

Original Article

Burden of Cancers in Iran from 1990 to 2010: Findings from the Global Burden of Disease Study 2010

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Abstract

Background: Cancer is one of the most common non-communicable diseases in both sexes and a major cause of disability and death around the world, as well as in Iran. The aim of the present manuscript is to report the results of the Global Burden of Disease study 2010 (the GBD 2010) to compare them with other similar findings. The paper also discusses the current deficiencies in the GBD study. Our aim was to describe and criticize the attributed burden of cancers according to the GBD results by sex and age.

Methods: The GBD 2010 has profited from 100 collaborators worldwide and provides a vast network of data on health outcomes, vital registries, and population surveys. The GBD has used various scientific-approved methods to estimate important health statuses like death rates, life expectancy, and healthy adjusted life expectancy, disability-adjusted life years, years of living lost due to premature death and years of life with disabilities. In the present study, we extracted and graphed the GBD results for Iran in order to present a better scheme for readers.

Results: The mortality rate of cancers in Iranians has increased by about 8.5%, while the disability-adjusted life year rates have declined by about 9%, and years lost due to premature death have also decreased by about 10% from 1990 to 2010 compared to an 85% increase in years of life with disabilities in the same time period.

Conclusion: The burden of all non-communicable diseases (NCDs) including cancers shows a decrease during the past two decades. However, these diseases still remain a global health challenge. Prevention should be considered as an important priority and responsibility. The health authorities also need to determine the burden of cancers at national and sub-national levels for implementation of effective preventive strategies.

Keywords: Burden, cancer, GBD, Iran, NCD, non-communicable

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Introduction

Cancer is one of the most common non-communicable diseases (NCDs) in both sexes and is a major cause of disability and death around the world. It includes various types of malignancies with similar biologic mechanisms but different causes. Cancers can affect people of all ages, as well as different body organs and systems. The estimates of the International Agency for Research on Cancer (IARC) indicate that cancer remains one of the world's greatest disease burdens, especially in

low and middle-income countries,¹ despite significant progress made in treatment in recent decades.

The Global Burden of Disease study 2010 revealed that, next to cardiovascular and infectious and parasitic diseases, cancers account for the highest number of deaths (seven million, 12% of all deaths) and almost 6% of the global burden of disease worldwide.^{2,3} The World Health Organization (WHO) reported that 14.1 million new cancer cases and 8.2 million cancer-related deaths (13% of all deaths) were recorded in 2012 worldwide.^{4,5}

By 2030, non-communicable diseases are predicted to globally claim about five times as many lives as communicable diseases.⁵ Based on Globocan 2012 estimates, cancer incidence will increase dramatically to 19.3 million people per year by 2025. In 2012, 56.8% of all cancers and 64.9% of all cancer deaths occurred in developing countries: these proportions are predicted to increase by 2025.⁶ The last national death registry report indicated that, among all NCDs, cancer is the second cause of death, with about 7.2% of all Years of Living Lost due to premature death (YLL) and with more than 90% of cancer burden accounting for YLL.⁷ Determining the burden of cancer may help policymakers and legislators make appropriate decisions and to establish evidence-based early detection programs and therapeutic facilities.

The burden of disease estimation is the first systematic and scientific effort to prioritize health challenges and public health poli-

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cymakers and programmers.⁸⁻¹⁶ Burden of disease is measured by disability-adjusted life years (DALY), which means the healthy life years lost because of premature death and disability. DALY has two components: YLL and years of life with disabilities (YLD). The YLL rate varies across different sex, age, and community groups and is estimated based on maximum life expectancy in each given group. For YLD, the disability rate is estimated for different age and sex groups using scientific and internationally approved methods.

The first report of the GBD was published in 1990 and included health effect estimates of more than 100 diseases and injuries in about eight regions of the world. The second report was released in 2004 and included 17 specific causes of mortality in 192 member states per country.¹⁷ The GBD study 2010 has been conducted for 291 causes of death (diseases and risk factors), 20 age groups, both sexes, and for 187 countries in the world at three points in time.¹⁸ Due to major lifestyle changes, limited access to health care, and aging populations, the burden of NCDs has increased significantly in undeveloped countries at rates comparable to those seen in developed countries. The last national report of the burden of disease in Iran was published more than ten years ago. In that report, YLL, YLD, and DALYs of cancers were reported to be 598.7, 63.7, and 662.4 years per 100,000 populations, respectively.

Accordingly, the aim of the present paper is to report the burden and trend of cancer in Iran and to discuss the GBD report between 1990–2010 in five-year intervals with a focus on neoplasms, in order to express the imperative need for cancer prevention and controlling programs in the country. In addition, this manuscript presents a discussion of the challenges of the GBD project and possible solutions, such as estimations for only the national level, model utilization, and data source limitations.

Materials and Methods

Death rates were estimated using vital registry datasets via two different processes for two separate age groups (i.e., 0–4 years and 5 years and older). In the 0–4 year age group, each year is divided into 52 weeks to follow up the probability of death at different ages. Vital registry data from more than 100 countries have been corrected for use in distribution methods. Gaussian regression has been used to generate final mortality estimates of the under and over 5-year age groups for about 187 countries (those countries with population rates of more than 50,000 individuals in the year 2000).⁵

Disability weight measurement was conducted using two different surveys: one was a household survey of adults aged 18 years or older (done either face-to-face or via a telephone interview) in 2009–2010; the other survey was an open-access and web-based survey carried out in 2010–2011. Both surveys included comparative questions in two hypothetical fields with different and randomly selected health states regarding the healthier individual status. Up to 279,492 paired comparison questions were analyzed using the Probit regression analysis method. All results were anchored on a disability weight scale from 0 (no loss of health) to 1 (equivalent to death) and the results were then compared to the recent WHO update of the GBD study 2004. The disability weight was estimated for about 220 health statuses. In the field of cancer status, the least mean disability weights with 95% uncertainty intervals (UI) were estimated for mastectomy 0.038 (UI 0.022–

0.059) and stoma 0.086 (UI 0.055–0.131). These were contrasted with the most weighted ones, that is the terminal phase of disease with (0.508; UI 0.348–0.670) or without (0.519; UI 0.356–0.683) medication. Cancer diagnosis and primary therapy with (0.294; UI 0.199–0.411) and metastatic cancer with (0.484; UI 0.330–0.643) disability weight estimations were placed between the two borderlines.¹⁹

Healthy life expectancy (HALE) was assessed at two points in time (1990 and 2010); that is, age-specific mortality rates and based on prevalence of 1160 squeals with related disability weights of 220 health statuses. Co-morbidities in individuals were captured using the Mont Carlo simulation method. Age-specific mortality was calculated using life tables based on two estimations: mortality rates between 0–5 and 14–60 years old and translation of these measures into a set of age-specific mortality rates. HALE estimations were produced through the conventional life table using the Sullivan method for each population per sex, country, and year.²⁰

Years lived with disability (YLD) were computed for just 289 of the 291 conditions, which were non-fatal causes of disabilities. A systematic review analysis (Bayesian meta-regression method, DisMod-MR) was performed for prevalence, incidence, remission, duration, and mortality from many different sources—population disease registries, published studies, surveys, cohort studies, and hospital data. YLDs by sex, country, year level, and cause at age were adjusted for co-morbidity with simulation methods. The prevalence of four cancer squeals (diagnosis or treatment phase, recurrence, remissions, and terminal phase) and the natural history of incident cases were estimated using calculated five-year survival and relative duration of each cancer phase.²¹

Years of life lost due to premature death (YLL) were estimated based on the difference between life expectancy (LE) and cause specific mortality dates. CODEm was used for cancer YLL estimations, like other major causes of death, in three steps: developing a range of plausible statistical models for each cause, performing all component models and ensembles, and selecting the best performing model based on out-of-sample predicting validity. Liver cancer YLLs were estimated as a sub-cause disaggregation.²²

Disability adjusted life years (DALYs) were calculated as the sum of YLL and YLD for 291 diseases and injuries, 20 age groups, both sexes, and 187 countries for five points in time from 1990 to 2010. The YLLs and YLDs were not age weighted, nor were they discounted.⁹

In this article, we extract and describe the data on cancer in Iran based on the GBD study 2010, critique the results, and provide suggestions for obtaining better results in this field. All graphs and figures have been designed with R software.

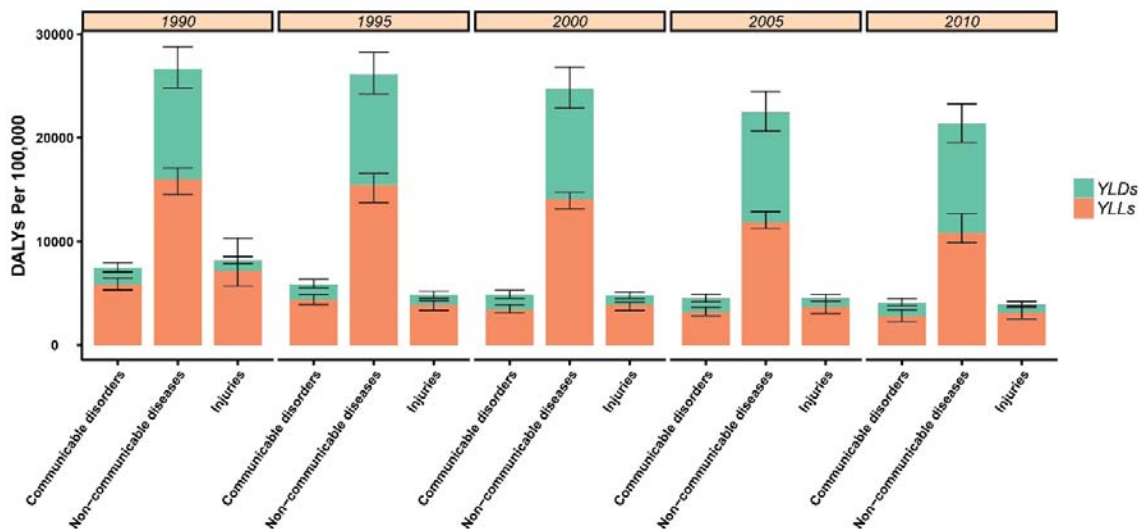
Results

According to the Global Burden of Disease study 2010, the most important components of non-communicable diseases were neoplasms, cardiovascular and circulatory diseases, cerebrovascular diseases, chronic respiratory diseases, cirrhosis of liver, other digestive diseases, neurological disorders, mental and behavioral disorders, musculoskeletal disorders, diabetes, urogenital, blood and endocrine diseases and others (such as congenital anomalies, skin and subcutaneous diseases, sense organs diseases, and oral disorders). Disability adjusted life years and its components

Table 1. Healthy Life Expectancy and Life Expectancy in Iranian men & women (1990-2010).

Year	Gender	HALE	95% UI	LE	95% UI
1990	Male	54.9	52.4–57.3	64.6	61.7–66.7
	Female	58.7	56–61	71	68.9–72.8
2010	Male	60.7	58–63.4	71.6	68.5–74.6
	Female	63.8	61.2–66.3	77.8	75.3–80.2

HALE= health adjusted life expectancy; LE= life expectancy

**Figure 1.** The major causes of death and Disability Adjusted Life Years in Iran: 1990 – 2010.

(YLL and YLD) were estimated based on the computed healthy life expectancy (HALE) and life expectancy (LE) of Iranian men and women (Table 1). An overall comparative view of the major causes of death and disability-adjusted life years in Iran is displayed in Figure 1 for all ages and both sexes at five-year intervals from 1990 to 2010. NCDs accounted for 71% and 81% of the age-standardized death rates per 100,000 population in both sexes compared to other death causes including communicable diseases (also including maternal, neonatal, and nutritional disorders) (8%, 10%) and injuries (12%, 19%) in 1990 and 2010, respectively.

Table 2 provides the number and age-standardized rate estimations for death, DALY, YLL, and YLD due to NCDs overall in comparison with all neoplasms for all ages and both sexes among Iranian males and females at five-year intervals from 1990 to 2010. In Iran, the DALYs of all NCDs in 2010 accounted for more than 70% of all DALYs. A 10.9% decline occurred, from 20746.4 years (95% UI 18747.6–22700.5) per 100,000 persons in 1990 to 18475.8 years (95% UI 1484.4–20635.6) per 100,000 persons in 2010. The DALY rates of all cancers per 100,000 Iranians (about 1.5% among all causes of DALY) declined by about 9%, from 1528.57 (95% UI 1234.45–1752.25) in 1990 to 1386.4 (95% UI 1232.5–1583.12) in 2010.

The YLD rate of NCDs per 100,000 persons increased from 7916 (95% UI 6528–9488) years in 1990 to 10,001 (95% UI 8271–11824) years in 2010. Additionally, the YLD rate of all neoplasms increased by 85% [from 9616 (95% UI 6775.9–13226.7) in 1990 to 17845 (95% UI 12976.7–23692.4) years in 2010].

The YLL rate of all neoplasms in Iranian population has decreased by about 10%, starting at 1511.03 (95% UI 1219.12–1731.19) in 1990 and dropping to 1362.3 (95% UI 1208.4–1560.96) in 2010.

On the other hand, a more than 4.5% increase occurred among all causes of YLL due to premature death. These indices and the trend of cancer burden (DALY) in each age group in 1990 and 2010 are shown in Figure 2.

Overall, the mortality rate of cancers in both sexes increased by about 8.5%, from 27387.4 (95% UI 22364.1–31007.3) persons in 1990 to 40106.2 (95% UI 35737.4–46001.9) persons in 2010. However, the portion of cancer-related deaths among all NCD-related deaths remained about 14.9%, without any significant change during these years. These mortality ratios of cardiovascular and circulatory diseases, cerebrovascular diseases, neurological disorders, and diabetes mellitus increased only by 5.5%, 1.1%, 1.4%, and 1.2%, respectively. Mortality rates associated with chronic respiratory diseases decreased by 1.1% during the same period. Neoplasms, after cardiovascular and circulatory disorders, had the most YLL and also the least YLD among the major NCDs, in both 1990 and 2010.

The mean age-standardized prevalence rates of each cancer type for the three times between 1990 and 2010 related to both sexes and all ages are displayed in Figure 3. According to Table 3, the age-standardized mortality rate of cancers decreased in 2010 compared to 1990. In addition, the most and the least predominant mortality rates in all cancers respectively belonged to the age groups of 80+ and 10–14 years of age during 1990–2010 (with or without gender taken into account).

Stomach and respiratory system cancers had the highest death rates (per 100,000 populations) compared to the other types of cancer in both time periods. The largest increases in mortality rates from 1990 to 2010 pertained to malignant melanoma of the skin with an approximately 154.7% increase, followed by liver

Table 2. Death, DALY, YLL, and YLD age-standardized rate estimations and number in NCDs and neoplasms in Iranian men & women.1990–2010.

			Non Communicable Diseases			Neoplasms			
			Both sexes	Male	Female	Both sexes	Male	Female	
1990	DEATH	Number	183,827.59	108,992.16	74,835.43	27,387.38	17,027.14	10,360.24	
		Rate per 100,000	661.863	771.329	546.833	102.93	126.994	77.5643	
	YLL	Number	7,033,779.04	4,032,400.29	3,001,378.75	828,367.60	491,851.37	336,516.23	
		Rate per 100,000	16002.5	18682.9	13195.1	2493.23	2955.21	1999.13	
	YLD	Number	4,339,726.70	2,050,197.93	2,289,528.78	9,615.83	5,225.35	4,390.48	
		Rate per 100,000	10681.3	10004.2	11354.5	33.2005	36.1302	30.0251	
	DALY	number	11,373,505.74	6,082,598.22	5,290,907.53	837,983.43	497,076.72	340,906.71	
		Rate per 100,000	26683.7	28687.1	24549.6	2526.43	2991.34	2029.15	
	1995	DEATH	Number	201,974.00	121,823.00	80,151.00	31,667.40	19,839.50	11,827.90
			Rate per 100,000	659.647	774.229	539.047	103.095	127.908	76.4923
YLL		Number	6,678,800.00	3,911,060.00	2,767,750.00	896,833.00	529,194.00	367,639.00	
		Rate per 100,000	15468.5	18270	12567	2443.06	2891.47	1961.44	
YLD		Number	5,070,280.00	2,384,270.00	2,687,710.00	11,140.20	6,045.37	5,090.58	
		Rate per 100,000	10667.3	9977.91	11361.4	32.2465	35.0785	29.0887	
DALY		Number	11749100	6295330	5455450	907974	535240	372730	
		Rate per 100,000	26135.8	28247.9	23928.4	2475.31	2926.55	1990.53	
2000		DEATH	Number	224101	134840	89261.3	34040.3	21079.5	12960.8
			Rate per 100,000	625.492	16652.1	511.998	92.5998	114.432	69.3335
	YLL	Number	6328710	3729710	2599000	915117	527204	387912	
		Rate per 100,000	14086.8	16652.1	11475.8	2159.95	2523.57	1774.07	
	YLD	Number	5894950	2764720	3133440	12843.3	6973.78	5861.73	
		Rate per 100,000	10653.6	9951.82	11368.6	31.3261	34.0801	28.1857	
	DALY	Number	12223700	6494430	5732440	927960	534178	393774	
		Rate per 100,000	24740.3	26603.9	22844.4	2191.28	2557.65	1802.26	
	2005	DEATH	Number	244,439.54	149,601.74	94,837.80	35,646.77	22,594.90	13,051.87
			Rate per 100,000	544.682	640.557	441.135	78.0457	96.6319	37.8511
YLL		Number	6,082,361.56	3,656,036.11	2,426,325.44	917,279.89	538,973.68	378,306.21	
		Rate per 100,000	11866	14015.4	9596.98	1815.25	2126.62	1478.39	
YLD		Number	6,751,755.71	3,190,974.83	3,560,780.88	14,586.46	8,007.34	6,579.12	
		Rate per 100,000	10640	9925.98	11376.1	30.4378	33.1313	27.3149	
DALY		Number	12,834,117.27	6,847,010.95	5,987,106.32	931,866.35	546,981.02	384,885.33	
		Rate per 100,000	22506	23941.4	20973.1	1845.69	2159.75	1505.7	
2010		DEATH	Number	268,699.60	165,587.53	103,112.07	40106.15	25,420.98	14,685.17
			Rate per 100,000	513.506	612.69	409.059	94.6974	94.6974	55.0227
	YLL	Number	6,268,286.41	3,823,134.11	2,445,152.30	1,007,597.94	593,470.31	414,127.63	
		Rate per 100,000	10828.6	13019.3	8573.89	1731.62	2057.76	1392.51	
	YLD	Number	7,397,042.21	3,490,739.73	3,906,302.47	17845.25	9713.07	8132.18	
		Rate per 100,000	10553.7	9894.36	11228.3	32.0301	35.1025	28.6634	
	DALY	Number	13665328.62	7313873.84	6,351,454.77	1,025,443.19	603,183.38	422,259.81	
		Rate per 100,000	21382.4	22913.7	19802.2	1763.66	2092.86	1421.17	

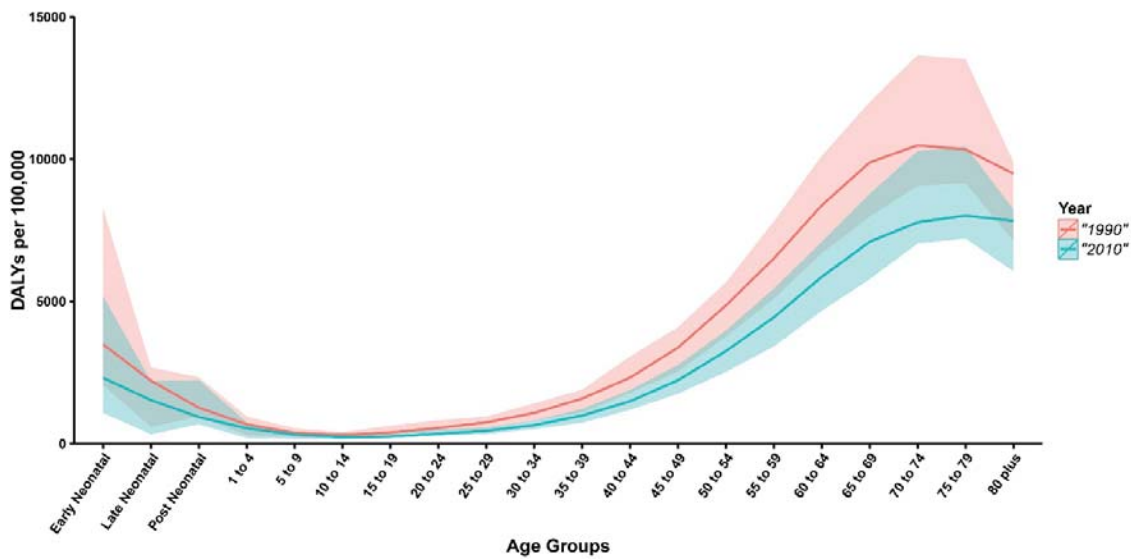


Figure 2. The cancer burden (DALY) per age group in 1990 and 2010.

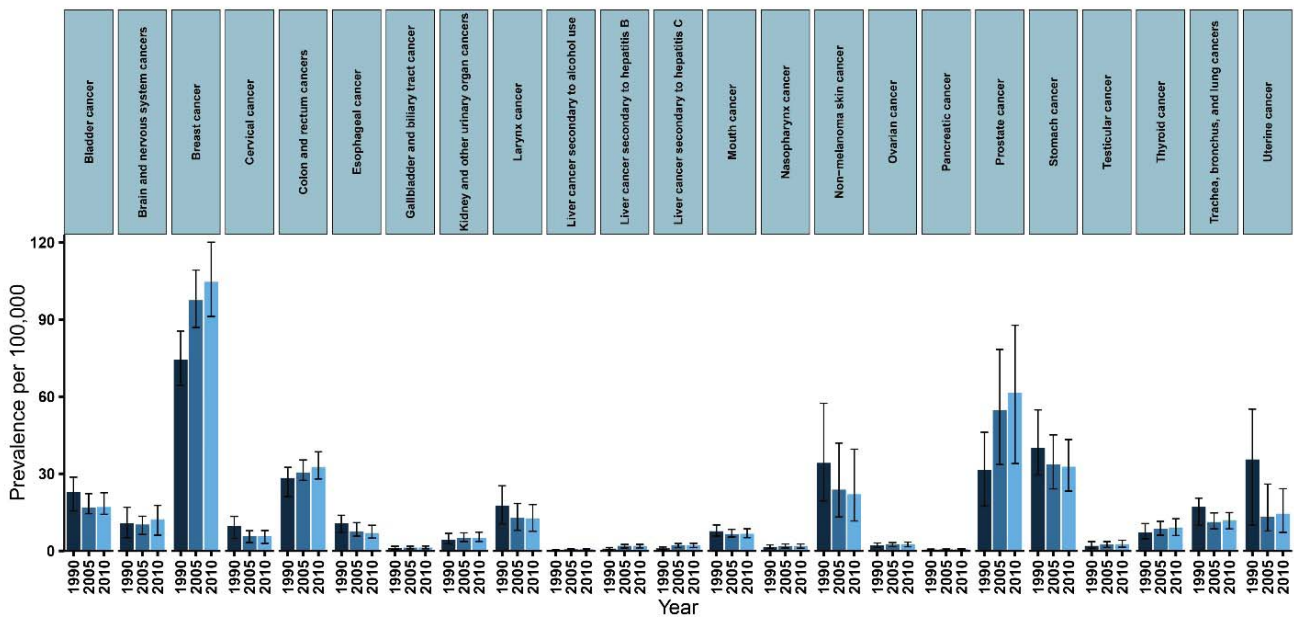


Figure 3. Mean age-standardized prevalence rates of cancers in both sexes and all ages: 1990, 2005 and 2010.

cancer with a 94% increase, pancreatic cancer with a 10.1% increase, prostate cancer with a 7.5% increase, and non-Hodgkin lymphoma with a 1.37% increase. On the contrary, mortality rates related to uterine cancer decreased by 64.1%, bladder cancer by 44.1%, cervical cancer by 43.6%, and esophageal cancer by 40.1% from 1990 to 2010 (Figure 4).

The DALY trends of these most common cancers in Iran are shown in Figure 5. Although the burden of liver cancers shows a 76% increase [from 58.7 (95% UI 45.9–81) to 103.2 (95% UI 66.3–127.8)], the others display DALY decreases: prostate 4% [from 58.8 (95% UI 29.4–85.5) to 56.2 (95% UI 26.4–83.6)], brain and nervous system 14% [from 136.3 (95% UI 65.9–204.1) to 117.2 (95% UI 61.3–160)], breast 23% [from 137.7 (95% UI 122.2–153.2) to 106.3 (95% UI 89.2–129.3)], colorectal 26% [from 128.8 (95% UI 88.6–147.3) to 94.9 (95% UI 80.1–116.1)], stomach 38% [from 518.5 (95% UI 390–707.1) to 321.5 (95% UI 221.3–410.8)], and respiratory system cancers 41% [from 343.3

(95% UI 202.2–405.6) to 203.1 (95% UI 145.4–257.8)], respectively, from 1990 to 2010.

The highest DALY rate per 100,000 population was also seen for stomach cancers, at 232.7 (95% UI 161.1–296.8) years, followed by the respiratory system at 149.6 (95% UI 106.5–189.9), brain and nervous system at 103.1 (95% UI 54.2–144), breast at 90.3 (95% UI 75.1–110.8), esophagus at 82.6 (95% UI 60.5–119.1), liver at 79 (95% UI 50.5–98.1), and colorectal cancers at 74.1 (95% UI 61.9–90.7) years in 2010.

The regional ranking of the leading cause of YLL due to premature death in 2010 for the Middle East region, including Iran, showed that the first remarkable malignancy was lung cancer (ranking 14th) followed by leukemia (ranking 23rd), breast cancer (ranking 26th), stomach cancer (ranking 27th), liver cancer (ranking 29th), and colon and rectum cancers (ranking 33rd), among all causes of YLLs. During 1990–2010, the highest YLL rate per 100,000 in Iran was again due to stomach cancer at 1.9 years, fol-

Table 3. Neoplasm related Death per 100,000 Populations. Iran 1990–2010.

Gender	Year	Age groups																Age-Standardized	
		Under 5	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	50 to 54	55 to 59	60 to 64	65 to 69	70 to 74	75 to 79		80 plus
Both sexes	2010	7	3	3	5	6	7	12	19	34	55	91	143	225	333	498	663	955	76
	95% UI	10.8-4.1	4.6-2.2	4-2	6.5-3.5	7.8-4.5	9.5-5.7	15-9.4	24.7-14.8	42.4-26.5	69.6-43.8	113.6-71.5	179.4-112.1	1179.9-274.7	269.8-411.1	-407.8-601.5	-545.2-792.9	1104-809.6	87-67.2
	1990	9	5	4	7	10	12	20	30	54	83	133	210	326	471	664	865	1070	103
Male	95% UI	13.2-5.8	6.8-2.9	5.5-2.7	9.2-4.9	12.9-6.8	16-8.7	26.1-15	38.6-22.2	68.9-39.9	-63.6-103.1	162-107.3	-167.9-258.1	259-391.8	374-563.8	-529.8-800.4	-691.6-1030.5	1241-885.8	116-84.3
	2010	7	4	3	6	7	8	12	17	30	53	100	168	291	443	681	876	1267	95
	95% UI	12.2-3.9	5.9-2.1	5.1-2	8.4-3.8	9.9-5	10.4-5.4	15.2-8.6	23.1-12.5	41.3-21.3	72.6-37.1	137.1-69.8	228.7-118.1	-210.8-385.7	865-533.6	-674.9-1097.7	-1016.6-1531.7	112-79.8	
Female	1990	9	5	4	8	12	13	20	28	53	87	151	255	421	598	871	1111	1400	127
	95% UI	17.3-5.1	8.7-2.8	6.8-2.4	11.7-5.3	16.9-7.9	17.6-8.1	27.9-14.1	37.7-19.6	71.2-36.4	-61.7-116.3	196.7-113	334.5-186	-313.3-538.8	-452.6-759.5	-669.7-1079.1	-851.7-1351.6	1118.8-1685.8	-101.5-145.8
	2010	6	3	2	4	5	7	12	21	37	56	82	117	163	224	301	408	604	55
Female	95% UI	11.6-2.9	4.7-1.5	3.9-1.5	6-2.5	7.6-3.2	10.5-4.9	17.4-8.6	30.8-13.9	51.8-26.7	74.9-42.3	108.9-60.7	152.1-88.7	-126.4-206.8	-171.6-289.6	-236.1-395.7	-321.5-509.7	490.6-733.7	65-46.8
	1990	8	4	4	5	8	12	20	32	56	78	116	161	222	325	441	597	770	78
Female	95% UI	13.1-4.8	6.4-2.3	5.8-2.2	8.1-3.6	11-5	17-8	28.2-14.3	44.5-22.3	75.9-39.2	-59.1-100.5	147-90.1	-128.6-203.9	-175.3-275.4	-246.4-407.9	543.6-326	-432.3-739.2	923.4-595.7	90-61.9

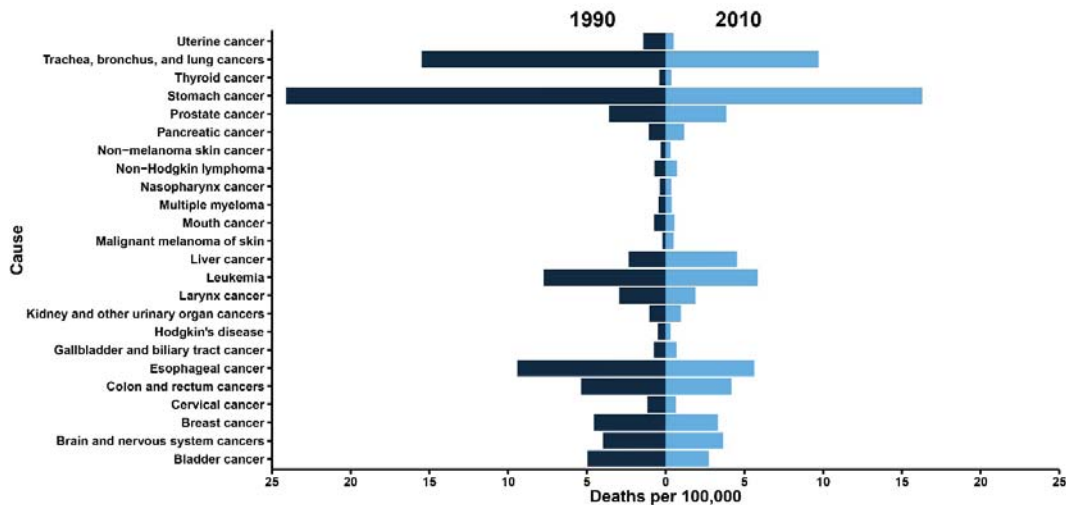


Figure 4. Cancer mortality rates (per 100,000 populations): 1990 and 2010.

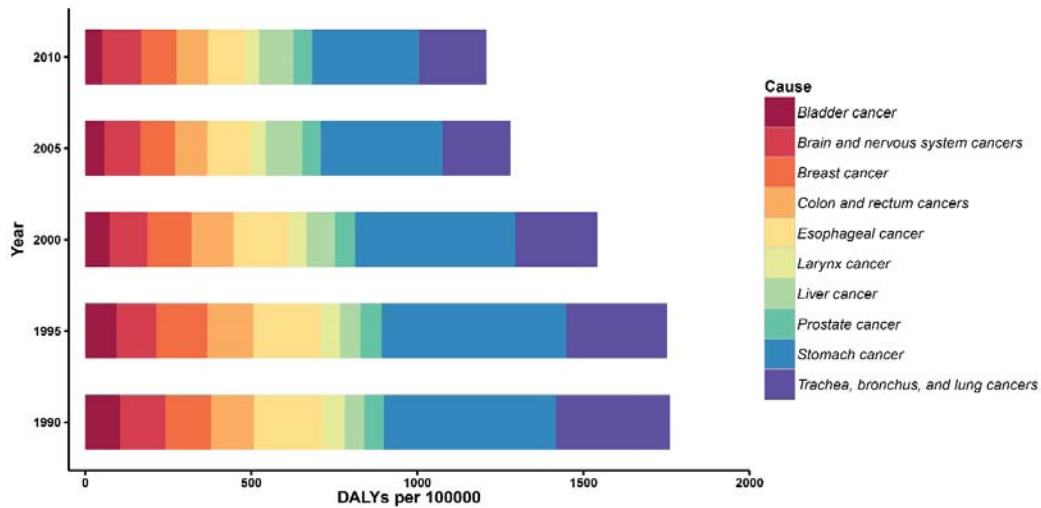


Figure 5. The DALY trends of most common cancers in Iran: 1990–2010.

lowed by trachea, bronchus, and lung cancers with 1.2 lost years. This could be due to late cancer detection, low survival rate of these malignancies, and premature death. Furthermore, the lowest YLL rate was related to non-melanoma skin cancer, with 0.04 lost years in both sexes because of easy recognition, and testicular cancer, with 0.02 lost year in males in the case of lower incidence, without change during the same period of 1990–2010. A significant difference was also noted in cancer-related YLL between men and women in different age groups; that is, a sharp increase in YLL at 70 years of age reflects much more deaths in this age group in men than women.

Among all the Middle Eastern countries and after Morocco (from 64 to 82 deaths per 100,000), Iran had the highest estimated neoplasm mortality rate (from 50 to 54 per 100,000) during 1990–2010.

Discussion

In recent decades, the health landscape in most regions of the

world has undergone a transition from the communicable diseases and injuries to NCDs. The global NCD-related mortality is now predicted to raise from 28.1 million deaths in 1990 to 49.7 million in 2020.²³ In low-income and middle-income countries, NCDs will be responsible for nearly five times as many deaths as communicable diseases by 2030.²⁴

More than two thirds of all cancer deaths are claimed to occur in less developed countries and cancer incidence will increase by 58% in upper middle-income countries and by 40% in high-income countries by 2030 compared to 2008.²⁴ Cancer is predicted to be an increasingly important cause of death and disease in subsequent decades in all regions of the world. Anticipated changes in population demographics in the next two decades predict an increase in the incidence of new cancer cases from 14.1 million in 2012 to 21.4 million by 2030. More than half of all cancer diagnoses will occur in low-income and middle-income countries.^{4,5,24}

Based on the WHO report in 2008, the largest increase in cancer DALY will be in low-income and middle-income countries during the next 15 years, with more than two thirds of all cancer deaths

occurring in these countries and 58% of cancer incidence occurring in upper middle-income countries.²⁴ This type of increasing trend might be associated with an increased prevalence of cancer risk factors including childhood obesity, smoking, and chronic infection in low-income and middle-income countries.

According to the GBD Study 2010 results, the increase in DALYs related to the cancers were due to increased involvement of kidney and other urinary organs by about 32.7% in comparison to Hodgkin's disease, which showed a 33.7% decrease. Lung cancer has also the greatest burden (ranking 22nd worldwide and 28th in the Middle East including Iran) alongside other causes of GBDs. Despite the overall decrease in the burden of NCDs as well as neoplasms worldwide and also in Iran (similar to the increased portion of global burden of neoplasm from 5.93% in 1990 to 7.06% in 2010), Iran's cancer DALY percentage of all DALYs has increased from 3.9% in 1990 to 5.3% in 2010, which clearly demonstrates an epidemiologic transition in diseases.

A similar increase in HALE (about 6 years) in both Iranian men and women indicates that improving national health programs have involved both sexes and no major discrepancies have arisen between men and women in terms of availability or accessibility of health services. However, the role of other important factors like increases in awareness, insurance coverage, and health promoting policies should be taken into account, as well.

The burden of NCDs in Iran for both sexes and all ages was estimated at 52% of all DALYs compared to communicable diseases and injuries, which accounted for 29% and 19% of DALYs, respectively, in 1990. While the NCD burden showed an approximately 20% increase (70.42% of all DALYs), communicable diseases and injuries indicated a decreased DALY (14.5% for communicable diseases and 15% for injuries of all DALYs) in 2010. As the global range of estimated non-communicable disease DALYs has shown, this increase was 3% in developed countries, 12% in developing countries, and 11% worldwide from 1990–2010.

Globally, among NCDs with YLDs, at 604988000 (95% Uncertainty Interval (UI) 506549000–714196000) in 2010, all cancers in all ages rank eighth with YLD rate at 65 (95% UI 48.2–85.3) years per 100,000 persons (about 0.7% of all non-communicable disease) with a 35.8% increase from 1990 to 2010. In Iran, the YLD rates of non-communicable diseases and all cancers have also increased 26% and 85%, respectively, from 1990 to 2010. This increase in cancer YLD in Iran has arisen mainly because of early cancer detection and the rise in LE, and partly because of improvements in cancer patient management and palliative care. In addition, Iran's list of cancers with highest YLDs in 2010 follows the worldwide trend and includes breast, colorectal, prostate, and respiratory system cancers. Stomach cancer still stands at the top of this list after breast cancer in Iran.

However, according to DALYs, Iran at 1386 years stand in the middle range after others such as Morocco at 2394 years, Tunisia at 1733 years, Egypt at 1654 years, and Jordan at 1505 years. This is acceptable with a low YLL due to higher cancer-caused mortality in the elderly and low YLD in case of national cancer care improvement in recent years. Also note that because of the incomplete national cancer registry data in Iran, some parts of the lower DALYs may be related to non-existent cancer incidence data. Cancer and cardiovascular diseases account for 16.4% of the DALYs in developing and 36% in developed countries. This rate, even though about 22% in Iran, demonstrates an industrializing

phenomenon effect on the burden of disease.

This report shows that cancer epidemiologic determinants have overall improved worldwide, as well as in Iran. The mortality rates, YLL, DALY, and the portion of cancer related to negative indices among all other diseases have markedly decreased. Cancer is predicted to be at the top of health challenge list in the following decades, especially in low-and middle-income countries. The regional ranking of YLL of all diseases shows that some cancers are strongly related to the demographic and epidemiological transitions. These include colorectal, breast, pancreatic, brain, non-Hodgkin lymphoma, kidney, and prostate cancers.¹¹

Excluding liver cancer DALY (because of the undetermined metastatic disease-related burden), stomach cancer with an age-standardized DALY rate of 556 (95% UI 363.9–666.6) years in 1990 and 321.5 (95% UI 221.2–410.7) years in 2010 also had the greatest DALY of all cancers, while prostate cancer with a DALY of 58.8 (95% UI 29.4–85.5) years in 1990 and larynx cancer with a DALY of 40 (95% UI 22.2–58.4) years in 2010 had the lowest DALYs among all cancers in Iran. The cancers with highest YLLs, including stomach cancers, are also the most common and major early detectable cancers in both sexes. Therefore, the use of globally-based control and screening programs with regard to national epidemiologic and demographic aspects, as well as utilizing available facilities and potential capacities, could potentially decrease the incidence and consequently the burden of cancers.

This study had some limitations, including making estimations and using modeling methods instead of using estimations based on the best available data and evidence; using verbal autopsy widely (despite its lower accuracy for cancers other than breast cancer); applying weak covariates in spatial or temporal variation in death-related kidney cancer; and drawing on unavailable, restricted and incomplete datasets, resulting in wider uncertainty intervals.^{15,17–20,23} The IHME has also only measured health at national levels without any regard for sub-national ones. In addition, for countries without reliable vital registries, like Iran, health status estimations have been imputed from existing data that are possibly neither national nor completed.^{15,20,25} Therefore, the study of NASBOD 2013 (National and Sub-national Burden of Diseases 2013) has been recently run at the NCDRC (Non-Communicable Diseases Research Center) of Tehran University of Medical Sciences to gather proper national data and assess the national and sub-national health status rate estimations in Iran.²⁵ The NASBOD study benefits from two advanced statistical methods.^{26,27}

In conclusion, this report shows that although the burden of all non-communicable diseases including cancers has decreased overall during the past two decades, all NCDs including cancers represent important global and regional health challenges as well as a preventable epidemic.²⁴ The negative effects of urbanization could be controlled with an approach that takes into account cost-effectiveness and population-wide healthcare interventions in order to describe risk factors and employ primary healthcare measures to manage persons who are at high risk for NCDs.⁴ Each health level prevention as well as control of NCDs should be prioritized. Responsibilities must be assumed at the highest levels by the government, as well as by the private sector, society, the United Nations, and international organizations and all should collaborate closely.⁴ Despite the cost-effectiveness of controlling cancer risk factor exposure (such as some infections, unhealthy diet, environment pollution, lack of physical activity, and tobacco and alcohol use), intervention includes multi-sectorial challenges

that need allocation of necessary resources while attracting the interest of key stakeholders. According to the WHO recommendations, preventive policies and programs, whether global or national, will noticeably reduce poverty and the expenditure required mostly for treatment in low- and middle-income nations, especially in the areas of private clinics and out-of-pocket health care. Lifetime primary health care packages, including essential measures and interventions along with palliative care services for affected patients, should be supported through health-related public policies.¹³ Further studies with national and subnational complete estimations are needed to apply modified global control programs in each health situation like that of Iran. In this regard, the NASBOD study is planned to estimate the burden of disease as well as neoplasms at the national and subnational levels in order to provide a better determination and facilitation of policy making regarding NCDs.

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Competing interests

The authors declare that they have no competing interests.

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