuscript and approved it.

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