



The Burden of Cancer in a Sample of Iranian Population

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Abstract

Background: We aimed at estimating the burden of cancer in Kurdistan Province, western Iran during 2011-2017.

Methods: In this cross-sectional study, incidence data extracted from the cancer registry system and death data were extracted from the system of registration and classification of causes of death of Kurdistan Province. We applied the WHO' methods to calculate the disability-adjusted life year (DALYs).

Results: The burden of cancer increased from a DALYs of 12309 in 2011 to 13969 in 2017, the YLL from 11644 in 2011 to 12951 in 2017 and the YLD from 665 in 2011 to 1018 in 2017. The top five cancers, according to DALYs (%) in both sex during 2011-2017 were: stomach (25%), lung (14%), liver (9%), esophagus (6%), and colon (6%). The most burden of cancer related to gastrointestinal tract (54% vs. 45%). Totally, more than 25% of DALYs were related to stomach cancer.

Conclusion: The increasing DALYs of cancer in Kurdistan Province is one of the major public health concerns as in most developed countries. More than half of the burden of cancer in the Kurdistan Province is related to gastrointestinal tract. Stomach cancer, is accounting for more than 25% of the burden in both sexes. Urgent policy, management and public health measures such as general education, screening, early detection and effective treatment are recommended to reduce the burden of cancers and especially gastrointestinal tract malignancies.

Keywords: Burden of disease; Gastrointestinal tract; Cancer; Noncommunicable disease; Iran

Introduction

As the current main cause of global mortality, non-communicable diseases (NCDs) are expected to remain a major cause of death in the world. In 2018, 18.1 million new cancer cases and 9.6 million deaths from cancer were globally reported (1). The prevalence of cancer is expected to rise to 45% in developed countries by 2025

(2). Increasing life expectancy, the growing population of older adults and the middle-aged and socioeconomic conditions are among the complicated causes of an increase in the prevalence of cancer (3, 4). In 2018, the top five cancers by incidence in both genders were reported as: lung cancer (11.6%), with a slight difference breast



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cancer (11.6%), colorectal cancer (10.2%), prostate cancer (7.1%), and stomach cancer (7.1%) (1). In 2008, WHO reported NCDs, especially cancers, as a crisis that requires serious global interventions (5).

In Iran, the age-standardised rate (ASR) of cancers was reported as 107.3 in 2008, 127.7 in 2012 and 141.6 in 2018 (6). Different regional reports in Iran suggest the growing incidence of certain types of cancer, especially breast and colorectal cancers (7, 8). In 2018, approximately 110115 new cancer cases and 55785 deaths from cancer were reported in Iran (6). Modirian et al. reported the disability-adjusted life year (DALY) of cancer as 1025443 in Iran, with gastric cancer contributed the most to DALYs (9). Rahmani et al. reported the burden of oesophageal cancer in Iran during 1995-2015 was 74399 DALYs (10). Cancer is the third leading cause of mortality after cardiovascular diseases and accidents in Iran (11). Developing cancer control programs is therefore considered a major objective of controlling NCDs in Iran (12). Successfully taking preventive measures such as early diagnosis, screening and treatment in recent decades has reduced the incidence of and mortality from some cancers. (13, 14). The ultimate goal of estimating the burden of diseases is designing, implementing and evaluating cost-effective interventions for prevention, treatment and rehabilitation (15).

The present study calculated the burden of 37 types of cancer in 2011-2017 in patients in Kurdistan Province, Iran as a sample of the Iranian population.

Methods

The present cross-sectional study was conducted in all age groups in Kurdistan Province in 2019 based on the data of this population obtained in 2011-2017. The burden of cancer was calculated as the global burden of disease (GBD) expressed with DALY as the sum of the years of life lost (YLL) due to premature deaths and the years lost due to disability (YLD). The standard population proposed by Segi-Doll was used to calculate the

ASR (16). The YLD was calculated by multiplying the incident of cancer (I) by the disability weight (DW) and the average duration of the disease until remission or death (D). The YLL due to premature deaths was calculated as the number of deaths from cancer (N) multiplied by the life expectancy of the age group (L). The present study calculated DALYs by gender and the incidence year of cancer in eight age groups. The incidence of cancer and the associated mortality were calculated for 37 types of cancer according to the codes of the International Classification of Diseases-10th Revision (ICD-10):lip, oral cavity(C00-C06);salivary glands (C07-C08); oropharynx(C09-C10);nasopharynx (C11); hypopharynx (C12-C13); esophagus (C15); stomach (C16); colon (C18); rectum (C19-C21); liver (C22); gallbladder (C23-C24); pancreas (C25); other and ill-defined digestive (C26); larynx (C32); lung (C33-C34); heart, mediastinum and pleura(C38); bone (C40); hematopoietic (C42); other malignant neoplasms of skin (C44); breast (C50); vagina (C52); cervix uteri (C53); corpus uteri (C54); uterus (C55); ovary (C56); prostate and testis (C60-C62); kidney (C64-C66); bladder (C67); brain, central nervous system (C70-C72); thyroid (C73); other and ill-defined sites (C76); lymph nodes (C77); and without specification of site (C80).

The DW used in the present study was obtained from the results of research on the GBD reported by the WHO and the disability weights used in South Korea (17). The life expectancy used in the present study was extracted from a study conducted in Kurdistan Province in 2016 (18). The incidence of cancer from the data of Kurdistan Cancer Registry. The province population was also extracted by year from the website of the Statistical Center of Iran. Recording the incidence of cancers in a population-based manner from 2013 onwards in Iran is a cause of the increase observed in the incidence in Kurdistan Province, as the number of cases diagnosed in the other provinces were added to the records of this province. Furthermore, the mortality data were extracted from the system of registration and classification of causes of death.

DALYs was calculated as follows: $DALYs = YLL + YLD$, in which $YLL = N \times L$ and $YLD = I \times DW \times D$. All the data were analyzed in Microsoft Excel 2016.

Results

The burden of cancer increased from of 12309 DALYs in 2011 to 13969 DALYs in 2017, the YLL from 11644 in 2011 to 12951 in 2017 and the YLD from 665 in 2011 to 1018 in 2017. The burden, incidence of, and deaths from cancer were found to be higher in the men than the women were in all the study years. The highest YLL and YLD were observed in the men in 2015 (Table 1). As the cancer with the heaviest burden,

stomach cancer was found to contribute to over 25% of the burden of cancer in both genders, i.e. a DALYs of 22152 versus an overall DALYs of 87731. Lung cancer with a DALYs of 12209, liver cancer with a DALYs of 7911, esophagus cancer with a DALYs of 6242 and colon cancer with a DALYs of 5273 were respectively the second to fifth cancers by burden (Table 2). According to Fig. 1, the highest DALYs (54%) obtained was associated with gastrointestinal cancers. The burden of all cancer cite increased during 2011-2017 (Fig. 2). The maximum DALYs of the first four prevalent cancers in both genders was observed in the 60-69 yr old and the maximum DALYs of colon cancer in both genders was observed in the 40-49 yr olds (Fig. 3).

Table 1: New cases, deaths and burden of cancer 2011-2017

FEMALE	YLL	4067	4455	4597	3801	3901	4426	5468
	YLD	256	294	280	355	425	388	424
	DALY	4322	4750	4876	4156	4326	4814	5893
	DEATH	262	298	299	251	250	274	356
	NEW CASE	507	586	579	720	880	790	886
MALE	YLL	7577	7624	7103	6265	7959	6950	7483
	YLD	409	474	422	577	609	548	594
	DALY	7988	8099	7525	6842	8568	7497	8076
	DEATH	553	551	512	451	537	452	549
	NEW CASE	724	841	790	1076	1076	1080	1045
BOTH SEX	YLL	11644	12079	11700	10066	11860	11376	12951
	YLD	665	770	701	932	1034	935	1018
	DALY	12309	12849	12401	10998	12894	12311	13969
	DEATH	815	849	811	702	787	726	905
	NEW CASE	1231	1427	1369	1796	1956	1870	1931
YEAR	2011	2012	2013	2014	2015	2016	2107	

Table 2: New Cases, DALYs, YLL, YLD for 37 Cancers 2011-2017

CANCER SITE	ICD	BOTH SEX					MALE					FEMALE				
		NE W CA SE	DAL Y	YLL	YLD	AS R*	NE W CAS E	DAL Y	YLL	YL D	AS R	NE W CA SE	DA LY	YLL	YL D	AS R
Stomach	C16	155 1	2215 2	2104 1	1110	14. 9	1108	1546 0	1466 5	794 .5	21. 5	443	669 2	6376 .6	315	8.5
lung	C33- C34	630 9	1220 7	1211 7	93	5.6	469	8809	8741	69. 3	7.6	161	340 0	3376 7	23. 7	3.7
liver	C22	253	7911	7851 .5	59.6	3.4	146	4524	4489 .9	34. 4	4.3	107	338 7	3361 .5	25. 2	2.5
Oesophagus	C15	861	6242	5499 .9	742	8.7	478	3427	3015 .1	412	10. 7	383	281 5	2484 .7	330	6.9
Colon	C18	556	5273	5154 8	118.	6.9	308	3206	3140 8	65. 8	7.6	248	206 7	2014 .2	53	6.4
Brain	C70- C72	469	4930	4525 6	404.	5	270	2619	2385 .4	233 .3	6	199	231 1	2139 .5	171 .3	4
prostate	C60- C62	519	4678	4609 .5	68.6		519	4678	4609 .5	68. 6	10. 2					
Breast	C50	957	4256	4175 .4	81	11. 8	30	211	208. 5	2.5 5	0.7	927	404 5	3966 .8	78. 5	22. 8
Larynx	C32	161	2496	2358 2	138.	2.2	143	1856	1732 .7	122 .8	3.7	18	641 3	625. 4	15. 4	0.7
Skin(non melanoma)	C44	151 9	2374	1191 .3	1182	18. 1	927	1436	714. 4	721 .4	21	592	938	476 .7	460 1	15.
Small intestine	C17	90	1889	1824	65	0.3	56	1292	1252 8	39. 8	0.5	34	597	571. 5	25	0.2
Bone	C40	49	1745	1701 .2	43.4	0.5	28	1090	1067 .7	22. 5	0.6	21	654 4	633. 9	20. 9	0.4
Pancreas	C25	124	1563	1534	28.8	1.9	78	1116	1097 .7	18. 1	1.8	46	447 2	436. 7	10. 7	1.9
Bladder	C67	692	1552	1493	58.3	3.3	515	1167	1124 4	43. 4	5.1	177	384 3	369. 9	14. 9	1.6
Other Digestive Organ	C26	32	1410	1386	23.5	0.5	20	965	949. 9	14. 7	0.6	12	445	436	8.8	0.3
Ovary	C56	91	1086	1078 .5	7.1							91	108 6	1078 .5	7.1	2.3
Kidney	C64- C66	140	751	643. 7	107	1.7	91	478	407. 8	69. 6	1.9	49	273 9	235. 5	37. 5	1.5
Rectum	C19- C21	302	677	612	64.2	2.9	179	379	341 2	38. 2	3.6	123	298	271	26	2.3
Hematopoietic	C42	687	508	0	507	8.2	423	313	0 .5	312 .5	9.9	264	195	0	195	6.6
Thyroid	C73	206	503	408. 6	94.9	2.7	43	195	175. 7	19. 7	0.6	163	308	232. 8	74. 8	4.9
Cervix Uteri	C53	59	443	411. 3	31.3							59	443	411. 3	31. 3	1.1
Uterus	C55	34	432	428. 6	2.9							34	432	428. 6	2.9	1.6
Connective and soft tissue	C49	119	428	339	87.8	1	73	294	240 9	53. 9	1.1	46	134	99.6 9	33. 9	0.9
Without	C80	250	401	216.	184.	2.7	122	184	93.6	90	3	128	218	123	94.	2.4

specification				6	5										5	
Corpus uteri	C54	71	310	303.	6.4							71	310	303.	6.4	1.3
Lymph nodes	C77	313	280	48.7	229.	2.8	178	163	31.6	131	3.4	135	117	17.1	98.	2.1
other	C76	269	270	70.3	198.	3.2	129	166	70.3	95.	1.6	140	103	0	103	4.8
Gallbladder	C23- C24	85	261	1493	58.3	0.6	35	150	1124	43.	0.5	50	111	369.	14.	0.7
Lip	C00- C06	150	215	22.1	201.	1.5	89	159	13.1	151	1.4	61	56	9	50.	1.5
Pleura	C38	88	160	94.9	65	0.9	48	54	18.6	35.	0.9	40	106	76.2	29.	1
Nasopharynx	C11	34	106	95.9	27.3	0.4	22	79	61.6	17.	0.5	12	27	34.3	9.6	0.3
Hypopharynx	C12- C13	31	95	68.1	27	0.1	16	64	51	14		15	31	16.9	13	0.2
Peritoneum	C48	124	92	91.5	0	0.8	58	43	42.8	0	0.4	66	49	48.7	0	1.2
Parotid gland	C07 - C08	27	20	0	19.9	0.2	15	11	0	11.	0.1	12	9	0	8.8	0.3
autonomic Nerves system	C47	15	11	0	11	0.1	8	6	0	5.9	0.2	7	5	0	5.1	0
Vagina	C52	4	3	0	2.9	0						4	3	0	2.9	0
Oropharynx	C09- C10	18	3	0	2.5	0.1	8	1	0	1.1	0.0	10	1	0	1.4	0.2

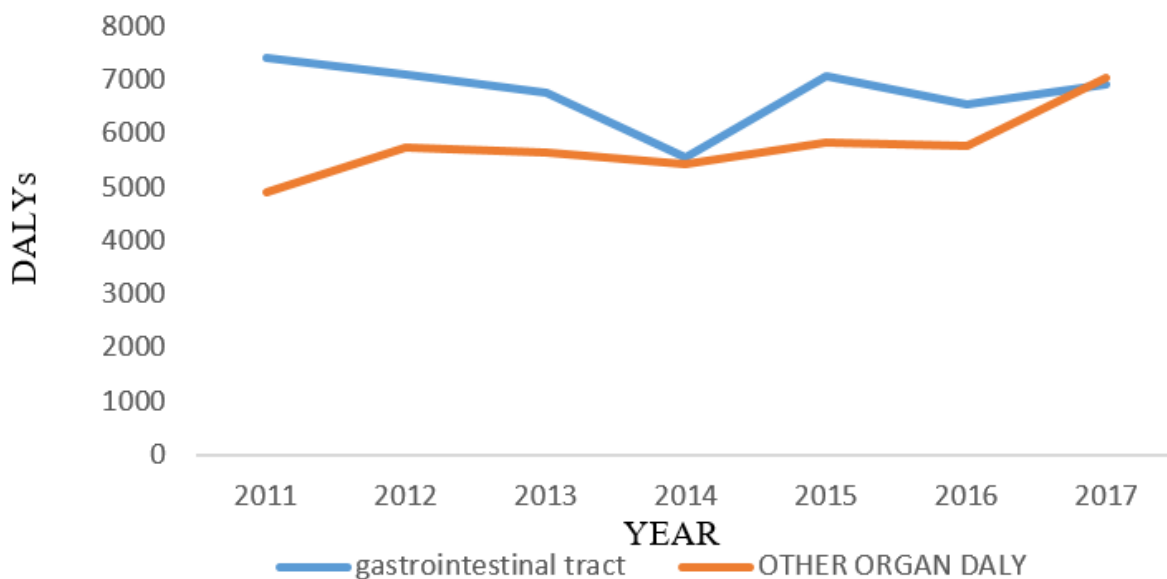


Fig. 1: Compare gastrointestinal tract DALYs with Other Organs DALYs

CANCER SITE	1390	1391	1392	1393	1394	1395	1396
Stomach	3149.6	3415.9	2906.8	3302.5	3462.9	2870.7	3044.0
Lung	1798.5	2262.6	1724.9	1767.7	1484.7	1542.9	1628.0
Liver	1517.6	1331.5	1142.1	1228.5	815.0	823.5	1053.0
Oesophagus	998.0	905.2	936.0	474.2	849.4	1180.9	898.3
Colon	715.5	691.9	810.9	245.5	965.4	738.3	1105.8
Prostate	651.9	651.7	762.7	575.3	635.2	657.1	744.3
Breast	531.5	521.6	378.6	504.7	680.6	595.4	1044.0
Small intestine	515.2	449.9	50.8	121.6	348.7	300.5	102.4
Skin	407.0	299.4	265.0	189.0	343.3	357.8	512.1
Bone	326.7	481.8	165.7	74.3	199.0	207.3	289.8
Larynx	298.8	386.7	393.9	484.4	393.3	236.4	302.9
Other digestive system	218.9	245.2	541.8	57.8	173.4	80.4	92.2
Bladder	219.0	200.9	161.6	110.3	420.7	170.5	268.8
Pancreas	208.2	46.6	215.1	49.1	249.7	377.3	416.9
Kidney	147.0	207.3	41.7	45.5	101.7	91.0	117.0
Cervix uteri	108.0	127.9	26.9	28.1	53.9	9.3	88.7
Ovary	90.5	210.2	83.1	213.3	76.0	195.0	217.6
Thyroid	87.1	177.9	32.3	20.1	96.3	45.4	44.0
Rectum	72.2	7.7	156.4	66.9	195.0	82.5	96.2
Hematopoietic	69.5	61.3	61.3	70.9	68.7	86.4	89.4
Uterus	33.1	0.4	77.6	84.7	83.5	49.5	102.9
Brain	32.7	56.8	1139.2	988.1	785.6	954.9	972.5
Lymph nodes	28.1	33.2	21.4	36.9	38.4	75.4	46.6
Without specification	24.4	13.3	92.6	64.5	125.2	34.7	46.7
Gallbladder	9.0	4.9	5.7	11.4	19.6	99.1	111.5
Peritoneum	8.9	6.6	8.1	27.3	3.0	28.1	9.6
Pleura	9.6	8.9	7.4	7.4	52.9	50.9	22.9
Connective and soft tissue	9.6	14.0	112.0	18.8	48.2	69.3	155.7
Other	12.6	19.2	34.0	37.9	81.9	33.3	51.0
Nasopharynx	3.2	1.6	2.4	4.0	6.4	21.2	67.3
Hypopharynx	4.4	1.8	0.0	4.4	1.8	44.8	38.3
Autonomic Nerves system	0.0	0.0	0.0	4.4	2.2	3.0	1.5
Lip	1.9	1.5	10.6	1.8	2.2	160.0	37.3
Parotid gland	1.5	1.5	3.0	2.2	6.6	1.5	3.7
Oropharynx	0.1	0.4	0.1	0.4	0.1	0.9	0.4
Vagina	0	0	0.0	0.7	1.5	0.7	0.0
Corpus uteri	0.4	1.0	30.0	74.2	22.7	35.1	146.5

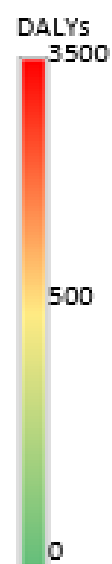


Fig. 2: DALYs based on cancer site (The red and green colors indicate the highest and the lowest DALYs, respectively)

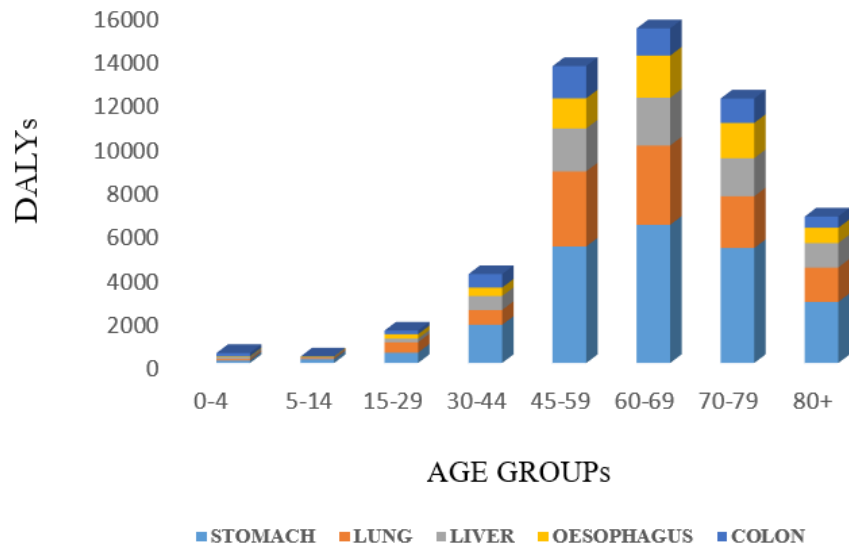


Fig. 3: Burden of Top Five Cancer by Age Groups 2011-2017

Discussion

In this study, we estimated the burden of 37 cancers in Kurdistan Province during 2011-2017 based on the DALY index and WHO guidelines. Accordingly, 54% of DALY cancers pertained to digestive organ cancers, making the top 5 cancers as follows: stomach, lung, liver, esophagus, and colon. with of increasing age, YLLs from cancers is caused by late diagnosis of cancer, which can be due to people's ignoring risk factors of cancer, especially among men or it may also be due to late detection, diagnostic problems or lack of access to appropriate treatment.

Burden of cancer was compared between Kurdistan and 6 other provinces per 100,000 in Great Khorasan (663 DALY), Yazd (797 DALY), Hormozgan (364 DALY), Bushehr (545 DALY), Chaharmahal-Bakhtiari (1275 DALY)(15). The burden of cancer in East Azarbaijan was reported as 1275 DALY(19), which was 891 DALY in Kurdistan Province in 2017. DALY was lower than that in East Azerbaijan Province, which can be attributed to differences in population, years of study, eating habits, lifestyles, genetics, or climate. More than half of the estimated incidence and mortality rates attributed to 7 cancers as follows: prostate, lung, lip and mouth, liver, breast and cervix (20). This finding is in contrast with

the results of our study that attribute more than half of the burden of cancer to gastrointestinal cancers. Different reasons may account for this difference such as climate in different parts of the world, income levels, education, increasing life expectancy, culture and customs, eating habits and genetics.

In our study stomach cancer is accounted 25% DALY of the total cancer DALYs Kurdistan Province that is almost similar with another study that revealed DALY of stomach is accounted 20% of the total cancer DALYs worldwide (21). Stomach cancer is accounted 6.5% DALY of the total cancer DALYs in Eastern Mediterranean Region (22). This finding is in contrast with the result of our study. Different reasons may account for this difference such as different lifestyles, education levels, genetics, income levels, age, sex and place of living which may be due to failure to treat *Helicobacter pylori* or lack of awareness of the infection status in Kurdistan Province (23, 24). Other risk factors for this cancer include low intake of fresh fruits and vegetables, consumption of different doses of alcohol in various provinces of Iran, different types and methods of smoking (1, 25), or unchangeable factors such as gender, age, blood group types and genetics. The highest DALY was reported of

232.7 per 100,000 for stomach cancer, which is consistent with our findings (9).

In our study lung cancer is accounted 13.9% DALY of the total DALYs Kurdistan Province that is in contrast with Soerjomataram et al that revealed DALY of lung cancer is accounted 23% of total DALYs worldwide (21). Lung cancer was accounted 11% DALY of the total cancer DALYs in Eastern Mediterranean Region (22). This finding is in contrast with the result of our study. In addition different doses of tobacco (26, 27), genetic causes and some specific genes, such as p53 on chromosome 17 (28), or exposure to solid fuel smoke during cooking may cause differences among provinces. Men in Kurdistan Province have a lower age-standardized incidence rate of lung cancer as compared to the world, with the exception of four regions: Central America (7.2), Central Africa (3.8), East Africa (3.4), and West Africa (2.4) (with higher rates of age-standardized lung cancer rate). The same is true for women in Kurdistan Province, that is, women in Kurdistan Province have lower rates of cancer than most parts of the world except 5 regions: North Africa (3.4), South Central Asia (3.4), Central Africa (2.3), East Africa (2.2), West Africa (1.2)(1). Lung cancer with 149.6 DALY per 100,000 was the second most common cancer in Iran, which is consistent with the findings of our study (8).

In our study, liver cancer was accounted 9% DALYs of the total DALYs Kurdistan Province that is in contrast with a study that revealed DALYs of liver cancer is accounted 28% of total DALYs worldwide (21). Liver cancer was accounted 6.3% DALYs of the total cancer DALYs in EMR (22). This finding is in contrast with the result of our study. This difference may be due to the prevalence of liver diseases in Kurdistan Province, including non-alcoholic fatty liver due to vitamin D deficiency (29), unidentified viral hepatitis or higher dose of alcohol consumed. According to the STEPs 2016 studies, Kurdistan Province has higher alcohol consumption than 27 other provinces in Iran. Another possible reason is obesity (BMI > 30), which is higher among men in Kurdistan than that in 22 other provinces and

higher among women than that in 18 other provinces. The age-standardised incidence rate of oesophageal cancer in Kurdistan Province is 10.7% and 6.9% among males and females, respectively, which is higher in both sexes than that of 20 other provinces mentioned in another study (30). Different diets in Kurdistan Province had no association with oesophageal cancer, but obesity had a significant relationship with it (31). Fruit and vegetable consumption had a preventive effect (32). However, according to the results of STEPs 2016 in Iran, fruit and vegetable consumption between both genders is lower in Kurdistan Province than that in other provinces. In a global comparison about esophageal cancer, the age-standardized incidence rate of female in Kurdistan Province is higher than that of the other regions in 5 continents except for Malawi (7.1), and this index is higher among men than the other five continents, except for East Asia (17.1) and South Africa (11.1). The age-standardised incidence rate of colon cancer is 7.6 in males and 6.4 in females, which is higher than males in only 2 provinces of Hormozgan (7.1) and Kohkiluyeh-Boyer Ahmad (6.3). As compared to the rest of the provinces, men in Kurdistan Province have a lower incidence. Furthermore, women in Kurdistan Province have a lower incidence rate except for the four provinces of Sistan-Baloochestan (6.2), Hormozgan (6.16), Bushehr (5.7), and Lorestan (5.6). Low physical activity, obesity, fecal occult blood are factors that can cause colon cancer (33). These may be due to presence of differences in various provinces. Age-standardized incidence rate of this cancer in Kurdistan's men is lower than other parts of the world, except for six regions of Oceania (7.3), North Africa (5.7), East Africa (3.4), West Africa (3.3), Central Africa (3), and Central Asia (3). In addition, women in Kurdistan Province have a lower age-standardized incidence rate in other parts of the world except for seven regions of the world: Southeast Asia (6.3), North Africa (5.1) Melanesia (3.8), East Africa (3.8), West Africa (3), Central Africa (2.5), and South Central Asia (2). Underestimating the incidence of cancer was a major limitation of the present study. This problem has

been alleviated since 2013 through recoding the data in a population based manner.

Conclusion

The increasing DALYs of cancer in Kurdistan Province is one of the major public health concerns as in most developed countries. More than half of the burden of cancer in the Kurdistan province is related to digestive organs. Stomach cancer, accounting for more than 25% of the burden in both genders. Urgent policy, management and public health measures such as general education, screening, early detection and effective treatment are recommended to reduce the burden of cancers and especially gastrointestinal tract cancer.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that they have no conflict of interest

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