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Iran Cancer Statistics in 2012 and Projection of Cancer Incidence by 2035

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ABSTRACT

Background: Burden of cancer is increasing worldwide, especially in the low and middle income countries (LMICs), including Iran. Several reports have been published about cancer statistics in Iran, although they had shortcomings and provided variable results. We reported the most valid cancer statistics about Iran.

Methods: We used Globocan database and reported age standardize incidence rate (ASR), mortality rate (ASMR), and five-year prevalence of cancer in Iran in 2012, and compared it with the results of 2008. We also provided the projection of cancer incidence for 2035 and estimated the life time cancer risks by age 75.

Results: ASRs per 100,000 were 134.7 for men and 120.1 for women. The most common cancers were breast (ASR 28.1), colorectal (ASR 10.5), stomach (ASR 9.7) cancers in women and stomach (ASR 20.6), bladder (ASR 13.2), prostate (ASR 12.6) cancers in men. The ASR was about 19% higher in 2012 (127.7/100,000) compared to 2008 (107.3/100,000). ASR of all cancer sites will increase about 2.17 times by 2035. ASMR was about 20% higher in men (90.4/100,000) than women (72.7/100,000) in 2012. The highest ASMRs was observed for breast cancer (9.9/100,000) in women and stomach cancer (17.3/100,000) in men. Five-year prevalence of all cancers was 79,194 for men and 90,521 for women in 2012. Lifetime risk of occurrence of all types of cancer was 25%. In other words, 1 in 4 Iranian people will be diagnosed with cancer before the age of 75 years.

Conclusion: Stomach and breast cancers were the most common cancers in Iranian men and women, respectively. Iran and other LMICs will experience major increase in the incidence and mortality of cancer in the next decades. They need to collocate further resources for cancer surveillance system and monitor the cancer statistics for evidence based cancer control program.

Keywords: Neoplasm, Iran, Prevalence, Incidence, Mortality, Statistics, Globocan

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INTRODUCTION:

Non-communicable diseases (NCDs) cause more deaths than all other causes worldwide. NCDs deaths are projected to increase from 38 million in 2012 to 52 million in 2035[1]. The poor and vulnerable countries are damaged more than the others due to lack of resources and lack of awareness among policy makers about the high burden of NCDs[2].

During the last decade, incidence rate of cancer rose 46% in the Eastern Mediterranean Region (EMRO) and increased from 495,000 patients in 2005 to 723,000 in 2015[3]. Moreover, in both sexes 2.6 million (2.65 million in men and 2.58 million in women) disability-adjusted life years (DALYs) was caused by cancer in the EMRO region in 2015 Iran[3].

The improvement in the socioeconomic and successful strategies in primary health care (PHC) system to control communicable, neonatal, maternal, and nutritional diseases and also aging population, urbanization, industrialization, and lifestyle changes, has caused Iran to be in the state of transition from communicable to non-communicable diseases dramatically. In 2012, 287,372 (357 per 100,000) of Iranian died due to non-communicable diseases (77% of total deaths), from which 53,837 deaths were due to the cancer (61.72 per 100,000; 13.3% of total deaths)[4].

Effective cancer control planning and monitoring of the programs require reliable data on incidence, prevalence and mortality of cancer at regional and national levels. Several reports about incidence and mortality of cancer were published in Iran during the previous years[5,6], however most of them were based on regional data or based on low quality pathology-based cancer registry[7].

Pathology-based cancer registry underestimates the cancer incidence and cannot be a reliable source for policy making and research prioritization[8,9]. Research showed that completeness of pathology-based registry in Iran was about 58% in men and 64% in women. The extremely low completeness was observed in cancers like lung, liver, pancreatic, and stomach cancers that are usually diagnosed through clinical examination in advanced stages[10].

In this study, we reviewed and analyzed data of the Globocan 2008 and 2012 and discussed incidence, mortality, and prevalence rates of cancers during these years in Iran.in addition we have reported projection for cancer incidence among Iranian population by 2035.

METHODS:

Data Sources and Method

We obtained data on incidence, mortality and prevalence for Iranian population from Globocan 2012, produced by IARC[11]. Globocan provides estimates, using data from population-based cancer registries; most of the registries do not cover the whole population of a country. In such cases, the nearest and the most similar areas (in regards to population pyramid and socioeconomic) is usually used for estimation. Rates are age-standardized using the World Standard Population (per 100,000)[12,13].

We used Globocan 2008 and 2012 to show any fluctuation in cancer during this period of time[11,14]. Human Development Index (HDI) based on United Nations database was used to compared the different between Iran and other countries[15]. HDI is a composite statistic of life expectancy, education, and per capita income indicator, and countries were categorized to four strata; 1) very high HDI (Russia, Australia, United States, France, Norway, United Kingdom etc.), 2) high HDI (like, Iran, China, Brazil etc.), 3) medium HDI (like Egypt, Morocco, Indonesia etc.), and 4) low HDI (like Yemen, Afghanistan, Sudan, Angola etc).

Estimating lifetime risk of developing cancer

We used age specific incidence and mortality rates of cancers (in 5-year strata) from Globocan 2012,

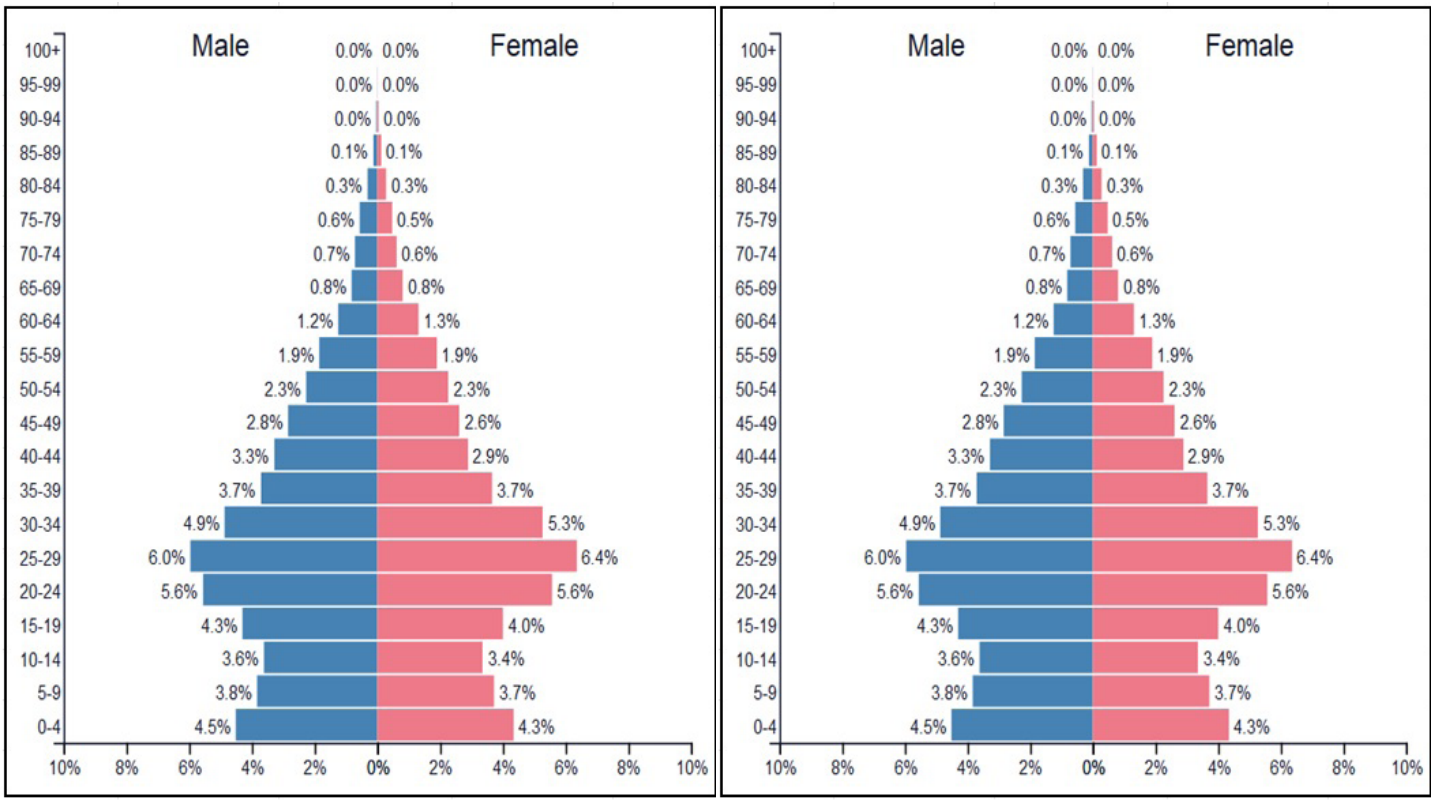


Figure 1. Iran population pyramid of 2012 and 2035, by age group (%)[17].

and obtained age-specific mortality rates from the national causes of death registry[16]. We used "adjusted for multiple primaries" (AMP) method to estimate life time risk of getting cancer by age 75 years for all types of cancer and common cancer in both sexes[17].

Population profile

Iran is situated in the Southwest of Asia and categorized as a high human development index (HDI = 0.774)[15]. In 2012, total population of Iran was 76,165,975 persons; by almost the same growth rate it has been estimated that it will be about 90 million by 2035[18] (**Figure 1**). Considering age structure and also inflation rate in young population (20-4yrs) in 2012, aging and its related health problems will be a public health issue in the future.

Results

Incidence and mortality rates

A total number of 84,829 of all cancers excluding non-melanoma skin cancers corresponding to the ASR of 127.7 per 100,000 were reported for Iran in 2012; the ratio of ASRs in men (ASR 134.7) compared to women (ASR 120.1) was 1.12. The most common cancers in 2012 were breast (ASR 28.1), colorectal (ASR 10.5), stomach (ASR 9.7), esophageal (ASR 8), and ovarian (ASR 4.8) cancers among Iranian women and stomach (ASR 20.6), bladder (ASR 13.2), prostate (ASR 12.6), colorectal (ASR 11.6), and lung (ASR 10.3) among Iranian men (**Table 1** and **Figure 2**).

The most common cancer deaths were breast (ASMR

Table 1. Estimated new cancer cases (age standardized incidence rate: ASR), deaths (age standardized mortality rate: ASMR) and 5-year prevalence (Proportion) by sex, Iran, 2012.

Cancer	Estimated New cases (ASR§¥)			Estimated Deaths (ASMR§£)		
	Both Sexes	Men	Women	Both Sexes	Men	Women
Lip, oral cavity	1380 (2.0)	763(2.2)	617 (1.8)	449 (0.7)	249 (0.7)	200 (0.6)
Nasopharynx	418 (0.6)	278 (0.8)	140 (0.4)	214 (0.3)	142 (0.4)	72 (0.2)
Other pharynx	217 (0.3)	123 (0.4)	94 (0.3)	152 (0.2)	85 (0.3)	67 (0.2)
Esophagus	5343 (8.6)	2898 (9.0)	2445 (8.0)	4915 (7.8)	2662 (8.3)	2253 (7.4)
Stomach	9660 (15.3)	6640 (20.6)	3020 (9.7)	8247 (12.9)	5665 (17.3)	25882 (8.3)
Colorectum	7163 (11.1)	3811 (11.6)	3352 (10.5)	4262 (6.6)	2267 (6.9)	1995 (6.3)
Liver	1567 (2.5)	889 (2.8)	678 (2.1)	1492 (2.3)	847 (2.6)	645 (2.0)
Gallbladder	753 (1.2)	328 (1.0)	425 (1.4)	707 (1.1)	306 (0.9)	401 (1.3)
Pancreas	1138 (1.8)	635 (2.1)	503 (1.6)	1096 (1.8)	608 (2.0)	488 (1.6)
Larynx	1381 (2.2)	1193 (3.8)	188 (0.6)	550 (0.9)	475 (1.5)	75 (0.2)
Lung	4888 (7.7)	3307 (10.3)	1581 (5.0)	4361 (6.8)	2950 (9.1)	1411 (4.5)
Melanoma of skin	531 (0.8)	295 (0.9)	236 (0.7)	208 (0.3)	116 (0.3)	92 (0.3)
Kaposi sarcoma	93 (0.1)	63 (0.2)	30 (0.1)	44 (0.1)	30 (0.1)	14 (0.0)
Breast	9795 (28.1)	-	9795 (28.1)	3304 (9.9)	-	3304 (9.9)
Cervix uteri	947 (2.8)	-	947 (2.8)	370 (1.2)	-	370 (1.2)
Corpus uteri	795 (2.5)	-	795 (2.5)	196 (0.6)	-	196 (0.6)
Ovary	1637 (4.8)	-	1637 (4.8)	1076 (3.4)	-	1076 (3.4)
Prostate	4111 (12.6)	4111 (12.6)	-	2297 (6.2)	2297 (6.2)	-
Testis	721 (1.7)	721 (1.7)	-	269 (0.7)	269 (0.7)	-
Kidney	1641 (2.5)	981(3.0)	660 (2.1)	1071 (1.7)	639 (2.0)	432 (1.4)
Bladder	5343 (8.4)	4277 (13.2)	1066 (3.4)	2280 (3.5)	1827 (5.5)	453 (1.4)
Brain, nervous system	3057 (4.3)	1699 (4.6)	1358 (3.9)	1844 (2.7)	1021 (3.0)	823 (2.5)
Thyroid	2025 (2.7)	513 (1.4)	1512 (4.0)	610 (1.0)	181 (0.5)	429 (1.4)
Hodgkin lymphoma	1057 (1.3)	613 (1.6)	444 (1.1)	491 (0.7)	286 (0.8)	205 (0.6)
Non-Hodgkin lymphoma	3257 (4.7)	1998 (5.7)	1259 (3.8)	1987 (3.0)	1216 (3.6)	771 (2.4)
Multiple myeloma	984 (1.6)	607 (2.0)	377 (1.2)	766 (1.3)	474 (1.6)	292 (1.0)
Leukemia	3926 (5.8)	2338 (6.9)	1588 (4.7)	3064 (4.6)	1822 (5.4)	1242 (3.8)
All cancers excl. non-melanoma skin cancer	84829 (127.7)	44838(134.7)	39991(120.1)	53350 (81.9)	30115 (90.4)	23235 (72.7)

§Incidence and mortality data for all ages. 5-year prevalence for adult population only, ¥ Age standardized incidence rate, £ Age standardized mortality rate

Table 1. Continue...

Cancer	Estimated 5-year Prevalence (Proportion§¥)		
	Both Sexes	Men	Women
Lip, oral cavity	3024 (5.2)	1673 (5.7)	1351 (4.7)
Nasopharynx	1153 (2.0)	762 (2.6)	391 (1.4)
Other pharynx	500 (0.9)	292 (1.0)	208 (0.7)
Esophagus	4811 (8.2)	2569 (8.7)	2242 (7.8)
Stomach	12070 (20.6)	8257 (27.9)	3813 (13.2)
Colorectum	15429 (26.4)	8131 (27.5)	7298 (25.2)
Liver	888 (1.5)	504 (1.7)	384 (1.3)
Gallbladder	838 (1.4)	374 (1.3)	464 (1.6)
Pancreas	775 (1.3)	431 (1.5)	344 (1.2)
Larynx	3585 (6.1)	3097 (10.5)	488 (1.7)
Lung	4015 (6.9)	2707 (9.1)	1308 (4.5)
Melanoma of skin	1250 (2.1)	720 (2.4)	530 (1.8)
Kaposi sarcoma	199 (0.3)	134(0.4)	65 (0.2)
Breast	34165 (118.1)	-	34165 (118.1)
Cervix uteri	2647 (9.1)	-	2647 (9.1)
Corpus uteri	2929 (10.1)	-	2929 (10.1)
Ovary	4074 (14.1)	-	4074 (14.1)
Prostate	10292 (34.8)	10292 (34.8)	-
Testis	2254 (7.6)	2254 (7.6)	-
Kidney	3440 (5.9)	2027 (6.8)	1413 (4.9)
Bladder	13589 (23.2)	10875 (36.8)	2714 (9.4)
Brain, nervous system	4917 (8.4)	2788 (9.4)	2129 (7.4)
Thyroid	7657 (13.1)	1885 (6.4)	5772 (20.0)
Hodgkin lymphoma	3085 (5.3)	1834 (6.2)	1251 (4.3)
Non-Hodgkin lymphoma	5130 (8.8)	3117 (10.5)	2013 (7.0)
Multiple myeloma	1527 (2.6)	903 (3.0)	624 (2.2)
Leukemia	3888 (6.7)	2268 (7.7)	1620 (5.6)
All cancers excl. non-melanoma skin cancer	169715 (290.1)	79194 (267.8)	90521 (312.8)

§Incidence and mortality data for all ages. 5-year prevalence for adult population only, ¥ Age standardized incidence rate, £ Age standardized mortality rate

9.9), stomach (ASMR 8.3), esophageal (ASMR 7.4), colorectal (ASMR 6.3), and lung (ASMR 4.5) cancers in women and stomach (ASMR 17.3), lung (ASMR 9.1), esophageal (ASMR 8.3), colorectal (ASMR 6.9), and prostate (ASMR 6.2) cancers in men (**Table 1** and **Figure 2**).

Five-year prevalence

Cancers with the highest 5-year prevalence were stomach (N = 10,875), prostate (N = 10,292), and colorectal (N = 8,131) cancers in men and breast cancer (N = 34,165), colorectal (N = 7,298) and ovarian (N = 4,074) cancers in women (**Table 1**).

Lifetime risk of developing cancer

The lifetime risk of cancer for all sites was 25% in both sexes, indicating that 1 in 4 Iranian people will get cancer by age 75 years (**Table 2**).

Cancer incidence trend

Similar to other developing countries, in Iran the incidence rates of breast, colorectal and prostate can-

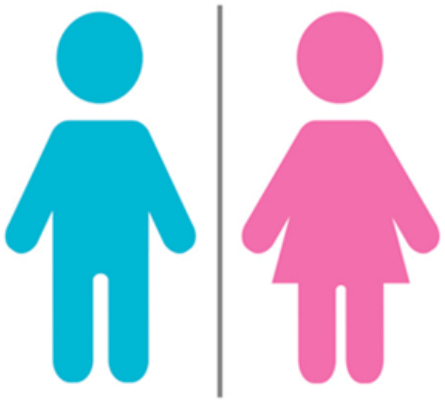
Table 2. Estimates of risk of developing cancer, by sex and site, in Iran.

	Site of cancer	
Men	Risk (%)	1 in Number of People who will get cancer by age 75
All sites	34.5	3
Stomach	6.5	15
Prostate	4.7	21
Bladder	3.9	26
Lung	2.6	39
Colorectal	2.5	39
Esophageal	2.5	39
Women		
All sites	19.5	5
Breast	3.1	32
Stomach	2.2	46
Colorectal	1.8	55
Esophagus	1.7	59
Lung	1.0	96
Both Sexes		
All sites	25.1	4
Stomach	4.1	24
Colorectal	2.3	44
Esophagus	2.2	46
Bladder	2.2	44
Lung	2.0	51

Figure 2. Ten leading cancer types for the estimated new cancer cases and deaths by sex, Iran, 2012.

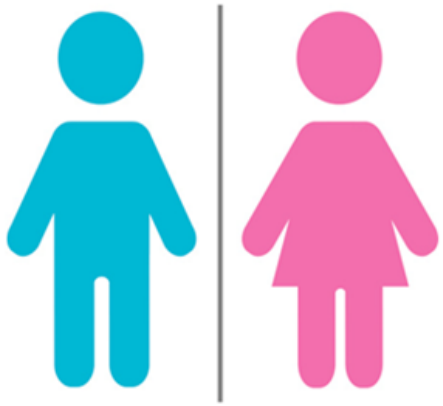
Estimated new cases

Cancer Type	Number	%	Male	Female	%	Number	Cancer Type
Stomach	6640	14.8			24.5	9795	Breast
Bladder	4277	9.5			8.4	3352	Colorectal
Prostate	4111	9.2			7.6	3020	Stomach
Colorectal	3811	8.5			6.1	2445	Esophagus
Lung	3307	7.4			4.1	1637	Ovary
Esophagus	2898	6.5			4	1588	Leukemia
Leukemia	2338	5.2			4	1581	Lung
Non-Hodgkin lymphoma	1998	4.5			3.8	1512	Thyroid
Brain, nervous system	1699	3.8			3.4	1358	Brain, nervous system
Larynx	1193	2.7			3.1	1259	Non-Hodgkin lymphoma
Other and unspecified	13759	30.7			34.3	13703	Other and unspecified
All cancers excl. non-melanoma skin cancer	44838	100			100	39991	All cancers excl. non-melanoma skin cancer



Estimated new deaths

Cancer Type	Number	%	Male	Female	%	Number	Cancer Type
Stomach	5665	18.8			14.2	3304	Breast
Lung	2950	9.8			11.1	2582	Stomach
Esophagus	2662	8.8			9.7	2253	Esophagus
Prostate	2297	7.6			8.6	1995	Colorectal
Colorectal	2267	7.5			6.1	1411	Lung
Bladder	1827	6.1			5.3	1242	Leukemia
Leukemia	1822	6.1			4.6	1076	ovary
Non-Hodgkin lymphoma	1216	4			3.5	823	Brain, nervous system
Brain, nervous system	1021	3.4			1.8	429	Thyroid
Other and unspecified	8388	27.9			34.9	8120	Other and unspecified
All cancers excl. non-melanoma skin cancer	30115	100			100	23235	All cancers excl. non-melanoma skin cancer



cers are increasing[19-21]. We observed 19% rise in ASR of all types of cancer in 2012 (ASR 127.7) compared to 2008 (ASR 107.3) (**Figure 3**). The ASR of breast, bladder, colorectal, esophageal, prostate, brain, nervous system, and laryngeal cancers increased but remained stable for stomach, leukemia, and non-Hodgkin lymphoma cancers during this interval.

Projection of Cancer incidence by 2035

The total number of 184,481 new cancer cases (97,655 in men and 86,826 in women) will occur in Iran in 2035, corresponding to about 2.17 fold increase in the number of new cancer cases in Iran during the next 23 years. The projection in the number of new cases was higher for esophageal cancer (2.17 times), stomach cancer (2.44), and prostate cancer (2.42) than other cancer types (**Figure 4 Series**).

International comparison

ASR of cancer in Iran (ASR 127.7) was 12% higher than ASR reported for low HDI countries (ASR 112.8); but lower than ASR reported for medi-

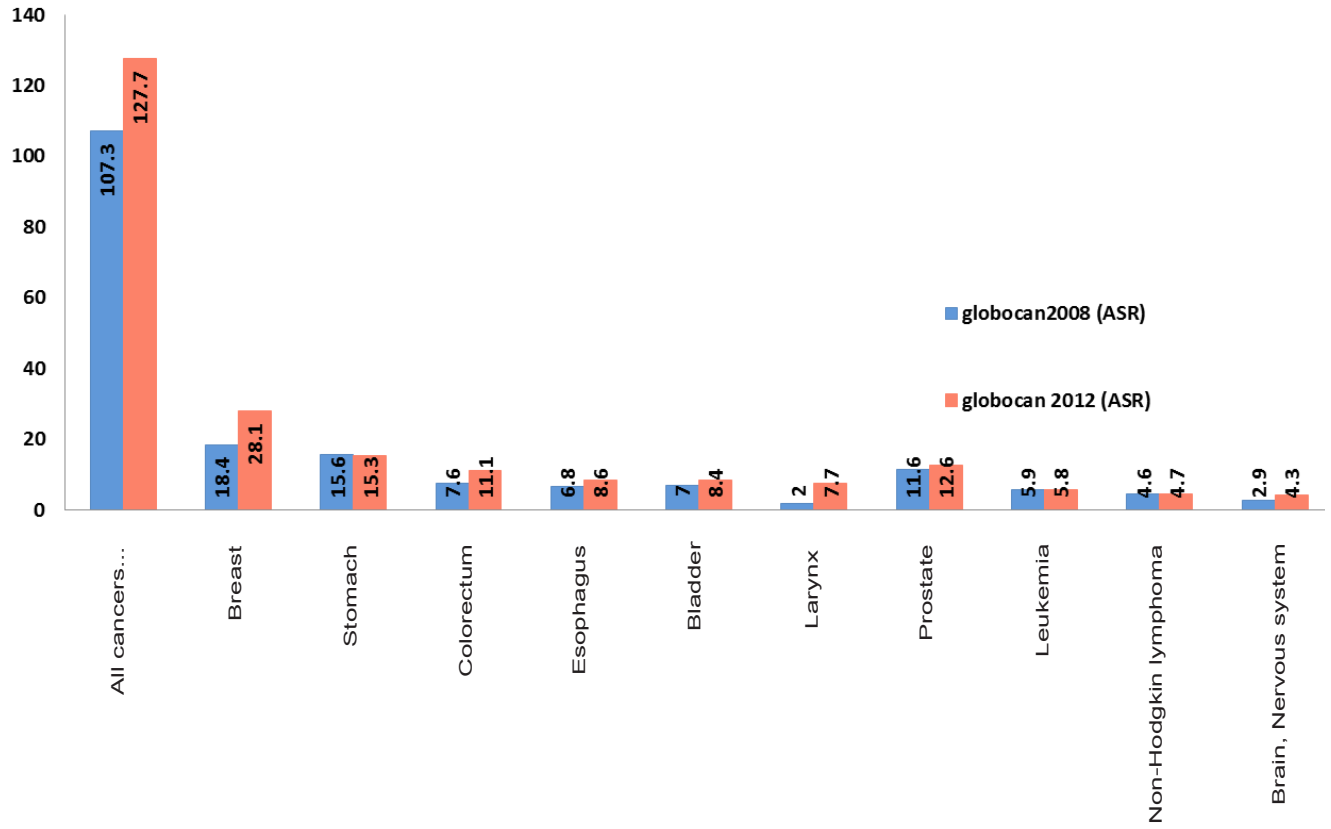


Figure 3. Most commonly diagnosed cancers incidence in Iran, 2008 and 2012.

um HDI countries (11.44%), high HDI countries (29.13%) and very high HDI countries (54.04%) (15) (**Figure 5**).

DISCUSSION:

The incidence rate of cancer (all sites excluding non-melanoma skin cancer) in Iran was lower than the rate reported for world on average. The most common cancers occurred among Iranian population and they died of it, were stomach and breast cancers in 2012. We showed that 1 in 4 Iranian will get cancer by age 75 year. Five-year prevalence of all types ofcancers was 79,194 for men and 90,521 for women. The incidence rate of cancer increased about 20% from 2008 to 2012. Iran will experience more than 2-folds increase in 2035 and the number of cancer incidence will increase from 84,829 in 2012 to 184,481 in 2035.

In EMRO and other neighboring countries, the highest incidence rates of cancer (in both sexes) were reported from Turkey (ASR 205.1), Lebanon (ASR 197.4), Jordan (ASR 182), and the lowest rates were reported from Yemen (ASR 80.2), and Oman (ASR 82.1). The ASR of cancers in Iran (ASR 127.7) was lower than the world average (ASR 182), the Iran cancer ASR was close to the average reported for EMRO (ASR 122.2)[11].

Analyses of causes of death in the Global Burden of Disease (GBD) project showed more than 20% decline in the cancer-related morality in Iran in 2013[22-24]. This achievement may be due to the investment in the health care system and medical education like the development of diagnostic and treatment in different parts of the country and training more persons in varied disciplines of cancer like oncosurgeons, oncologists, and radiation therapists.

Globocan 2012 has predicted that the number of new cancer cases in Iran will increase to 54% by 2035, assuming that no changes will happen in diagnostic methods and risk factors status. This enhancement may be due to increase in life expectancy, improvement of cancer registration system, as well as the population aging. Policy-makers need to take this into account and prepare for the higher influx of patients to the cancer hospitals in the future. Evidence based cancer control planning, enhancing infrastructures for cancer care, improving human resources and considering appropriate strategies for prevention, early detection, treatment, and palliative care services needed to respond these inevitable challenges.

Breast Cancer

Similar to other countries, breast cancer was the most common cancer among Iranian woman in 2012. However, the ASR was considerably lower than other high HDI countries, and EMRO[4,11]. ASR of breast cancer mortality among Iranian woman was also lower than the average rate reported in high HDI countries and EMRO. However, mortality to incidence ratio (M:I ratio) in Iran (M:I ratio = 0.35) was approximately similar to high HDI countries (M:I ratio = 0.32) but lower than the EMRO (M:I ratio = 0.44). These findings could be either due to better survival rate of breast cancer or underestimation of the cancer mortality rate in Iran. Population-based survival studies are needed to verify these results.

Clinical breast examination (CBE) has been suggested as a method for screening in LMICs, including Iran, where a large percentage of breast cancers are diagnosed at advanced stages[25]. Although mammography screening is the most promising approach for early detection of breast cancer, WHO recommended conducting research to evaluate the feasibility of cost-effectiveness of organized mammography and screening in EMRO including Iran[26].

Similar to other countries breast cancer risk factors are associated with reproductive life of the popula-

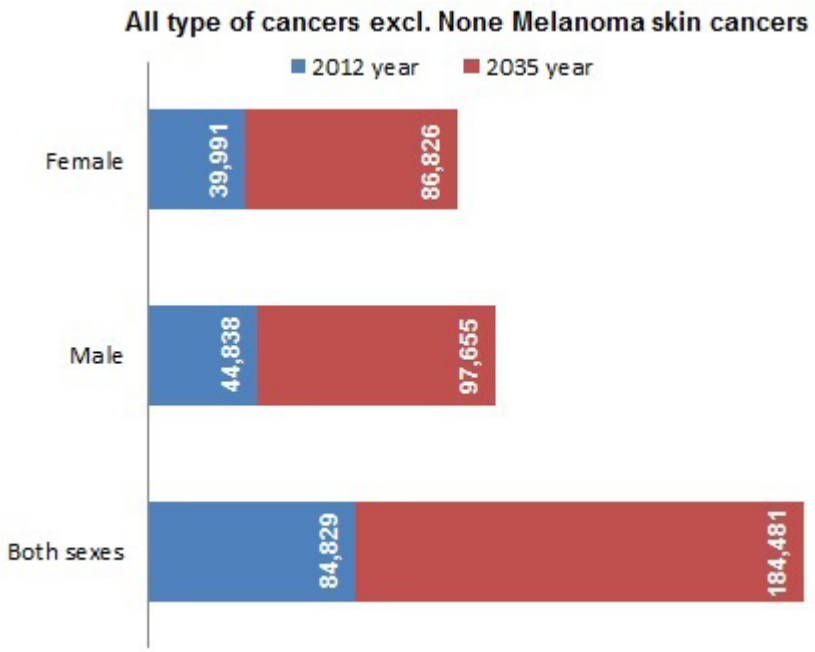


Figure 4-1. Projection of all cancer excl. non-melanoma skin cancer and the five most incident cancers, considering gender, all ages in 2012 and 2035 by cancer in Iran.

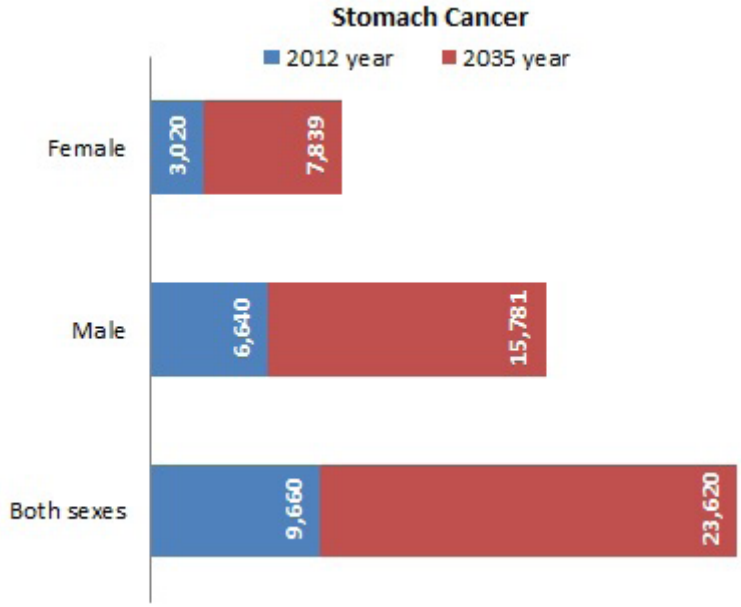


Figure 4-2. Projection of Stomach Cancer, considering gender, all ages in 2012 and 2035 by cancer in Iran.

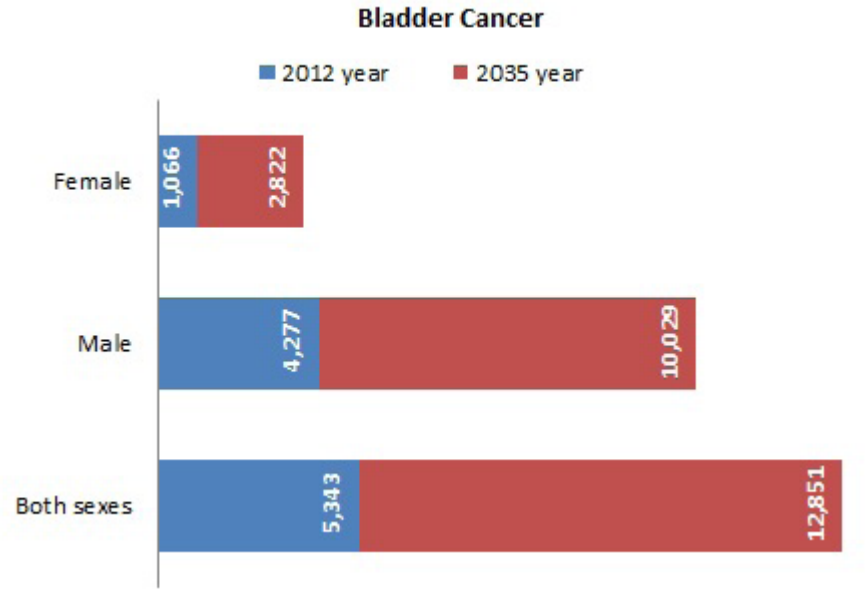


Figure 4-3. Projection of Bladder Cancer, considering gender, all ages in 2012 and 2035 by cancer in Iran.

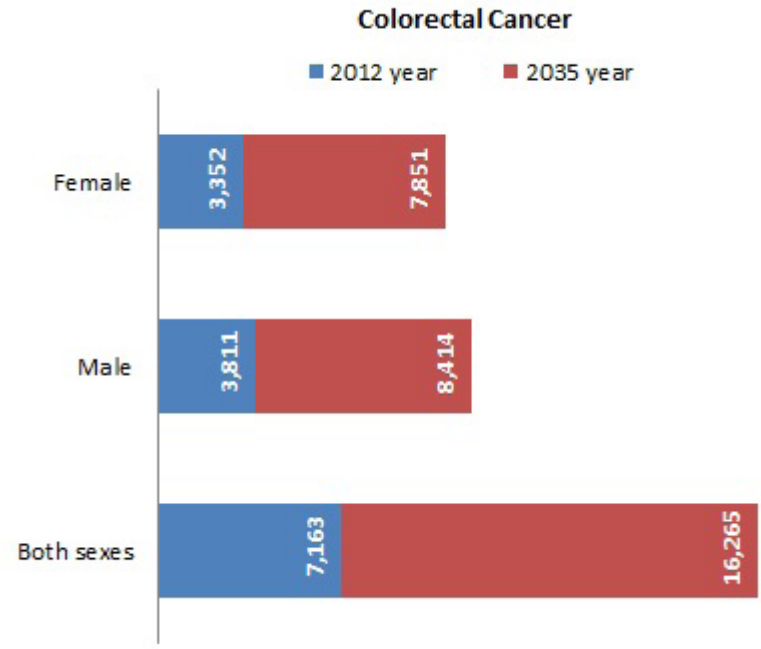


Figure 4-4. Projection of Colorectal Cancer, considering gender, all ages in 2012 and 2035 by cancer in Iran.

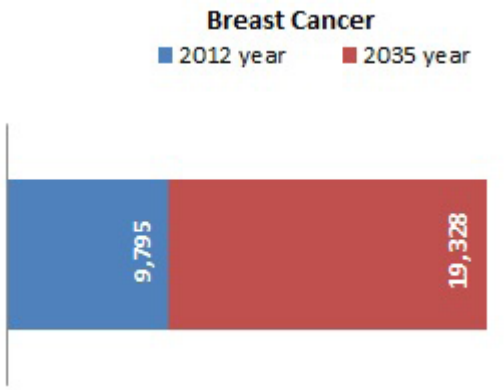


Figure 4-5. Projection of Breast Cancer, considering gender, all ages in 2012 and 2035 by cancer in Iran.

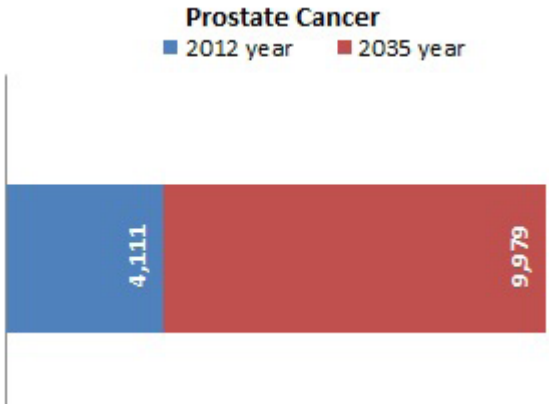


Figure 4-6. Projection of Prostate Cancer, considering gender, all ages in 2012 and 2035 by cancer in Iran.

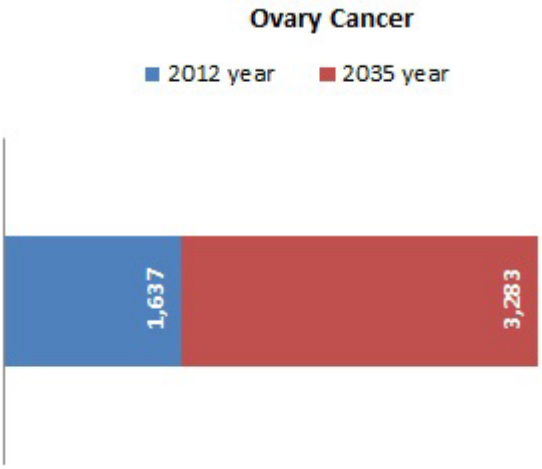


Figure 4-7. Projection of Ovary Cancer, considering gender, all ages in 2012 and 2035 by cancer in Iran.

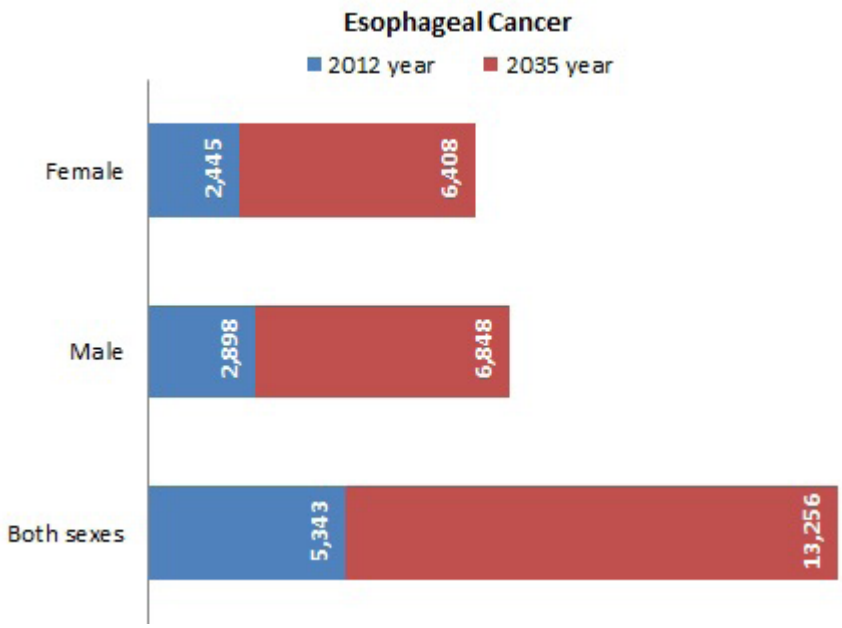


Figure 4-8. Projection of Esophageal Cancer, considering gender, all ages in 2012 and 2035 by cancer in Iran.

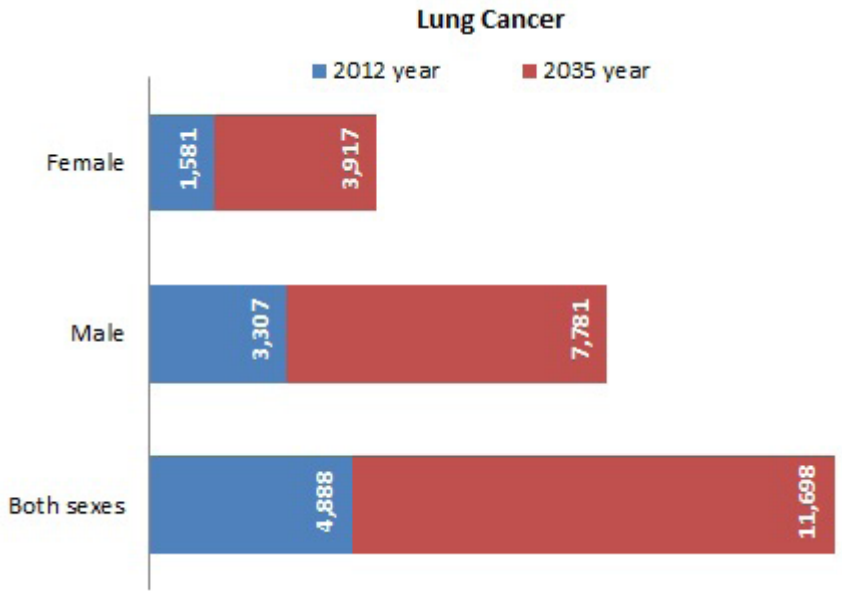


Figure 4-9. Projection of Lung Cancer, considering gender, all ages in 2012 and 2035 by cancer in Iran.

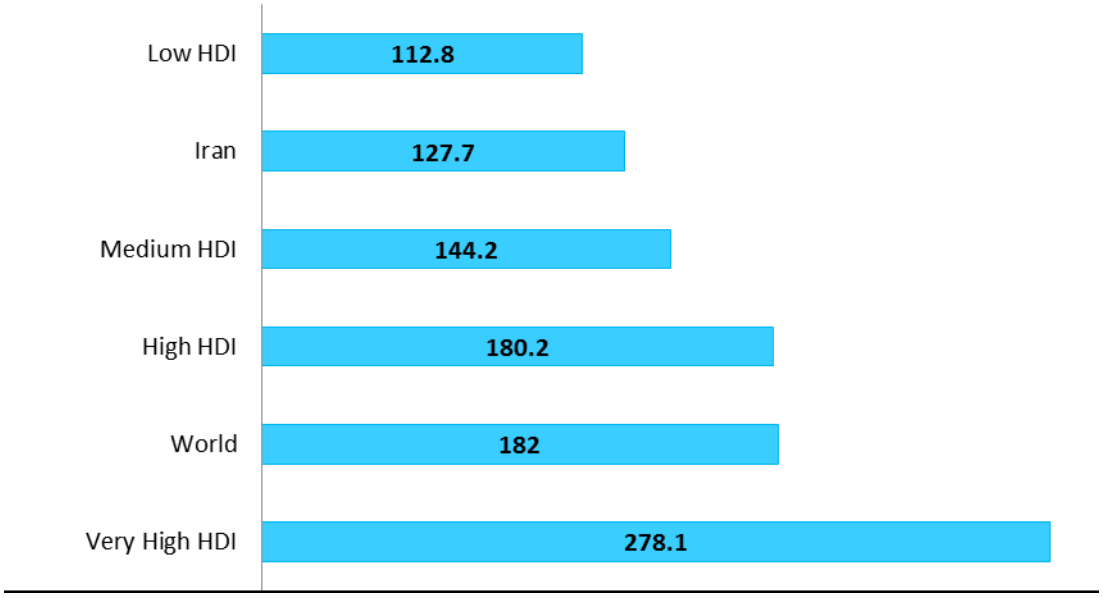


Figure 5. Comparison of cancer incidence in Iran with other countries based on human development index (HDI) and world in 2012.

tion in Iran. According to the local research in Iran, a decrease in the childbearing among Iranian women was significantly associated with risk of breast cancer[27]. The fertility rate has been significantly decreased from 2.8 to 1.7 from 1996 to 2007[28,29]. We expect an increasing trend for the occurrence of breast cancer, especially among postmenopausal breast cancer, and in urban population[30]. The positive association between BMI and risk of postmenopausal breast cancer was also determined as risk factor among Iranian women[27]. Other reported risk factor for Iranian women were the family history of breast cancer, oral contraceptive pill, and being employed, inadequate breastfeeding and early menarche[31]. Further studies are needed to verify the risk factors of breast cancer and high risk group in Iran for the occurrence of breast cancer.

Stomach Cancer

Despite decreasing trend in the incidence rate of stomach cancer in developed countries including the United States, northern and western Europe, and Japan, it is still the sixth common malignancy and the third leading cause of cancer related mortality worldwide[30]. Stomach cancer was the first cause of cancer death and second common cancer in Iran[30]. ASR and ASMR of stomach cancer in Iranian population in 2012 were higher than that in other HDI countries and EMRO. The incidence rate of stomach cancer was two folds higher in men compared to women[30]. A wide geographical variation exists in the incidence and mortality of stomach cancer in Iran. The highest incidence rate of stomach cancer (ASRs 49.1 in men and 25.4 in women) was reported from Ardabil province in the northwestern part of the country[32], and the lowest rate has been reported from Kerman province in the southern part (ASRs 10.2 for men and 5.1 for women)[33]. The ASR was intermediate in capital Tehran province (ASRs 19.8 for men and 10 for women)[33,34]. A six fold difference in the ASMR of stomach cancer among men was reported from Kurdistan province in the northwest-

ern (ASMR 29.1) and Hormozgan province in the southern part of Iran (ASMR 5.0)[35].

The etiology of stomach cancer is multi-factorial and different risk factors have been associated with the risk of stomach cancer, including age, sex, Helicobacter pylori (H. pylori) infection[36,37], unhealthy diet[38-41], tobacco smoking and alcohol drinking[42,43], low socioeconomic status[44], low physical activity[45], high salt intake[38,46], ethnicity[47], genetic susceptibility and positive family history[48,49].

About 80% of the people are living in the developing countries are infected with H. pylori[50]. The seroprevalence of H. pylori as an important risk factor of stomach cancer, considerably high in Iran and reaches about 90% among people who are living in the high risk areas, highly likely due to early transmission and high colonization of the bacteria caused by poor socioeconomic status during the childhood, including lack of refrigeration, not drinking tap water and crowded housing conditions[51]. Although eradication of H. pylori infection seems to be the most promising candidate for prevention of stomach cancer[52,53], there is no consensus about screening of stomach cancer worldwide[54]. On the other hand, appropriate management of precancerous lesion and standard treatment of stomach cancer patients, especially those are diagnosed at early stages may decrease the mortality of stomach cancer[55,56]. Therefore, primary prevention strategies and population awareness about gastric cancer risk factors, and early symptoms of stomach cancer seem to be priori strategy for prevention of stomach cancer in a high risk population like Iran[56]. In addition, population awareness about symptoms and early diagnosis of stomach cancer has been suggested to decrease the burden of cancer in Iranian population[57].

Colorectal cancer

Colorectal cancer is the fourth most common cancer in Iran. The incidence rate of colorectal cancer was considerably lower than other high HDI countries, but higher than other EMRO countries on average. However, it was considerably lower than the rate reported from Jordan and Lebanon[11]. A substantial variation in the incidence rate of colorectal cancer incidence between the southern and northern parts of Iran has been reported[5,6]. The ncidence rate of colorectal cancer in the southern part of Iran was similar to the rates reported by countries around the Persian Gulf, including Oman and Yemen[11]. The mortality rate of colorectal cancer in Iran was 6.6 per 100,000 and the M/I ratio was 0.59 in Iran, which was similar to the ratio in high HDI and the EMRO countries[5].

Colorectal cancer screening programs are established merely in high-income countries[58]. In the United States, there was a recent decrease in the incidence and mortality of colorectal cancer from 1999 to 2006[59]. At the initial glance, this decreasing trend in the US could be attributed to dietary and lifestyle factors, and changes or the utilization of chemopreventive agents. However, it is clear that enhanced use of colonoscopy with polypectomy has resulted in a significant decreasing trend for colorectal cancer in some areas[60]. Based on the WHO/EMRO policy recommendation, screening reduces mortality of colorectal cancer and it has been shown to be cost-effective compared to no screening in middle and high-income countries that have high incidence rate for colorectal cancer[61]. The incidence rate of colorectal cancer in Golestan province that has the only high-quality population-based cancer registry in Iran was (13.6 in men and 10.4 in women). Therefore the true incidence rate seems to be higher than the rate reported in Globocan 2012 (ASR 11.1). High quality data from other regional cancer registries is needed.

In addition to the underestimation in Globocan 2012, one might also consider that incidence rate

of colorectal cancer is increasing rapidly in many medium-to-high HDI countries[62,63]. We need to be prepared for the next decade, when the incidence rate of colorectal cancer will be much higher than that reported in Globocan 2012. Conducting a pilot project for organized screening in a defined population and evaluation of feasibility and cost-effectiveness may pave the way for planning of regional or national screening program for colorectal cancer in the future in Iran. In addition to the screening, we need to pay particular attention to the primary prevention. Public health awareness about the risk factors of colorectal cancer, including diet, obesity, and low physical activity and intervention to mitigate the risk factors at the individual and population level, is needed[61].

Esophageal cancer

A total of 5,343 new cases of esophageal cancer occurred in Iran in 2012 and it was the fifth most common cancer and the second cause of cancer death in Iran[11]. According to Cancer Incidence in Five Continents, Volume IX, the highest number of esophageal cancer occurred in China, Yangcheng county (ASRs 192.7 for men and 108.5 for women), Malawi (ASRs 37.6 for men and 23 for women), South Africa (ASRs 32 for men and 19.6 for women), and Iran, Golestan province (ASRs 23.2 for men and 18.8 for women)[64]. Generally, there is a positive correlation between incidence and prevalence of esophageal cancer and socio-economic development[65]. Diverse risk factors are well established for esophageal cancer which caused a specific type of esophageal cancers like squamous cell carcinoma and adenocarcinoma. While heavy alcohol drinking, tobacco smoking and inappropriate diet are well-known risk factors for squamous cell carcinoma[53], esophageal adenocarcinoma is mostly associated with gastro-esophageal reflux and Barrett's esophagus[53]. In addition, to the above risk factors, esophageal cancer was associated with specific risk factors in the high risk region of Iran (i.e. Golestan province), including hot tea, opium, animal contact[66-69]. There is no screening program for early detection of esophageal cancer worldwide[70]. A pilot study reported high sensitivity (100%) and specificity (97%) of a screening tool - a capsule sponge examination- coupled with a cytological examination and p53 IHC in the high-risk area of Iran. The results were promising compared to those conducted in China[71]. Attempts are ongoing to find an efficient and cost-effective method for screening of esophageal cancer in high-risk areas. However, primary prevention and control of risk factors like smoking, alcohol drinking, and dietary pattern are the available options at the moment. In parallel, population awareness about risk factors and symptoms of esophageal cancer and timely management of esophageal cancer may decrease the burden of cancer in the high-risk areas of Iran.

Bladder cancer

Similar to other countries in the EMRO (ASR 6.8), bladder cancer was the sixth common cancer in Iranian population (ASR 8.4) which was the second most common cancers among Iranian men. It was not common cancer in other high HDI countries (ASR 5.9). Higher incidence rate of bladder cancer in Iran could be due to high prevalence of opium use and tobacco smoking[72]. Bladder cancer mortality was higher among men in Iran (ASMR 5.5) and EMRO (5.6), while it was lower in other high HDI countries (ASMR 4.5). The M/I ratio in men was higher in Iran and EMRO compared to other HDI countries, highly likely due to the detection of patients in more advanced stages and lower survival rate in our region. Although there is no screening program for bladder cancer in Iran, it is suggested that evaluating feasibility, effectiveness and cost-effectiveness of bladder cancer screening in high risk

areas like Kerman province, where the ASR is very high (ASR 26.5)[73,74]. In addition, primary prevention on tobacco smoking in high prevalent area is necessary by increasing the availability of tobacco cessation clinics and also the increasing price of cigarettes/water-pipe in the context of a tobacco tax increase.

Invasive Cervical cancer

Invasive Cervical cancer (ICC) is the fourth most common one worldwide among women. Every year 528,000 new cases are diagnosed in the world; most of which are diagnosed in low HDI countries. ICC is a preventable cancer and screening has significantly reduced the incidence and mortality rate in the high-income countries[75,76]. Unlike other regions of WHO, incidence and mortality rates of cervical cancer in EMRO was low without organized screening program in these countries. Likewise, the incidence and mortality rates of ICC were very low in Iran. The low incidence rate of ICC can be attributed to the low prevalence of HPV infection (7%) and safe sexual behavior among Iranian population[77].

Although, there is no organized screening program for ICC in Iran, opportunistic screening is available and women may be offered Pap-smear testing in health care centers or private clinics. Following several health economic analyses and consensus meetings, Ministry of Health and Medical Education launched a new national screening program with HPV-DNA testing every 10 years after the age of 30 years[78]. Because HPV vaccination is very expensive at the time being, it was considered not to be cost-effective in the low risk women population like Iran[79,80].

Lung cancer

Similar to other countries in EMRO, the incidence rate of lung cancer in Iran was low[11]. This low incidence rate is mostly attributed to low quality cancer registries in the region which has led to underestimation of the incidence rate of lung cancer. Results from the population-based cancer registry in Golestan province showed that ASRs of lung cancer was higher and reached to 17.5 in men[64], indicating that the true ASR for lung cancer is higher than the rate estimated in Globocan 2012.

ASR of lung cancer was high in other high HDI countries such as Norway (ASR 30.0) and Australia (ASR 27.0)[11]. Apart from the poor cancer registration systems in Iran, the observed differences could be due to lower prevalence of tobacco smoking in Iran particularly among Iranian women[81]. Improving the population-based cancer registries in Iran and along with increasing trend in prevalence of tobacco smoking particularly water-pipe smoking among Iranian men and women[82], we believe that the burden of lung cancer will rise in the near future. Strengthening prevention strategies for tobacco use, including both cigarette and water-pipe use is the most appealing strategies for prevention and control of lung cancer in Iran.

Conclusion

In conclusion, the incidence and mortality rate of cancers are modest in Iran which is lower than the world and high HDI countries and even medium HDI ones. Similar to other LMICs, the burden of cancer is increasing in Iran and particular attention is needed. Number of cancer incidence will be doubled in the next two decades, which requires appropriate planning and preparation for the future to combat cancer. In addition to the established risk factors, country specific risk factors like opium consumption and water-pipe use warrant particular attention. Several cancers, including breast, colorectal, cervix, bladder, prostate, esophageal, and gastric cancers are subject to early detection and require research and pilot project to evaluate feasibility, ef-

fectiveness, and cost-effectiveness of the suggested intervention. Due to the importance of cancer statistics, regular monitoring of cancer registry results at the national and regional level is needed.

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Not applicable

Conflict of Interest

The authors declare no conflict of interests.

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